European Commission

Reference Document on

Best Environmental Management Practice in the

Tourism Sector

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EXECUTIVE SUMMARY

A.1. GENERAL ASPECTS, STRUCTURE AND CONTENT OF THE DOCUMENT

A.1.1 General aspects

Legal background
On 25 November 2009, the Council and the European Parliament adopted the proposed revision of the EcoManagement and Audit Scheme (EMAS) regulation (EC) No 1221/2009, which went into force on 11 January, 2010.

One of the new elements of this revised regulation is Article 46 stating that sectoral reference documents (SRD) on best environmental management practice (Article 46(1)) shall be developed which shall contain best environmental management practices, sector-specific environmental performance indicators and, where appropriate, benchmarks of excellence and rating systems identifying environmental performance levels.

Objective of this document
In the future, the aforementioned reference documents shall be elaborated for a range of sectors identified as priorities for EMAS regulation based *inter alia* on their environmental impact and/or their suitability for EMAS uptake. This SRD for the tourism sector was compiled by the Institute for Prospective Technological Studies (IPTS), part of the European Commission's Joint Research Centre. This is a pilot SRD that may become a reference for further reference documents.

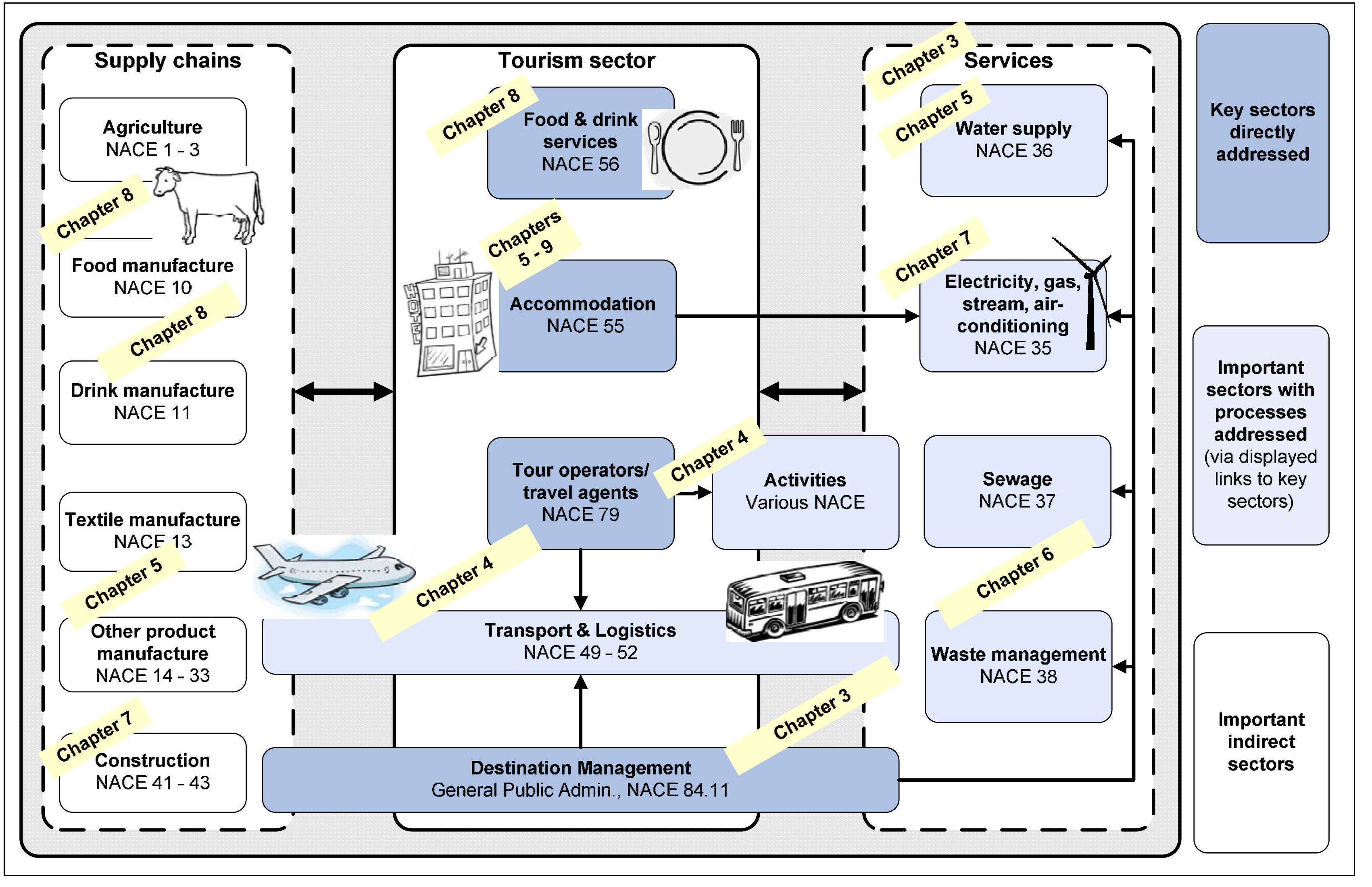
Information sources
For drafting this document, a lot of information is already publicly available from various sources including a number of comprehensive reports. That information has been considered with information collected directly from stakeholders, including tourism companies, public administration, consultancy firms, non-governmental organisations, and technology providers. A number of site visits proved invaluable for obtaining technical and performance data and information on economic considereations.

Intention of this document
EMAS is a voluntary scheme. This document is intended to support environmental improvement efforts of all actors in the tourism sector. Consequently this document is not only for EMAS registered organisations but for all actors in the sector with or without a certified or registered environmental management system.

However, EMAS registered organisations, shall take into account the relevant sectoral reference document(s) when assessing their environmental performance. The same applies to the EMAS environmental verifiers when checking the requirements according to Article 18 of the EMAS regulation.

A.1.2 Structure of the document

The document covers the whole value chain of the tourism sector, from land planning to building end of life (the *economic* lifecycle), and from sustainable sourcing to waste recycling and reuse. On the basis of mass stream thinking, the following input/output scheme has been used to structure the document.



Overview of inputs and outputs of the tourism sector

At the heart of the document are the 'Best Environmental Management Practice' (BEMP) descriptions. Reflecting the overview above, they are grouped as follows:

- Cross-cutting BEMPs applicable to all actors (Chapter 2)
- BEMPs for destination managers, with an influence over all aspects displayed in the figure above (Chapter 3)
- BEMPs for tour operators, including their influence over transport operations, accommodation, and tourist choice/behaviour (Chapter 4)
- BEMPs to minimise water consumption in accommodation (Chapter 5)
- BEMPs to minimise waste in accommodation (Chapter 6)
- BEMPs to minimise energy consumption in accommodation (Chapter 7)
- BEMPs for kitchen operations (Chapter 8)
- BEMPs for campsites (Chapter 9)

The content of these chapters covers the most significant environmental aspects of the actors (sub-sectors) targeted by this document.

The structure to describe the techniques is very similar to the one used in the Best Available Techniques Reference Documents (BREFs) according to the Industrial Emissions Directive, which replaced the IPPC Directive with effect from January 2014.

In addition, Chapter 1 contains general information about the tourism sector such as data on turnover and employment as well as the direct and indirect environmental aspects which are illustrated by means of the overview of the inputs and outputs (see figure above).
Chapter 10 of the SRD provides a brief overview for micro-, small- and medium-sized enterprises. Specifically, it lists the applicability of the BEMP techniques described in this document to SMEs, and highlights any restricting factors particularly relevant to micro-enterprises and SMEs. Options to facilitate SMEs with environment-related investments are referred to.

Chapter 11 of the SRD contains concluding tables that compile the information from BEMPs description. Conclusions are drawn with respect to key environmental performance indicators and benchmarks of excellence.

A.2. ENVIRONMENTAL INDICATORS AND BENCHMARKS OF EXCELLENCE

A.2.1 Approach to conclude on environmental indicators and benchmarks of excellence

This document was developed based on an information exchange with stakeholders, consultations with experts, a literature review and site visits. Some of the cooperating companies are big players in the market.

The conclusions on the environmental indicators and benchmarks of excellence have been derived by expert judgement of the European Commission through the JRC-IPTS, and by the technical working group (TWG). This group was composed of companies, umbrella associations, verification bodies, accreditation bodies and other stakeholders. The European Commission organised and chaired the meetings of the TWG.

A.2.2 Presentation of the environmental indicators and the benchmarks of excellence

The conclusions on the benchmarks of excellence, best environmental management practice (BEMP) summaries, and environmental indicators associated with the application of BEMP are compiled in the following summarising table.

Common specific key performance indicators of the tourism sector

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
Sectoral Reference Document Chapter 2: Cross-cutting BEMP			
– appropriate indicators are used to continuously monitor all relevant aspects of environmental performance, including less easily measured and indirect aspects such as biodiversity impacts – all staff are provided with information on environmental objectives and training on relevant environmental management actions – best environmental management practice measures are implemented where applicable	undertake an assessment of the most important direct and indirect environmental aspects associated with the enterprise, and **to apply relevant performance indicators and compare with relevant benchmarks of excellence** as described in this document.	The enterprise holds a certified EMS such as EMAS or ISO 14001 All relevant management and process-level indicators, and benchmarks of excellence referred to in this SRD	**Applicability:** all tourism actors, including destination managers, tour operators, accommodation providers, food and drink providers, transport operators and activity providers. Organisation and site level. **Economics:** this BEMP provides a framework for the systematic assessment of enterprise performance compared with what is achievable by front-runners, and can thus help to identify cost-saving opportunities across operations as per the economics of specific process-level BEMPs described subsequently.
– the organisation has applied lifecycle thinking to identify improvement options for all major supply chains that address environmental hotspots – ≥97 % of chemicals, measured by weight of active ingredient, used in accommodation and restaurant premises are ecolabelled (or can be demonstrated to be the most environmentally friendly available option) – ≥97 % of all wood, paper and cardboard purchased by accommodation and restaurant enterprises are recycled or environmentally certified (ecolabelled, FSC, PEFC)	screen supply chains for products and services used by the enterprise in order to **identify supply chain environmental hotspots,** considering the entire value chain, and to **identify relevant control points** (e.g. product selection, avoidance, green procurement, supplier criteria) that can be used to minimise the environmental impact over the value chain.	% of products or services complying with specific environmental criteria Lifecycle assessment indicators	**Applicability:** all tourism actors, including destination managers, tour operators, accommodation providers, food and drink providers, transport operators and activity providers. **Economics:** initial costs of supply chain assessment and certification may be paid back or offset by: (i) identifying suppliers or products that are both more sustainable and cheaper (e.g. local suppliers); (ii) by rationalising procurement volumes; (iii) by marketing the value-added of green procurement decisions.
Sectoral Reference Document Chapter 3: BEMP for destination managers			
– implement a Destination Plan that: (i) covers the entire destination area; (ii) involves coordination across all relevant government and private actors; (iii) addresses key environmental challenges within the destination – destination managers report on all applicable indicators developed by the Tourism Sustainability Group and/or the Global Sustainable Tourism Council, at least every	establish a unit or organisation responsible for the **strategic sustainable development of the destination**, that **coordinates relevant departments and stakeholders** to implement specific actions within the framework of a Destination Plan.	Implementation of Destination Plan Tourism Sustainability Group destination indicator set	**Applicability:** all destinations, applying to either units within government structures responsible for destination management, or public-private destination management organisations. **Economics:** direct administrative costs are low compared with tourism income, whilst this

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
two years		Global Tourism Sustainability Council indicator set	BEMP can maintain the attractiveness and competitiveness of the destination for tourism into the future. Some measures can raise revenue directly (e.g. efficiency-related energy and water charges).
– minimise and compensate for any biodiversity displaced by tourism development so that destination-level biodiversity is at least maintained in high nature value areas, and increased in degraded areas	monitor the state of biodiversity within the destination, and to **implement a biodiversity conservation and management plan that protects and enhances total biodiversity** within the destination through, for example, development restrictions and compensation measures.	Implementation of destination biodiversity management plan (y/n) Species abundance Protected area (hectares, % of destination)	**Applicability:** all destinations. High nature value destinations should conserve biodiversity, low nature value destination should take measures to increase biodiversity. **Economics:** development control may reduce or redirect potential economic activity in the short term, but preserve non-market values and realise greater economic benefits in the medium to long term. Best practice is to generate revenue from tourism in relation to use of natural resources (e.g. park entrance fees, etc).
– environment-related services, including public transport, water provision, wastewater treatment and waste recycling, are designed to cope with peak demand and to ensure the sustainability of tourism within the destination – ≥95 % wastewater generated in the destination receives at least secondary treatment, or tertiary treatment for discharge to sensitive receiving waters, including during peak tourist season – ≥95 % of waste is diverted from landfill and recycled, or at least sent for anaerobic digestion or incineration with energy recovery – average tourist water consumption of ≤200 L per day – public transport, walking and cycling accounts for ≥80 % of journeys within city destinations	ensure that **environment-related services** within the destination, especially water supply, wastewater treatment, waste management (especially recycling measures) and public transport/traffic management, **are sufficient to cope with peak demand during tourism high season in a sustainable manner.**	Sustainable water provision % wastewater tertiary treatment % waste recycled % public transport % renewable energy	**Applicability:** all destinations. This BEMP relates to good management by public administrations more generally, but is particularly relevant where tourism generates large additional and seasonal demand on services. **Economics:** the additional cost of providing services of sufficient capacity to cope with peak tourism demand should be seen in the context of safeguarding or enhancing tourism revenue by maintaining or improving the attractiveness of the destination. Some services, such as recycling, traffic management, renewable energy generation, can generate economic activity within the destination.
	monitor the environmental impact of large events, **and implement environmental management plans** for such events that avoid and mitigate impacts, such as the provision of additional public transport to the event, the provision of good waste management facilities,	kg waste sent for final disposal per visitor % waste recycled	**Applicability:** destination management organisations and/or specific units or departments within local authorities with influence over event planning. Also applies to private event organisers.

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
	and the offsetting of carbon and biodiversity impacts.	kg CO_2/visitor % CO_2 offset with certified carbon credits	**Economics:** good event planning can reduce costs for e.g. waste disposal. Organising public transport to the event and charging for parking can generate revenue directly, and indirectly by saving space and reducing congestion. Any additional costs (e,g, carbon offsetting) should be considered against possible benefits arising from green-marketing.
Sectoral Reference Document Chapter 4: BEMP for tour operators			
– tour operators do not offer flights for: (i) destinations less than 700 km; (ii) destinations up to 2 000 km away for a duration of stay less than eight days, or; for destinations more than 2 000 km away with a duration of stay less than 14 days – tour operator airline fleets achieve average specific fuel consumption of ≤2.7 litres per 100 passenger km, falling to ≤2.4 litres per 100 passenger km by 2014 – average coach or bus fleet fuel consumption of ≤0.75 litres per 100 passenger km and at least 90 % of fleet are EURO 5- compliant or run on alternative fuel systems – transport GHG emissions from all packages sold are automatically compensated by investing directly in GHG avoidance projects or by purchasing certified carbon credits	implement choice editing of packages offered to **avoid unnecessary flights** (e.g. Forum Anders Reisen criteria), to **implement energy efficiency measures for transport fleets** (owned or supplied), including green procurement of the most efficient vehicles, retrofitting aircraft and coaches/buses with energy saving options such as winglets, **to optimise operations** (e.g. maximise load factors), **and to offset all transport GHG emissions** using certified offset schemes.	Forum Anders Reisen flight criteria kg CO_2/passenger-km % CO_2 offset with certified carbon credits	**Applicability:** directly applicable to tour operators with control over their own transport fleets, and applicable as selection and contract criteria for tour operators who contract transport services. **Economics:** procuring efficient vehicles and optimising operations can significantly reduce fuel costs. Offsetting CO_2 emissions is relatively inexpensive, and can be considered against green-marketing advantages. The main economic barrier is potential loss of revenue by deselecting short-distance and short-stay flights as per Forum Anders Reisen criteria.
– ≥90 % accommodation suppliers, based on sales value or overnight stays, are in compliance with at least basic environmental requirements (preferably recognised by third-party certification)	**require or encourage environmental certification of accommodation** providers, or to require compliance with specific **environmental criteria**, or to require **environmental performance reporting** that can be used to implement benchmarking.	% of bed nights or value sold complying with specific environmental criteria	**Applicability:** all tour operators. It may be easier for smaller tour operators to select suppliers based on third-party environmental certification, and for larger tour operators to apply their own criteria and/or a benchmarking process. **Economics:** the administrative costs of implementing supplier environmental requirements can be minimised by integrating them with existing health and safety

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
			inspections. As described in the accommodation chapter of this SRD, many measures to improve environmental performance are associated with economic savings and short payback periods.
– the tour operator drives destination environmental improvement by: (i) improving supply chain performance; (ii) influencing destination management; (iii) direct improvement schemes	work on discreet projects, ideally coordinated through tour operator consortia and involving destination managers, **that address environmental hotspots associated with tourism within destinations.**	% services environmentally improved within destinaiton Influence over destination managers Participation in destination improvement projects (y/n)	**Applicability:** directly applicable to larger tour operators, but smaller tour operators may coordinate actions through consortia. **Economics:** the direct cost to tour operators may be very low, especially where improvement is based on leveraging influence over destination managers to drive improvement. Any costs should be balanced against the benefits of maintaining or enhancing future tourism business within the destination.
– the tour operator promotes sustainable tourism packages in mainstream advertising material, and front-runner sustainable (e.g. ISO Type-I ecolabelled) tourism packages represent a sales share ≥ 10 %	develop and promote tourism packages that exclude the most environmentally damaging options, and **include environmental front-runner transport, accommodation and activity options.**	% front-runner sustainable tours sold (by value) Tour component ecolabels	**Applicability:** all tour operators, but achieving a high sales share of 'eco tours' may be easier for small tour operators who can target the niche 'eco market'. **Economics: t**he costs of developing sustainable tourism packages, including certification of specific components where relevant, are minor compared with sales turnover. Additional costs of sustainable tour development and procurement may be recouped in sales prices for these value-added packages, and promotion of sustainable tours may have a positive influence on tour operator image and thus overall sales (a 'halo effect').

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
– the tour operator employs effective marketing and communication methods to encourage more sustainable choices in the selection of tourism packages – the tour operators informs all it's guests with destination specific information and awareness raising to promote correct behaviour in the destination	**provide information to customers** on the environmental impacts of tourism packages, and targeted, positive and engaging **messages on actions that can be taken by customers** during selection, and guests during holidays, to **minimise their environmental impact.**	% tour packages with environmental information provided at booking % tour package components with environmental messages	**Applicability:** all tour operators can implement measures from this BEMP. **Economics:** the costs of providing environmental information to customers in advertising material is low. Influencing customers to select more environmentally friendly options can reduce revenue from some options, but increase revenue for others, and may increase overall revenue if well managed. Influencing guests to adopt more environmentally friendly behaviour can potentially generate revenue and reduce costs.
– hard copy office and promotional material: (i) is avoided wherever possible; (ii) uses 100 % recycled or environmentally-certified (e.g. ecolabelled, FSC, PEFC) paper; (iii) is printed by environmentally-certified (e.g. EMAS, ISO14001) printing services – energy and GHG management plans are implemented and energy and GHG emissions arising from retail and office activities are reported and expressed per m2 retail and office space per year, and per customer – water consumption ≤2.0 m3 per employee per year	**minimise the use of resources**, especially paper and ink, for advertising and office operations, **to select environmentally certified materials and services** (e.g. printing services), and to **ensure energy and water efficiency** across all office and retail operations.	Grams paper per customer Environmental certification of paper and printing kg CO_2/customer	**Applicability:** all tour operators. **Economics:** material-, water- and energy-efficiency measures described in this BEMP can significantly reduce costs. Some of these cost savings may be invested in green procurement of environmentally certified materials and services, which may also pay back through a green marketing effect.
Sectoral Reference Document Chapter 5: BEMP to minimise water consumption in accommodation			
– implementation of a site-specific water management plan that includes: (i) sub-metering and benchmarking all major water-consuming processes and areas; (ii) regular inspection and maintenance of water system "leak points" and appliances – total water consumption ≤140 L per guest-night in fully serviced hotels, and ≤100 L per guest-night in accommodation where the majority of the bathrooms are shared across rooms (e.g. hostels)	**undertake a water consumption audit and monitor water consumption across key water-consuming processes and areas** (i.e. sub-metering) in order to **identify efficiency improvement options,** and to ensure that all equipment is maintained through appropriate periodic inspection, including during housekeeping.	Implementation of a water management plan (y/n) L/guest-night total water consumption	**Applicability:** all types and sizes of accommodation. It may not be necessary to retrofit sub-meters in small enterprises. **Economics:** the cost of implementing a water management plan is low compared with the significant savings that can be realised through appropriate maintenance and simple (no- or low- investment) options.

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
– water consumption, and associated energy consumption for water heating, of ≤100 L and 3.0 kWh per guest-night, respectively, for ensuite guest bathrooms – shower flow rate ≤ 7 L/min, bathroom tap flow rate ≤6 L/min (≤ 4 L/min new taps), average effective toilet flush ≤ 4.5 L, installation of waterless urinals	**install efficient water-fittings,** including low-flow spray taps and low-flow thermostatic-controlled showers, low- and dual-flush WCs, and waterless urinals. In the interim, aerators may be retro-fitted to existing fittings.	L/minute % of low-flow fittings	**Applicability:** all types and sizes of accommodation. Where refurbishment has recently taken place, measures such as the fitting of aerators are still applicable. **Economics:** selecting the most efficient fittings during construction or renovation does not cost much more and can result in water and water-heating-energy savings of over 50 %. Worst case scenario retrofitting of water-efficient fittings is still associated with payback times of months to less than 4 years in most cases.
– at least 80 % of bedclothes are cotton-polyester mix or linen, and at least 80 % of bedroom textiles have been awarded an ISO Type 1 ecolabel or are organic – consumption of active chemical ingredients within the tourist accommodation of ≤10 grams per guest-night – reduction in laundry achieved through reuse of towels and bedclothes of at least 30 % – at least 80 % by active-ingredient weight of all-purpose cleaners, sanitary detergents, soaps and shampoos used by the tourist accommodation shall have been awarded an ISO Type I ecolabel	minimise laundry requirements through **green procurement of bedclothes and towels** (in terms of size, density, colour, material), and by requesting or encouraging **guests to reuse bedclothes and towels.** Best practice is also to train staff on the implementation of **water- and chemical-efficient cleaning methods,** and to **procure environmentally certified consumables** for bedrooms and bathrooms.	kg laundry/guest-night % reduction in laundry through guest reuse Grams/guest-night active chemical ingredients for washing/cleaning % ISO type-1 ecolabelled chemicals	**Applicability:** all types and sizes of accommodation. Laundry minimisation through selection of more efficient room textiles is universally applicable, but the applicability of laundry minimisation by encouraging guest reuse is restricted for accommodation with a high percentage of single-night guests. **Economics:** selecting textiles with lower laundering requirements, encouraging guests to reuse sheets and towels, and training staff in efficient cleaning techniques that minimise water and chemical consumption an reduce costs. These savings may offset costs associated with the procurement of ecolabelled textiles, cleaning detergents and room consumables (providing soap dispensers instead of single-use items can significantly reduce costs).
– laundry is outsourced to efficient commercial laundry service providers complying with benchmarks specified in section 5.5 – all new domestic washing machines have an EU energy label rating of 'A^{+++}', or average annual laundry water consumption ≤7 L per kg laundry washed in laundries with commercial machines	procure the most **water- (and thus energy-) efficient washing extractors** and the most **energy efficient driers** (e.g. heat-pump driers) **and ironers,** to **reuse rinse water** and, in high-water-stress areas, main wash water following micro-filtration. Best practice is also to **recover heat from waste water and exhaust ventilation air.**	L/kg laundry kWh/kg laundry A+++ rated washing machines and driers Installation of	**Applicability:** all types and sizes of accommodation that perform laundry operations on site. Selection of efficient equipment may only be feasible when existing equipment is nearing the end of its working life. **Economics:** the modest price premium that may be demanded by the most efficient washer-

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
– total laundry process energy consumption ≤2.0 kWh per kg textile, for dried and finished laundry products – at least 80 % by active-ingredient-weight of laundry detergent shall have been awarded an ISO Type I ecolabel (e.g. Nordic Swan, EU Flower)		heat-pump driers % laundry detergents ecolabelled	extractors, driers and ironers is paid back within a few years through water and energy savings. Measures to recover waste heat from wastewater and ventilation exhaust, and to reuse rinse water, are cost effective, but reuse of wash water via micro-filtration is relatively expensive and only justified where water is particularly scarce.
– all laundry is outsourced to a provider who has been awarded an ISO type-1 ecolabel (e.g. Nordic Ecolabelling, 2010), and all in-house large-scale laundry operations, or laundry operations outsourced to service providers not certified with an ISO Type-1 ecolabel, shall comply with the specific benchmarks for large-scale laundries described in this document – total water consumption over the complete wash cycle ≤5 L per kg textile for accommodation laundry and ≤9 L per kg textile for restaurant laundry – total process energy consumption for dried and finished laundry products ≤0.90 kWh per kg textile for accommodation laundry and ≤1.45 kWh per kg textile for restaurant laundry – exclusive use of laundry detergents compliant with Nordic Swan ecolabel criteria for professional use (Nordic Ecolabelling, 2009), applied in appropriate doses – wastewater is treated in a biological wastewater treatment plant having a feed-to-microorganism ratio of <0.15 kg BOD_5 per kg dry matter per day	**select an efficient laundry service provider that is certified by an ISO Type-1 ecolabel** or that complies with criteria in such labels (e.g. Nordic Ecolabelling, 2009), or to ensure that on-site large-scale laundry operations comply with such criteria.	Ecolabelled laundry service (y/n) L/kg laundry kWh/kg laundry % laundry detergents ecolabelled Wastewater sent to effective wastewater treatment plant (y/n)	**Applicability:** large accommodation enterprises with on-site large-scale laundry operations, commercial laundry operators, and other accommodations in as far as criteria are applicable for green procurement of laundry services. **Economics:** optimising large-scale laundries can significantly reduce operational costs by reduce energy, water and detergent consumption, and increasing the lifetime of textiles (textile replacement costs may be incurred by accommodation or by laundry services who provide the textiles). Some of these savings may be invested in the procurement of ecolabelled or environmentally friendly detergents.
– implementation of an efficiency plan for swimming pool and spa areas that includes: (i) benchmarking specific water, energy and chemical consumption in swimming pool and spa areas, expressed per m^2 pool surface area and per guest-night; (ii) minimisation of chlorine consumption through optimised dosing and	**optimise the frequency and timing of backwashing** based on pressure drop rather than fixed schedules, to use ozonation or UV treatment and careful dosing control to **minimise chlorination,** and to **recover heat from exhaust ventilation air.**	Water consumption (L/m^2yr or L/guest-night) Implementation of a pool	**Applicability:** accommodation enterprises with on-site swimming pools. Full optimisation of HVAC systems for indoor pools may only be applicable during construction or renovation. **Economics:** most measures described in this

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
use of supplementary disinfection methods such as ozonation and UV treatment		management plan (y/n) Application of ozonation or UV treatment (y/n) Chlorine added (kg/m^2yr)	BEMP achieve a short payback period through water, energy and chemical savings. Micro-filtration of filter backwash water is expensive and only justified in areas o high water scarcity.
– installation of a rainwater recycling system that supplies internal water demand, or a greywater recycling system that supplies internal or external water demand	**install a greywater recovery system** that recovers greywater for use in indoor processes (e.g. toilet flushing) following treatment or exterior processes (e.g. irrigation), **or a rainwater collection system that uses rainwater for indoor purposes.**	Implementation of greywater or rainwater recycling (y/n) Recycled water % of total consumption	**Applicability:** water recycling systems may be installed during building construction or major renovation. **Economics:** it is not economic to retrofit greywater and rainwater reuse systems to accommodation unless a major renovation is planned. When installed in new buildings, the investment in such systems may be paid back over a period of two to fourteen years depending on water prices.
Sectoral Reference Document Chapter 6: BEMP to minimise waste from accommodation			
– total waste generation (sorted plus unsorted) of ≤0.6 kg per guest-night	prevent waste generation through **green procurement of products,** considering product lifecycle impacts – for example by avoiding single-use items (food, soaps, shampoos) and by buying cleaning agents in concentrated and bulk form – and by **careful management of procurement volumes.**	kg/guest-night total waste generation	**Applicability:** all types and sizes of accommodation. **Economics:** waste prevention can significantly reduce costs, for both unnecessary procurement and waste disposal.

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
– at least 84 % of waste, expressed on a weight basis, is recycled – unsorted waste sent for disposal is less than 0.16 kg per guest-night	**provide separated waste collection facilities** throughout the establishment, to ensure that there is a clear **procedure for staff waste separation,** and to **contract relevant recycling services** at least for glass, paper and cardboard, plastics, metals and organic waste.	% waste reused or recycled kg unsorted waste per guest night	**Applicability:** all types and sizes of accommodation. **Economics:** waste sorting and recycling can significantly reduce disposal costs, by minimising the more expensive mixed waste fraction.
– where it is not possible to send wastewater for centralised treatment, on-site wastewater treatment includes pre-treatment (sieve/bar-rack, equalisation and sedimentation) followed by biological treatment with >95 % BOD_5 removal, >90 % nitrification, and (off-site) anaerobic digestion of excess sludge	install an on-site wastewater treatment system that treats wastewater at least to secondary, and preferably to tertiary, level, and **includes at least pre-treatment** to screen solids and settle particulate matter **followed by efficient biological treatment (e.g. in a sequencing batch reactor) to remove a high proportion of COD, BOD, nitrogen and phosphorus** from the final effluent. Sludge is treated and disposed of in an environmentally acceptable manner.	BOD_5 , COD, total nitrogen, total phosphorus removal efficiency (%) BOD_5 , COD, total nitrogen, total phosphorus concentration in final effluent (mg/L)	**Applicability:** all types and sizes of accommodation not connected to a sewer network. Different specific solutions described in the BEMP will be relevant depending on the situation (accessibility, climate, etc). **Economics:** .this BEMP incurs significant costs. Consequently, implementing best practice beyond regulatory requirements is based on environmental responsibility, preparedness for future regulation, and green marketing.
Sectoral Reference Document Chapter 7: BEMP to minimise energy consumption in accommodation			
– implementation of a site-specific energy management plan that includes: (i) sub-metering and benchmarking all major energy-consuming processes; (ii) calculation and reporting of primary energy consumption and energy-related CO_2 emissions – for exiting buildings, final energy consumption for HVAC and water heating ≤75 kWh, or total final energy consumption ≤180 kWh, per m^2 heated and cooled area per year	**undertake an energy audit and monitor energy consumption across key energy-consuming processes and areas** (i.e. sub-metering) in order to **identify efficiency improvement options,** and to ensure that all equipment is maintained through appropriate periodic inspection.	Implementation of an energy management plan (y/n) kWh/m^2yr total energy consumption	**Applicability:** all types and sizes of accommodation. Extensive sub-metering and building management systems are not applicable to small enterprises. **Economics:** the cost of implementing an energy management plan is low compared with the significant savings that can be realised through appropriate equipment maintenance and no- or low- investment options (e.g. timing processes such as laundry and dish washing to use cheaper electricity).
– the rated energy performance of new buildings conforms with Minergie P or PassiveHouse standards	**ensure that new buildings are compliant with the highest achievable energy ratings,** as indicated by conformance with **PassiveHouse** and **Minergie P** standards, and that existing buildings are **retrofitted to minimise heating and cooling energy requirements.**	PassiveHouse or Minergie P standard conformance (y/n)	**Applicability:** all types and sizes of accommodation during construction or major renovation, and during building selection for tenant enterprises. **Economics:** achieving PassiveHouse or Minergie P standards incurs a construction cost

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
			premium <10 % and is associated with a payback of less than ten years, but is expensive and may not pay back for existing buildings. Nonetheless, specific measures such as roof insulation and upgrading the specification of e.g. windows during refurbishment can pay back over acceptable periods for building owners.
	minimise energy consumption from HVAC systems **by installing zoned temperature control and controlled ventilation with heat recovery** (ideally controlled by CO_2 sensors), energy-efficient components (e.g. variable-speed fans), and to **optimise HVAC in relation to building-envelope and energy source characteristics.**	**Installation of heat-recovery controlled ventilation** (y/n) Appropriate HVAC zoning (y/n) kWh/m^{2}yr	**Applicability:** all types and sizes of accommodation. Full optimisation can only be made during construction or major renovation, but specific measures can be implemented at any time. **Economics:** when integrated at the building design or renovation phase, HVAC optimisation does not necessarily result in significant additional costs, and may reduce investment costs (e.g. by enabling lower capacity heating and cooling systems to be installed). Retrofit measures are usually associated with a relatively short payback time of few years.
– water-source heat pumps and/or geothermal heating/cooling is used in preference to conventional heating and cooling systems wherever feasible, and heat pumps comply with EU Flower criteria	**install efficient (e.g. eoclabelled) heat pumps for heating and cooling, or where possible ground water cooling.**	kWh/m^{2}yr	**Applicability:** all types and sizes of accommodation. In urban areas, it may only be possible to install ground water systems during building construction or major renovation. Air-source heat pumps easy to retrofit, but may not be suitable for very cold climates. **Economics:** when integrated with building design and HVAC system, heat pump installation is not necessarily associated with additional costs. When retrofitted, total system installation may be approximately EUR 400 per kW installed capacity, producing heating and cooling cost savings of up to 75 % and 70 %, respectively, with typical payback periods of four to five years.

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
– installed lighting capacity <10 W per m^2 or lighting electricity consumption <25 kWh/m^2yr (heated and cooled floor area) – total electricity consumption ≤80 kWh m^2yr (heated and cooled floor area)	**install zoned and appropriately sized compact fluorescent and LED lighting with intelligent control** based on motion, natural-light and time. Optimise building design and interior layout with respect to use of natural light, considering the energy consequences of large glazed areas for heating and cooling.	W/m^2 kWh/m^2yr	**Applicability:** all types and sizes of accommodation. Compact fluorescent and LED lamps can often directly substitute incandescent and halogen lamps. Building modification to optimise use of natural light is restricted to initial construction and renovation. **Economics:** installation of low energy lamps typically pays back within a year, and each lamp may save a few hundred EUR of electricity over their lifetime. Intelligent lighting control systems also have a short payback time. Payback time may be longer for modifications to the building envelope to optimise natural lighting.
– the equivalent of 50 % of the accommodation's annual energy consumption is generated by on-site renewable sources, or by verifiably additional off-site RE sources – 100 % of electricity is from traceable renewable electricity sources not already accounted for by another organisation or in the national electricity average generating mix, or that is less than two years old	**install on-site geothermal, solar or wind energy generation** where appropriate, and to procure electricity from a genuine (verifiable additional) **renewable electricity supplier.**	% final energy from renewable sources kWh certified renewable energy credits	**Applicability:** the potential to exploit particular renewable energy technologies on site depends on location- and site-specific factors such as climate, shading, available space, etc. investment in off-site renewable energy schemes may be undertaken by any enterprise. **Economics:** wood boilers typically pay back within five to 12 years, solar thermal systems within five to 20 years, solar photovoltaic systems within eight to 11 years where subsidies or feed-in tariffs are available (e.g. UK, Germany), and small-medium-scale wind turbines (~20 kW capacity) within three to 11 years depending on the electricity price and load factor. Payback times depend strong on site-specific characteristics, energy prices and subsidy or feed-in tariffs available.
Sectoral Reference Document Chapter 8: BEMP for kitchens			

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
– the enterprise is able to provide documented information, at least including country of origin, for all main ingredients – at least 60 % food and drink products, by procurement value, are certified according to basic or high environmental standards or criteria – at least 40 % food and drink products, by procurement value, are certified according to high environmental standards or criteria	assess food and drink supply chains to **identify environmental hotspots and key control points,** including **choice editing of menus** to avoid particularly damaging ingredients (e.g. some out-of-season fruit), and **selection of environmentally-certified products.**	% key ingredients certified with relevant environmental standards (e.g. MSC)	**Applicability:** all kitchens. Kitchens in rural locations may be able to source food on site. Larger kitchens may have a stronger influence over suppliers. **Economics:** green procurement can be initiated by selecting cost-positive or cost-neutral options, such as local products, followed later by environmentally certified products associated with a price premium. Additional product procurement costs may be offset by increased turnover arising from marketing of value-added products and services, e.g. local food with a traceable chain of custody can be successfully marketed as authentic local produce to tourists.
– ≥95 % of organic waste separated and diverted from landfill, and, where possible, sent for anaerobic digestion or alternative energy recovery – total organic waste generation ≤0.25 kg per cover, and avoidable waste generation ≤0.18 kg per cover	**minimise avoidable food waste** by careful **menu development** and **portion sizing,** and to ensure that all **organic waste is separated and sent for anaerobic digestion** where available, or alternatively incineration with energy recovery or local/on-site composting.	kg/cover % organic waste recycled	**Applicability:** all kitchens. The preferred waste recycling option of anaerobic digestion may not be available in some locations, in which case waste may be sent for incineration with energy recovery or composting. **Economics:** minimising avoidable waste can reduce procurement and collection/disposal costs. Savings from the former may be over EUR 500 per tonne avoided. Kitchens may be paid up to EUR 0.30/L for used cooking oil collected for biodiesel production. Separating organic waste for recycling can reduce collection costs by up to EUR 100 per tonne depending on local charges.
– implementation of a kitchen water management plan that includes monitoring and reporting of total kitchen water consumption normalised per dining guest, and the identification of priority measures to reduce water consumption – installation of efficient equipment and implementation	**select efficient washing equipment,** including **trigger-operated low-flow pre-rinse spray valves, efficient dishwashers and connectionless steamers,** and to **monitor and benchmark water consumption** in kitchen/restaurant areas.	Implementation of water management plan (y/n) L/cover	**Applicability:** all kitchens. Installation of more efficient dishwashers may only be economically viable when existing dishwashers are approaching the end of their working life or require repairing. **Economics:** price premiums of up to 20 % for

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
of relevant efficient practices described in this document, as far as possible within demonstrated applicability and economic constraints			the most efficient dishwashers can be paid back within one to two years in reduced energy, water and chemical costs. Payback periods for specific modules range from 1.3 years for a heat-recovery condensing unit to 6.8 years for a heat-pump. Implementation of a water management plan and installation of low-flow and sensor-controlled fittings can pay back within one year.
– at least 70 % of the purchase volume of chemical cleaning products (excluding oven cleaners) for dish washing and cleaning are ecolabelled – implementation of a kitchen energy management plan that includes monitoring and reporting of total kitchen energy consumption normalised per dining guest, and the identification of priority measures to reduce energy consumption	**select efficient cooking equipment,** including **induction-hob** or **pot-sensor-controlled** gas ovens, efficient refrigeration equipment that uses a **natural refrigerant** such as ammonia or carbon dioxide, and to **control ventilation** according to demand.	Implementation of energy management plan (y/n) kWh/cover	**Applicability:** all kitchens. Installation of more efficient cooking and refrigeration equipment may only be economically viable when existing equipment is approaching the end of its working life. **Economics:** energy monitoring does not require significant investment, and can realise significant savings by identifying low-cost energy-saving opportunities. Price premiums for the most efficient cooking, refrigeration and ventilation equipment can be paid back within a few years in reduced energy costs. Installing heat recovery for a large refrigeration system can pay back in three to five years. Maintenance costs to avoid and repair refrigerant leakages pay back within one or two years.
Sectoral Reference Document Chapter 9: BEMP for campsites			
– the accommodation enterprise encourages and facilitates environmentally responsible behaviour and activities, and provides environmental education for guests through on-site activities and courses	provide guests with interactive on-site education of environmental issues, including **courses, nature-trails, or equipment such as low-carbon transport** (bicycles, electric bicycles).	Effective environmental education is provided for guests on site (y/n)	**Applicability:** all campsites and other types of accommodation (especially rural). **Economics:** provision of environmental education courses and nature-based activities may be integral to the offer and business case of campsites and some rural accommodations. Measures such as provision of bicycles for use locally are associated with small costs that may be paid back quickly through increased business. On-site education courses may be

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
			provided in association with education centres that receive public funding, or may be supported by government grants.
– maintain or increase on-site biodiversity by planting native species, creating refuges for local animal species, and installing green or brown roofs where possible, and by minimising chemical inputs, light and noise pollution – minimise light pollution and wildlife disturbance by installing timer- or sensor-controlled, efficient, and appropriately angled luminaries producing zero-uplight – minimise water consumption by planting native species and mulching, and by installing controlled irrigation systems fed with greywater where possible	maximise on-site biodiversity through **planting of native species, installation of green or brown roofs and walls,** and to **minimise water consumption for irrigation and light pollution** arising from outdoor lighting (e.g. through use of correctly-angled low-pressure sodium lamps). Use greywater or rainwater for irrigation.	Onsite biodiversity management plan (y/n) Number plant and animal species onsite L/m^2 non-recycled water for irrigation	**Applicability:** all campsites and other types of accommodation (especially rural). **Economics:** the planting of native species and careful design and control of outdoor lighting is not associated with additional costs. Investment costs for rainwater and greywater harvesting may be significantly lower on campsites than built accommodation. Additional costs for installing brown or green roofs should be balanced against potential economic benefits arising from provision of an attractive recreational area for guests, reduced maintenance and replacement costs for the roof waterproofing layer, reduced energy costs for heating and cooling, reduced drainage system construction costs owing to roof water retention.
– on-site final fossil-energy and electricity consumption of ≤2.0 kWh per guest-night – 100 % of electricity is from traceable renewable electricity sources not already accounted for by another organisation or in the national electricity average generating mix, or that is less than two years old	minimise energy consumption for water-heating, HVAC and lighting through installation of **low-flow fittings, good building insulation, and fluorescent or LED lighting,** and also to **install on-site renewable energy** generating capacity (e.g. solar water heating). Heat may be recovered from wash-room greywater using a heat pump.	kWh/guest-night	**Applicability:** all campsites. Installation of specific renewable energy technologies depends on site-specific characteristics. **Economics:** installation of low-flow water fittings and low-energy lighting are associated with short payback times (as for built accommodation). Renewable energy options are associated with longer payback times, ranging from three years for wood heating with on-site fuel supply to ten years for solar-thermal water heating.

Benchmarks of excellence	BEMP is to	Recommended indicators	Applicability and economics
– total water consumption of ≤94 litres per guest-night on fully serviced four- and five-star campsites, and water consumption of ≤58 litres per guest-night on all other campsites	minimise water consumption through the **installation of low-flow taps and showers, shower-timer controls, and low- and dual-flush WCs.**	L/guest-night % low-flow fittings	**Applicability:** all campsites. **Economics:** owing to high fitting use rates in wash-rooms, installation of low-flow water fittings is associated with short worst-case payback periods of between 2 months for low-flow taps and 18 months for low- and dual-flush toilets. Investment costs for rainwater and greywater harvesting may be significantly lower on campsites than built accommodation.
– total residual waste sent for disposal of ≤0.2 kg per guest-night	minimise residual waste generation by implementing **waste prevention, by providing convenient on-site waste sorting facilities,** and by **contracting waste recycling services.**	% energy from renewable sources kWh/guest-night non-renewable final energy consumption	**Applicability:** all campsites. There is less scope for waste prevention than in other types of accommodation because most waste originates from guest purchases. **Economics:** waste prevention is associated with procurement and disposal cost savings. Encouraging a high rate of waste sorting can significantly reduce waste collection costs, by up to EUR 100 per tonnes depending on local charges.
– the on-site swimming pool(s) incorporate(s) natural plant-based filtration systems to achieve water purification to the required hygiene standard	**installation of, or conversion of an existing pool to, a natural pool.**	Installation of a natural pool (y/n)	**Applicability:** all campsites. Natural pools may be installed from new or converted from existing pools. **Economics:** construction costs are similar to conventional pools (EUR 400 to EUR 470 per m^2 for a pool of ≥50 m^2), but maintenance and operation costs lower owing to low energy and chemical demand.

PREFACE

1. Status of this document
This document is a working draft of the Sustainable Production and Consumption Unit with the Institute for Prospective Technological Studies. It is not an official document and does not necessarily reflect the position of the European Commission.

2. Relevant legal background
The Community Eco-Management and Audit Scheme (EMAS) was introduced in 1993 for voluntary participation by organisations, by Council Regulation (EEC) No 1836/93 of 29 June 1993 (EC, 1993). Subsequently, EMAS has undergone two major revisions:

- Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001 (EC, 2001)
- Regulation (EC) No 1221/2009 of the European Parliament and Council on 25 November 2009.

The latest EMAS Regulation followed a large-scale evaluation of the EMAS scheme that began in 2005. This evaluation, together with input from the various stakeholders in the scheme, identified the strengths and weaknesses of the scheme and proposed options to improve the effectiveness of EMAS. Consequently, on 16 July 2008, the Commission adopted a proposal for the revision of the EMAS Regulation as part of the Sustainable Consumption and Production Action Plan (EC, 2008a). The objective of the proposal was to strengthen the scheme by increasing its efficiency and its attractiveness for organisations, and aimed to:

- ensure that EMAS is a high-quality environmental management scheme that guarantees to external stakeholders and national enforcement authorities that EMAS organisations comply with all relevant environmental legislation and continuously improve their environmental performances;
- raise the attractiveness of the scheme for participating organisations[1], particularly for small organisations (SMEs and small public authorities), by reducing the administrative burden for participating organisations and by increasing the visibility of participation in EMAS;
- have EMAS recognised as a benchmark for environmental management systems;
- allow organisations applying other environmental management systems to upgrade their system to EMAS;
- creating an impact beyond the EMAS registered organisations by requiring these organisations to take into account environmental considerations when selecting their suppliers and service providers.

The proposed changes gave special attention to the needs of small organisations (SMEs and small public authorities), the institutional setup and the links to other Community policy instruments. It was proposed that EMAS would remain based on the environmental management system as embodied in the ISO 14001 standard, complemented by the following elements.

- Reinforced compliance mechanism. The EMAS organisation has to demonstrate its compliance with applicable environmental legislation before the first registration. Dialogue between the organisation and the national enforcement authorities is encouraged. The role of verifiers in ensuring that the organisations comply is reinforced. The definition of non-compliance is clarified and the procedures by the competent bodies for registration and de-registration due to non-compliance are harmonised.

[1] 6000 EMAS registered sites at the end of 2007 (EC, 2008b)

- Reinforced environmental reporting. Reporting on environmental performance using the core performance indicators is mandatory for the EMAS registered organisation. These indicators are defined for the following environmental areas: energy efficiency, material and resource efficiency, waste, emissions, and biodiversity/land use.
- Guidance on best practice in environmental management. In order to support a more harmonised implementation of best practice in environmental management, the Commission initiates the process of development of reference documents. These documents cover specific sectors and focus on direct environmental aspects of production operations as well as indirect aspects, e.g. product design, the environmental impact of downstream and upstream activities.

Following a number of amendments arising from compromises negotiated with the Council, the European Parliament adopted the proposed revision of EMAS in regulation (EC) No 1221/2009 of the European Parliament and Council on 25 November 2009 (EC, 2009). The revised EMAS came into force on 11th January, 2010. Article 46 within (EC) No 1221/2009 (EC, 2009) introduces sectoral reference documents of which this document is an example (see box below).

These documents will describe best environmental management practice, and shall include environmental performance indicators for specific sectors and, where appropriate, benchmarks of excellence and rating systems identifying performance levels. The use of reference documents is voluntary but the EMAS organisations are encouraged to use them for setting up their environmental management system and for defining their environmental targets. The verifiers are required to refer to the documents as a benchmark for an effective management system. However, the reference documents will be made freely available for use by any organisation that wishes to improve its environmental performance, irrespective of whether or not a formal environmental management system is in place.

Article 46 of (EC) No 1221/2009, pertaining to sectoral reference Documents

Article 46
Development of reference documents and guides

1. The Commission shall, in consultation with Member States and other stakeholders, develop sectoral reference documents that shall include:

(a) best environmental management practice;

(b) environmental performance indicators for specific sectors;

(c) where appropriate, benchmarks of excellence and rating systems identifying environmental performance levels.

The Commission may also develop reference documents for cross-sectoral use.

2.The Commission shall take into account existing reference documents and environmental performance indicators developed in accordance with other environmental policies and instruments in the Community or international standards.

3. The Commission shall establish, by the end of 2010, a working plan setting out an indicative list of sectors, which will be considered priorities for the adoption of sectoral and cross-sectoral reference documents.

The working plan shall be made publicly available and regularly updated.

4. The Commission shall, in cooperation with the Forum of Competent Bodies, develop a guide on registration of organisations outside the Community.

5. The Commission shall publish a user's guide setting out the steps needed to participate in EMAS.

That guide shall be available in all official languages of the institutions of the European Union
and online.

6. Documents developed in accordance with paragraphs 1and 4 shall be submitted for adoption. Those measures, designed to amend non-essential elements of this Regulation, by

3. Objective of this document

In the future, the aforementioned reference documents shall be elaborated for a range of sectors identified as priorities for EMAS regulation based on their environmental impact and/or their suitability for EMAS uptake. This document on the tourism sector is being produced by the Institute for Prospective Technological Studies (IPTS), part of the European Commission's Joint Research Centre, as part of a pilot study on the development process for these reference documents. This pilot document may set the line for further reference documents, and is a proposal for how such documents could be structured and presented.

4. Information sources

Concerning environmental management and available measures to increase environmental protection and sustainability of this sector, a lot of information is already publicly available from various sources including a number of comprehensive reports. For drafting this document, that information has been considered along with information collected directly from tourism businesses and other stakeholders, including consultancy firms, non-governmental organisations, and technology providers.

5. How to understand and use this document

EMAS is a voluntary scheme. This document is intended to be used as a support for the efforts for all the actors in the tourism sector who intend to improve the environmental performance therein. This means that this document is elaborated not only for those organisations who have implemented EMAS but also for all those who have implemented any other environmental management system or who just want to contribute to increasing environmental protection and sustainability.

6. Environmental indicators and benchmarks of excellence

With respect to the development of EMAS reference documents for best environmental management practice, environmental indicators will be used. They are defined as follows:
An environmental indicator is '…a parameter, or a value derived from parameters, which points to, provides information about, describes the state of the environmental performance of a technique or measure'.

Environmental indicators express useful and relevant information about the environmental performance of a firm or organisation and efforts to influence performance. Annex IV, C of the revised EMAS legislation states that indicators shall:

(a) give an accurate appraisal of the organisations performance

(b) be understandable and unambiguous

(c) allow for a year on year comparison to assess the development of the environmental performance of the organisation

(d) allow for comparison with sector, national or regional benchmarks as appropriate

(e) allow for comparison with regulatory requirements as appropriate.

The legislation defines three categories of environmental indicator to evaluate and report the environmental performance of an organisation:

- Operational Performance Indicators (OPIs)
- Management Performance Indicators (MPIs)
- Environmental Condition Indicators (ECIs).

The indicators can be designed as:

- Absolute indicators
- Relative indicators
- Aggregated indicators
- Weighted indicators.

Annex IV, C foresees the use of absolute and relative (or normalized) indicators for the following key environmental areas:

- Energy efficiency
- Material efficiency
- Water
- Waste
- Biodiversity
- Emissions.

In the same Annex it is stipulated that apart from the previous core indicators, 'where an organisation concludes that one or more core indicators are not relevant to its significant direct environmental aspects, that organisation may not report on those core indicators'.

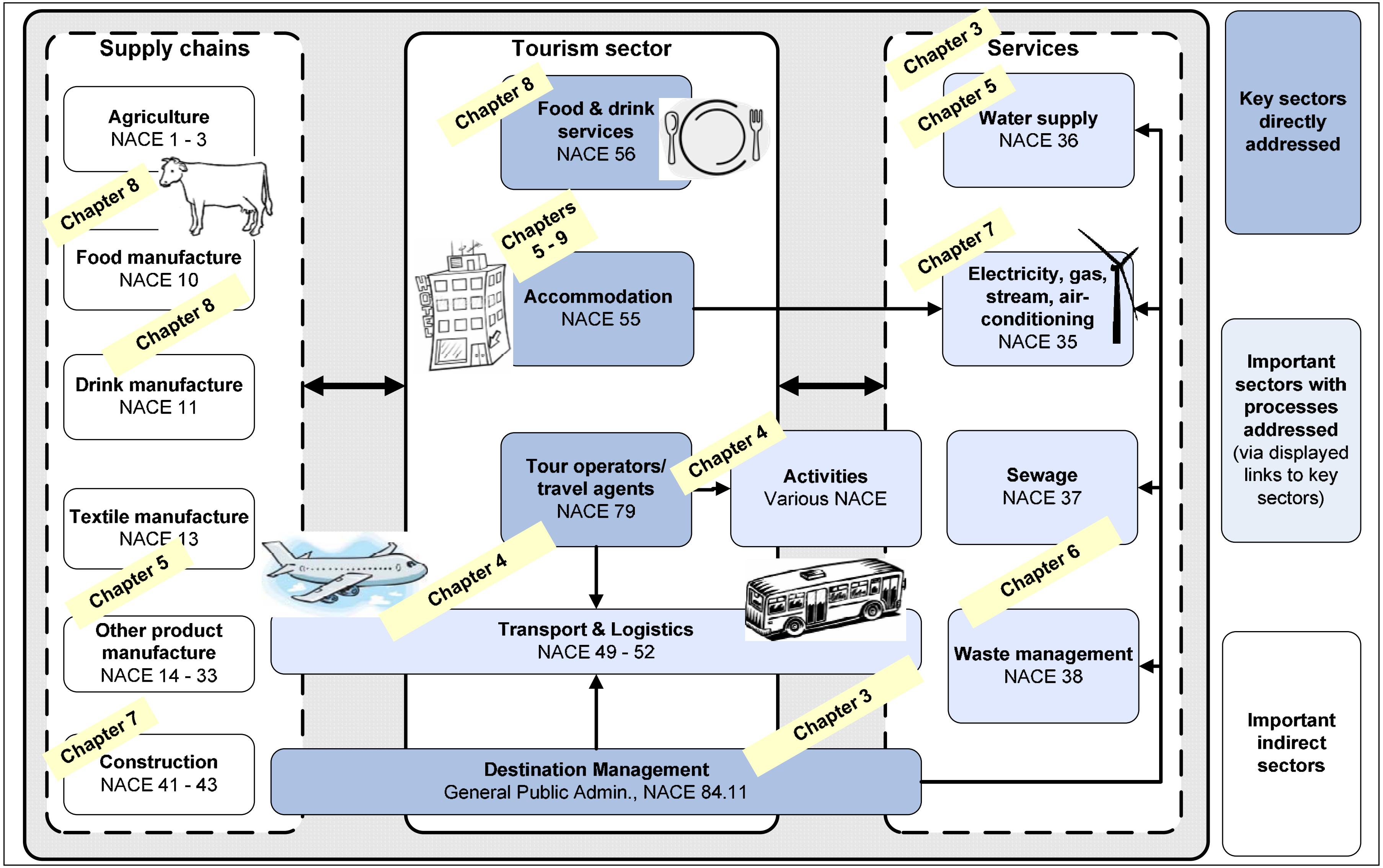
An environmental indicator may be appropriate for a certain company, enterprise or administration but may not be for others. If an indicator can be applied to many companies, enterprises or administrations of a similar type, a benchmark may be derived from it.

An environmental indicator may concern a whole site or only a certain process or aspect of site. For instance, with regard to energy efficiency, it may not be appropriate to compare the overall specific energy consumption of different whole sites but certain processes of energy-consuming units which are directly comparable. Usually, comparability is only possible on this 'unit operation' or process level. The comparison of certain processes, not of whole sites, may also find significantly higher acceptance as it fully concentrates on the technical level.

SCOPE

This document addresses certain of the activities specified in section I 55 of Annex I of Regulation 1893/2006/EC (NACE Rev.2), namely: *'Accommodation and Food Service Activities'* and section N 79 *'Travel agency, tour operator reservation service and related activities'.*

The scope of this Sectoral Reference Document (SRD) primarily covers best environmental management practices within organisations providing accommodation, food and beverage services, or that manage tourism destinations or provide tourism travel, accommodation or activities (travel agents and tour operators). These sectors are inter-linked with a variety of other sectors as portrayed in the tourism supply chain diagram below. In terms of the tourism product, the activities that a tourist participates in whilst on holiday are also an important part of the tourism value chain, and of potential interest for EMAS registered organisations. However, it has not been possible to include best practice in the management of activities in this document owing to the resource constraints of this project. Activities are referred to as far as they may be influenced by destination managers and tour operators.



Scope of the tourism value chain, comprising dedicated tourism sectors and related product and service sectors, referred to directly and indirectly in this document

The following sections provide a systems description of the sectors that are the focus of this tourism reference document – accommodation, food and beverage and tour operators and travel agents.

1. Accommodation Services

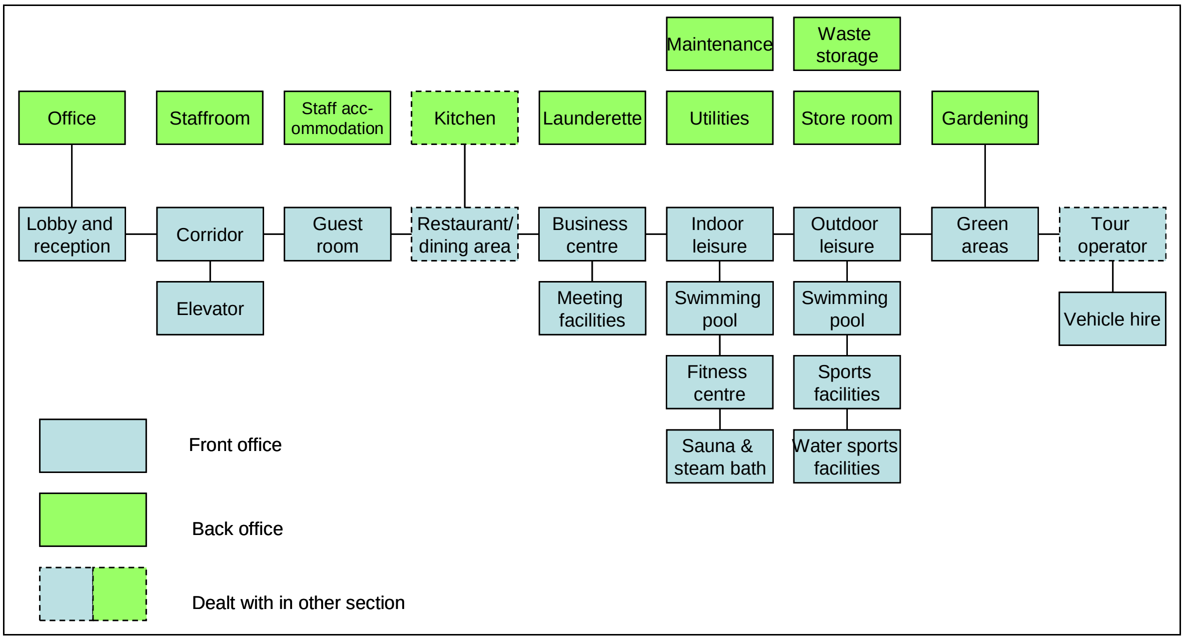
Two basic types of accommodation are focussed on:

- Built accommodation, such as hotels, guest houses, hostels
- Campsites and camping parks.

The systems related to these are described below.

1.1. Built accommodation

Built accommodation varies immensely in relation to the level and quality of services offered to guests, with star rating systems making specific requirements on the level of equipment and infrastructure offered, as well as the price of the rooms. The diagram below and the following descriptions are thus indicative only, providing an illustration of the functions found in typical fully service built accommodation.

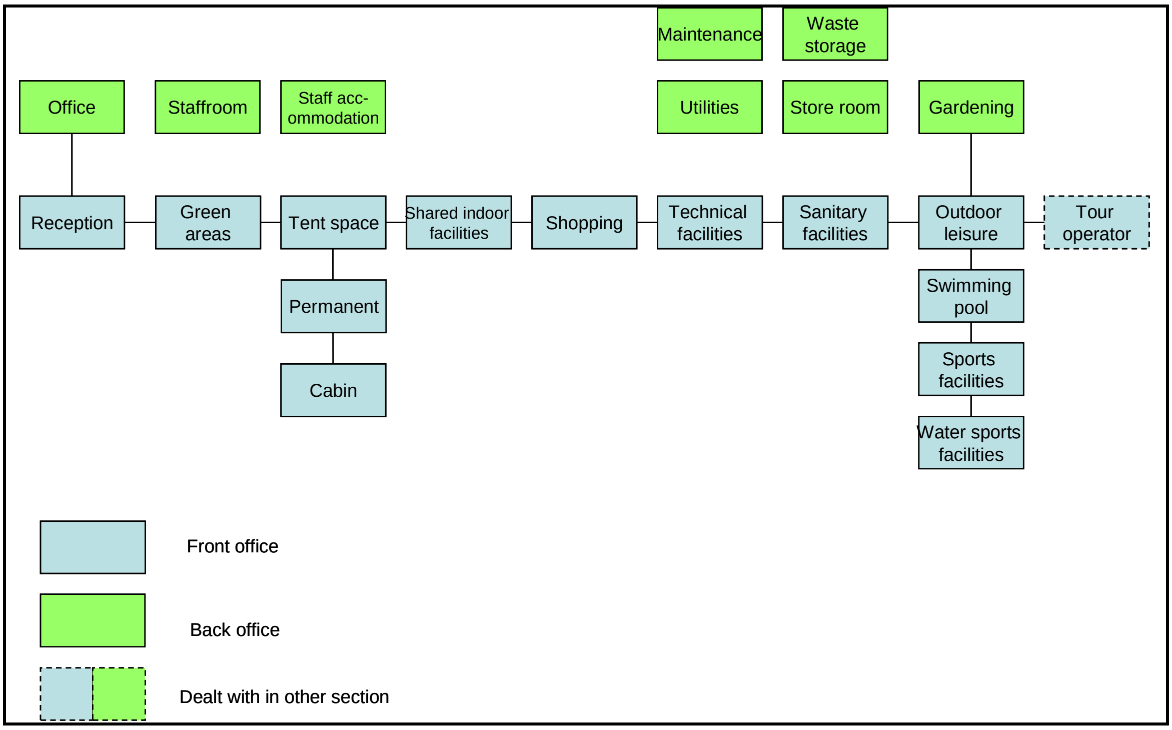


Front of house functions	
Lobby and reception	On entry into service accommodation, the guest usually enters a lobby area which is lighted, heated, cooled and ventilated. The reception features computers, printers and other standard office equipment.
Corridor and elevator	Guests reach their room via corridor and/or elevator. The corridors are lighted and heated, cooled or ventilated.
Guest accommodation	The guest accommodation may be either a room or an apartment. The rooms are lighted and heated, cooled or ventilated. The rooms normally incorporate the following: – bed – bathroom including toilet, wash basin, shower and bath – minibar/fridge – multimedia including television, internet connection, etc – furniture including table and chairs – windows An apartment usually has more than one room and includes a kitchenette, which features a larger fridge/freezer, kitchen utensils, plates and cutlery.
Restaurant and dining area	Please refer to section on Food and Beverage.
Business Centre and meeting facilities	Larger serviced accommodation, especially in urban locations, often offer office services to their guests. This may be provided in a specialised room with computers, internet access and printers. Additional functionality includes lighting, heating/cooling, desks and chairs. In addition, some accommodation facilities may offer varying levels of meeting capacity, ranging from basic boardrooms to full scale meeting rooms with break out rooms attached. These areas are furnished with tables and chairs, audiovisual aids, heating/cooling, lighting, toilet facilities.
Indoor leisure	Service accommodation may offer indoor leisure facilities to guests such as gym/fitness, wellness and swimming pool.
Outdoor leisure	Depending on size, location and market, the service accommodation may offer outdoor leisure activities to guests including heated/unheated swimming pool(s), tennis courts, and playgrounds for children, outdoor dining/barbequing area, (access to) golf court. The whole area may be equipped with lighting.
Green areas	A green area/park may surround the buildings and would normally be intensively maintained. The whole area may be equipped with lighting and could feature automatic irrigation systems.
Tour operations	Please refer to section on Travel Agents and Tour Operators.
Vehicle hire	Hotels may offer vehicle hire and/or have agreements with taxi and shuttle ompanies.

Back of house functions	
Office	The management office has similar facilities to the front office/reception area. Management keeps records of transactions, which can be an important source of environmental data, on for example electricity consumption and water usage.
Staff room / accommodation	Depending on the size of the serviced accommodation and the number of employees, staff facilities may be offered including dining and accommodation.
Kitchens	Please refer to section on Food and Beverage
Laundries	Serviced accommodation generates a range of washing requirements related to use of textiles used in the guest rooms, restaurant, kitchen etc. In addition, hotels may offer washing/dry cleaning services for the guests' own garments. Serviced accommodation may outsource its laundry needs or may operate in-house laundries, which are usually equipped with a variety of energy consuming devices including steamers (for spot-cleaning), washing machines (wet and dry) and tumble-dryers/drying closets. Apart from these devices, resources are consumed (detergents and water) to deal with the textiles. Dry cleaning uses fluent solvents to wash garments. For the drying of the dry-clean process, warm air is used.
Cleaning	The organisation may employ its own cleaning staff or use a cleaning company. Cleaning involves detergents, electrical apparatus and water – some of these might be stored in locked closets in the corridors, and some could be stored separately in a room designated for dangerous materials/chemicals.
Utilities	The main utilities used by a hotel are electricity, natural gas, piped drinking water and sewerage. In urban areas, hotels may be connected to district heating distribution systems. The utility companies typically bill the accommodation on a quarterly basis, providing useful consumption data. The utility companies may also provide advice to their consumers on resource efficiency. Some hotels use alternatives to the utilities, either in a drive to become more self-sufficient or because of unavailability of utilities. Examples being operation of their own wastewater treatment plants, and generation of their own electricity and hot water.
Maintenance	Involves fixing/repairing the mechanical or electrical devices of the hotel but also the performance of routine actions which keep the device in working order. Air-conditioning, heating, gas and electricity are controlled from here.
Gardening	Serviced accommodation may maintain its surrounding green areas or outsource this. For winter sports/skiing hotels, this also includes clearing of snow and ice. Much of the equipment requires power for operations, e.g. lawn mowers (petrol or electric), rotivators (petrol) and hedge trimmers (electric). In addition the gardening area may also feature storage of hazardous materials for use in gardening, e.g. pesticides to combat vermin and herbicides to remove unwanted plants.
Store room and waste storage	Serviced accommodation may have a store room for storage of materials used in the process. There are also requirements for storage of waste materials produced from the serviced accommodation and potentially from the restaurant/kitchen. The handling and sorting of waste is depending on local arrangements.

1.2. Campsites

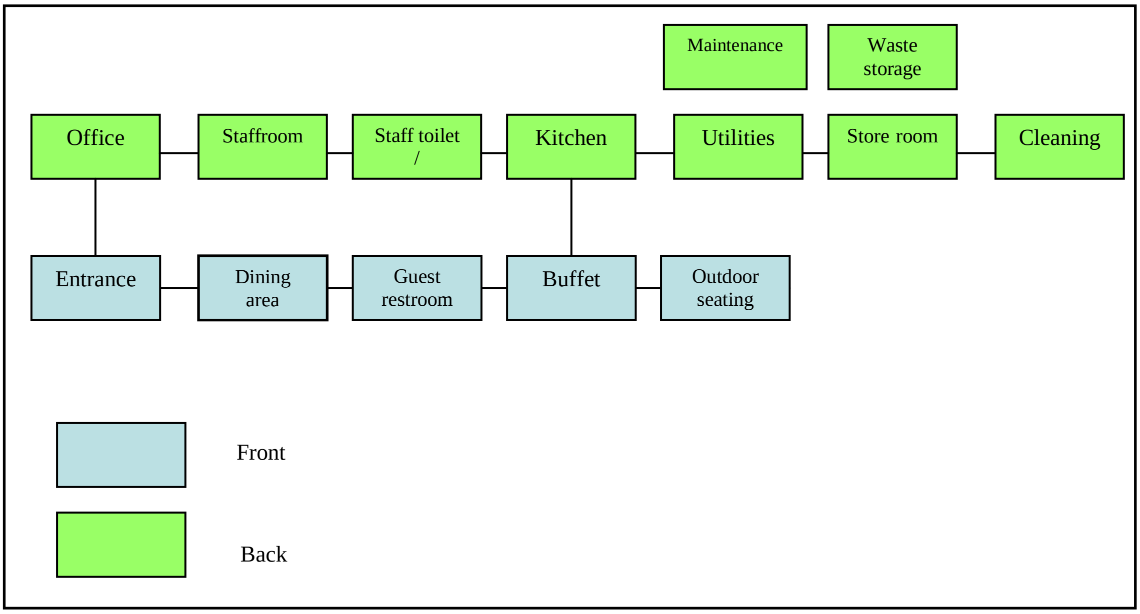
Campsites consist of pitches for tents and caravans or motorhomes, and may feature cabins and holiday cottages of varying standard and price. Holiday cottages can be fully equipped with rooms, kitchen, bathroom and modern facilities such as TV, internet etc. Typical features of a campsite are illustrated below.



Campsite functions	
Reception and/or administrative building	Normally, a camp-site has some sort of closed area where guests need to register at arrival. The reception features computers, printers and other standard office equipment. It which may be heated, cooled or ventilated, and will have lighting. Somewhere in the area, a storeroom and maintenance room may be located.
Tent and caravan space	Appointed areas for tents, caravans and auto campers are made available. These units are self-contained areas for a pre-determined number of tents, caravans and auto campers. They are typically equipped with toilet and wash facilities as well as electricity.
Lodgers	Most camp-sites feature areas for year-round guests that are able to locate their shelter, such as a trailer, on-site on a permanent basis.
Technical facilities	A camp-site offers various technical facilities to its guests reflecting price and market parameters. Some of the following facilities may be provided:´ – electrical connections – lighting (area) – car-wash area – TV and cable-TV connection/satellite signal – telephony – wireless hotspots – workshops
Sanitary facilities	When it comes to sanitary facilities, the variation is considerable depending on market parameters. However, at least some of the below facilities would normally be provided: – toilets (common area) – wash basins – showers (hot and cold water) – washing cabins – nursing room(s) – facility/ies for emptying chemical toilets – sashing machine(s) and tumble dryer(s)
Shopping/retail	Campsites may provide retail shopping opportunities and restaurants/bars. Restaurants and bars are dealt with in other sections of this document. Retail and shopping will not be elaborated on in this document – please refer to the Sectoral Reference Document for the retail trade sector.
Green areas – outdoor leisure	Campsites may include activities for all ages and the outdoor area is the main scene for many of these. The following might be present in the camp-site area: – sports halls – playing fields – playing areas (inodoor and outdoor) – garden (planted) areas
Shared indoor facilities	Shared indoor facilities at campsites may include TV-room, cooking area, game hall, internet area and sauna/pool facilities.
Tour operations	Please refer to section on Travel Agents and Tour Operators.

1.3. Food and Beverage Services

The food and beverage sector includes restaurants, mobile food service activities, event catering, and beverage serving activities. Restaurants vary greatly and, depending on location and market, may serve both tourists/one time visitors and residents. A restaurant/bar prepares and serves food and drink to its guests. Meals are generally served and eaten on premises but take-away and food delivery services may also be part of the restaurant/bar offer. The basic features of a food and beverage service are described below. Accommodation buildings usually include facilities to prepare food and drink for breakfast, and often have their own restaurants.



A restaurant/bar may consist of a combination of the above mentioned functions and not necessarily include all of them. Generally, there is a front area and a back area (and possibly an outdoor seating area).

Front of house functions	
Entrance	Guest entry may be either directly into the dining area or, in case of adjacency to a hotel, via the shared areas.
Dining area	The dining area is where the bar/restaurant performs its main function: serving food and drink to the guests. The area is lighted, and usually heated, cooled and ventilated.
Guest toilets	Guests will have access to toilets which are usually equipped with lighting, heating, cooling and ventilation.
Buffet	The serving area may contain a buffet area where guests serve themselves. This includes heating and cooling equipment to maintain the food and drink at the required temperatures.
Outdoor seating	The dining area may include outdoor seating. This features use of more durable furniture and outdoor patio heaters in colder climates.

Back of house functions	
Office	Larger restaurants and bars typically have office facilities on the premises – where they are part of a hotel, these might be shared. It would feature computers, printers and other standard office equipment.
Staff room and toilet	Staff have access to changing, toilet and washing facilities. Depending on the size of the food and beverage service, a dedicated room may be provided for changing clothes and/or taking breaks.
Kitchen	The kitchen is the backbone of the restaurant. Foodstuffs are stored in the kitchen area, possibly in store rooms and (walk-in) freezers and fridges. Food is processed through cleaning, cutting, slicing, mixing and heating/freezing. Equipment and serving ware is washed, and waste is managed. Kitchens contain a variety of different equipment including: – ovens (gas or electricity) – grills (open grills, gas-fired) – steamers – griddles (flat plate of heated metal) – fryers – kettles – coffee machines – ice machines – Industrial scale mixers – dishwashers – spray valves
Utilities	The main utilities used by a restaurant/bar are electricity, natural gas, drinking water and sewerage. In urban areas, restaurants may be connected to district heating distribution systems. The utility companies typically bill the restaurant/bar on a quarterly basis, providing useful consumption data. Some restaurants/bars might use alternatives to the utilities, either in a drive to become more self-sufficient or because of unavailability of utilities. Examples being operation of their own wastewater treatment plants, and generation of their own electricity and hot water.
Maintenance	Involves fixing/repairing the mechanical or electrical devices of the restaurant/bar but also the performance of routine actions which keep the devices in working order. Air-conditioning, heating, gas and electricity are controlled from here. Use of pesticides to control vermin and insects.
Cleaning	The restaurant might employ its own cleaning staff or use the service of a cleaning company. Cleaning involves detergents, electrical apparatus and water.
Store room	Restaurants require storage space for a variety of materials including vegetables, spices, herbs and flavourings as well as cleaning materials. The handling and sorting of waste materials depends on local arrangements

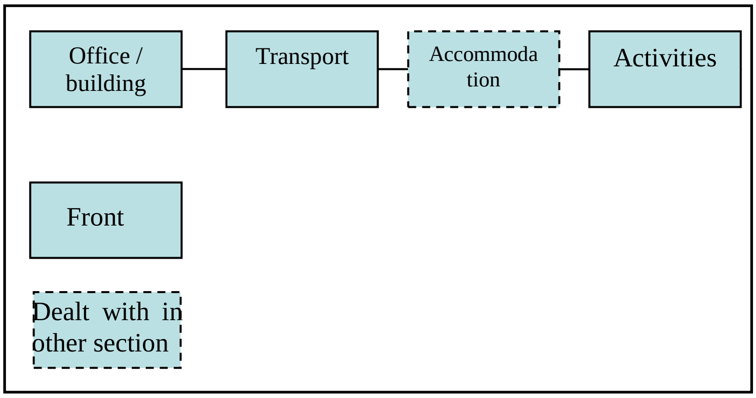
1.4. Tour Operators

Tour Operators are the organisers and providers of packaged holidays. They make contracts with hoteliers, airlines and ground transport companies then print brochures advertising the holidays that they have assembled in tourism packages. Some larger tour operators might directly control airlines and ground transport operations, and so have directly responsibility for the whole supply chain of their services. Although the holidays 'manufactured' by tour operators are usually sold by travel agents, some companies have their own retail outlets or sell directly to the public by telephone or post. Thus the work of a large operator may encompass all the stages in the production and sale of a holiday.

Travel agents give advice and sell and administer bookings for tour operators. Much of their time is spent advising clients in person, finding out what type of holiday the client wants, showing them brochures, answering any questions and maybe suggesting particular resorts or hotels. When the client has chosen, the travel agent checks to confirm availability and books the holiday using a computer system linked to the tour operator. They collect deposits from clients and complete booking forms. When the tour operator sends the holiday tickets to the travel agency, the agent passes them on to the client. In this role, the travel agent is only indirectly related to hoteliers, air companies and other links in the tourism supply chain.

Travel agents also deal with independent travellers, and may help plan their journey using timetables before booking their air, rail or ferry tickets and accommodation. Some agents specialise in business travel, dealing with complicated itineraries. They also offer advice on passport, visa and vaccination requirements and services such as holiday insurance, car hire, holiday excursions, foreign currency and travellers' cheques.

In this document, 'Tour operators' is used to refer to both tour operators and travel agents, and all activities and influences associated with them. The following system description is proposed for Tour Operators.



Tour operator and travel agent responsibilities	
Office/retail	Both travel agents and tour operators reside in some sort of office/building which means that their functioning is related to typical office equipment such as computers, printers, fax, internet connection, telephones and office supply such as paper. Especially, tour operators produce brochures, catalogues and leaflets often presented on dense, glossy paper. Tour operators also often have offices at destination wherefrom they pick up guests, arrange guided tours or perform tourist information centre services.
Transport	Transport is one of the main elements of tour operators' activities and the first link in the tourism supply chain between the guest and the destination. Transport implies air, land and sea travel. Tour operators interrelate with: – air companies/flights – taxis – car hire – buses/shuttles – trains – ferries/cruise ships
Accommodation	The accommodation services that tour operators interact with are described above in sections 4.2 – 4.4. As part of their services, tour operators often check the quality of the accommodation services that they sell to their customers. This may include site visits by managerial staff to assess and review the accommodation performance using pre-defined check lists. This may include environmental criteria.
Activities	Tour operator representatives may be based in the destination and meet their customers there. In this way, and through the booking process, tour operators may organise and influence customer excursions and activities. Examples include guided tours of cultural heritage, diving, golfing, skiing and day trekking.

STRUCTURE

Following a brief description of the context and scope of this document (current section), Part 1 ('GENERAL INFORMATION') provides some background information on the European tourism sector in short chapters. Part 2 is the main body of the document, containing Best Environmental Management Practices (BEMPs). These are divided according to: (i) actors; (ii) environmental aspects; (iii) processes. Part 3 contains conclusions. Contents are summarised in the table below 9see also the sectoral scope diagram).

Part	Chapter	Target actors	Contents
1	1	All tourism actors	General information about the sector, including: – Turnover and employment – Environmental aspects – Environmental management systems
2	2	All tourism actors	Cross-cutting BEMPs, in particular related to: – Use of appropriate indicators and benchmarks – Suppy chain management
	3	Destination managers (e.g. local authorities, destination management organisations)	Key aspects of destination management including: – Implementation of an overarching 'Destination Plan' – Planning and biodiversity management – Provision of environmental services – Event management
	4	Tour operators and travel agents	Six BEMPs addressing a range of direct and indirect aspects including: – Management of transport operations/providers – Management of accommodation operations/providers – Actions to improve destination sustainability – Promotion of more sustainable tourism packages – Encouraging more sustainable tourist behaviour – Efficient office and retail operations
	5	Accommodation managers	Seven BEMPs to minimise water consumption in accommodation, including: – Water consumption monitoring and system optimisation – Installation of efficient water fittings – Efficient housekeeping – Optimised small-scale laundry operations – Optimised large-scale (also out-sourced) laundry operations – Optimised pool management – Rainwater harvesting and greywater recycling
	6		Three BEMPs to minimise waste generation in accommodation, including: – Waste prevention – Waste sorting and recycling – Wastewater treatment
	7		– Six BEMPs to minimise energy consumption in accommodation, including: – Energy monitoring and management – Improved building envelope – Optimised HVAC systems – Efficient heat pump application – Efficient lighting and electrical equipment – Use of renewable energy
	8	Kitchen managers	Four BEMPs addressing:

Part	Chapter	Target actors	Contents
			– Green sourcing of food and drink – Organic waste management – Minimising water consumed for dish washing, cleaning and food preparation – Minimising energy consumed for cooking, ventilation and refrigeration
	9	Campsite managers (first two sections for all users)	Six BEMPs, addressing issues including: – Environmental education of guests – Management of outdoor areas – Energy efficiency on campsites – Water efficiency on campsites – Waste minimisation on campsites – Installation of natural swimming pools
3	**10**	Micro-enterprise and SME managers	Information on specific challenges and solutions for SMEs and guidance on relevant and applicable BEMP measures referred to elsewhere in this document.
	11	All tourism actors	Summary of main conclusions, focussing on BEMP descriptions, relevant environmental indicators and benchmarks of excellence.

Reference literature

- EC, *Regulation (EEC) No 1836/93 of the European Parliament and the Council of 29 June 1993 allowing voluntary participation by companies in the industrial sector in a Community eco-management and audit scheme*. OJEU L 168 (1993).
- EC, *Regulation (EC) No 761/2001 of the European Parliament and the Council of 19 March 2001 allowing voluntary participation by organisations in a Community ecomanagement and audit scheme (EMAS)*, OJEU L 114 (2001).
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- EC, *Commission staff working document accompanying the proposal for a regulation of the European Parliament and of the Council on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS): Impact Assessment*, EC, 2008, Brussels.
- EC, *Regulation (EC) No 1221/2009 of the European Parliament and the Council of 25 November 2009 on the voluntary participation by organisations in a Community ecomanagement and audit scheme (EMAS), repealing Regulation (EC) No 761/2001 and Commission Decisions 2001/681/EC and 2006/193/EC*, OJEU L 342 (2009).

1 GENERAL INFORMATION ABOUT THE TOURISM SECTOR

1.1 Turnover and Employment

1.1.1 Main Economic Data

Europe is the largest tourism region in the world enjoying 53% of market share in terms of international tourist arrivals (Table 1.1). Ranked according to international tourist arrivals, Europe has five destinations within the global top ten: France, Spain, Italy, United Kingdom and Germany (in order of magnitude). Looking at the sub-regions in Europe in the table below, it can be seen that there has been incremental growth since 1990, with a near doubling in total international tourist arrivals2:

Table 1.1: Sub regional tourism activity by international arrivals across Europe

	International Tourist Arrivals (million)							**Market share (%)**	**Average annual growth (%)**
	1990	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2008**	**00 – 08**
Europe	**265.0**	**309.5**	**392.6**	**441.8**	**468.4**	**487.9**	**489.4**	**53.1**	**2.8**
Northern Europe	28.6	35.8	43.7	52.8	56.5	58.1	57.0	6.2	3.4
Western Europe	108.6	112.2	139.7	142.6	149.6	154.9	153.3	16.6	1.2
Central/Eastern Europe	33.9	58.1	69.3	87.5	91.4	96.6	96.6	10.8	4.6
SouthernEurope/ Mediterranean	93.9	103.4	139.3	158.9	170.9	178.2	179.6	19.5	3.2
Source: UNWTO (2009).									

The regional level average annual tourism growth rate is relatively steady at 2.8% which is slightly lower than the world average of 3.8%. Looking at the national level results in Table 1.2, it can be seen that the five destinations in the global top 10 dominate. However, it should be borne in mind that these statistics exclude domestic tourism which can be a significant part of national tourism.

Although France is the global leader in terms of international tourist arrivals, Spain is second to USA at the global level in international tourism receipts with France third.

Tourism is an important economic sector in Europe. In 2006 there were 1.7 million enterprises in the EU-27 hotels and restaurants sector, employing some 9.3 million people. This corresponded to 8.3% of the non-financial business economy's enterprise population and 7.1% of its workforce3. In 2006, EU-27 hotels and restaurants generated EUR 433.7 billion of turnover, of which EUR 181.9 million was value added, which represented 3.2% of the total for the non-financial business economy (Eurostat, 2010).

[2] Note that these figures are taken from UNWTO who's definition of Europe includes non-Member States such as the Russian Federation and Turkey.

[3] Non-financial business economy consists of NACE Rev. 1.1 Sections C to I and K

Table 1.2: International tourist arrivals by number and share of receipts in 2008

Country	International Tourist Arrivals		International Tourism Receipts	Country	International Tourist Arrivals		International Tourism Receipts
	(1000)	Share (%)	Share (%)		(1000)	Share (%)	Share (%)
Austria	21 935	4.5	4.6	**Ireland**	8 026	1.6	1.3
Belgium	7 165	1.5	2.6	**Italy**	42 734	8,7	9.7
Bulgaria	5 780	1.2	0.8	**Netherlands**	10 104	2.1	2.8
Czech Republic	6 649	1.4	1.6	**Poland**	12 960	2.6	2.5
France	79 300	16.2	11.7	**Portugal**	-	-	2.3
Germany	24 886	5.1	8.4	**Spain**	57 316	11.7	13.0
Greece	-	-	3.6	**Sweden**	-	-	2.8
Hungary	8 814	1.8	1.3	**United Kingdom**	30 182	6.2	7.6
Source: UNWTO (2009).							

1.1.2 Structural Profile of the Sector

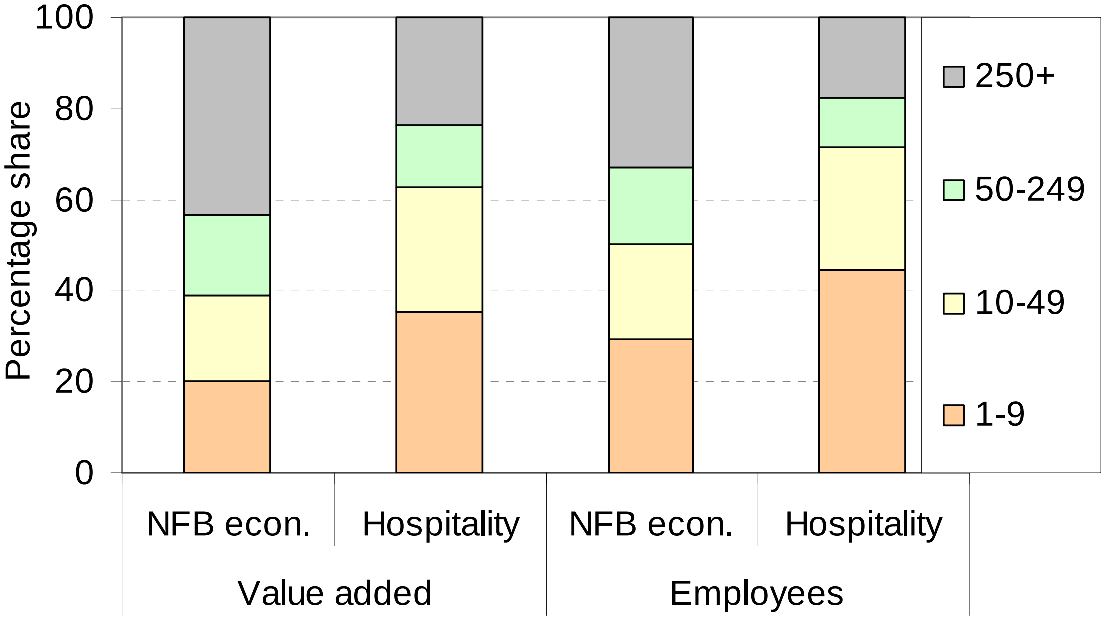
In the EU-27, restaurants, bars, catering and canteens is the larger of the two aggregates that make up the hotels and restaurants sector, contributing 64 % of the value added in 2006 while employing 75 % of the workforce (Table 1.3). Apparent labour productivity by subsector was considerably higher for hotels, camping sites and other provision of short-stay accommodation than for restaurants, bars, canteens and catering – see table below.

Table 1.3: Structural profile of hotels and restaurants within the EU-27 in 2006

	Number of enterprises	Number of persons employed	Turnover	Value added	Apparent labour productivity
	(1000)		(EUR million)		(EUR 1000 /Employee)
Hotels and restaurants	**1 682**	**9 266**	**433 696**	**181 912**	**19.6**
Hotels, camping sites, other providers of short-stay accommodation	259	2 287	135 108		28.6
Restaurants, bars, canteens and catering	1 423	6 978	298 588	116 499	16.7
Source: Eurostat (2010).					

Generally, micro- (<10 persons employed) and small (<50 persons employed) enterprises dominate the tourism sector in Europe. As Figure 1.1 shows, a large proportion of the value added created in the EU-27 hotels and restaurants was concentrated in organisations with less than 50 employees. Together, micro and small enterprises generated 63 % of the sector's value added in 2006 and employed 72 % of its workforce in 2005.

Among the member states the UK, and to a lesser extent the Netherlands, stood out from other countries as large enterprises (over 250 employees) make significant contributions (45 % and 35 % respectively) to total value added within the hotels and restaurant sector.

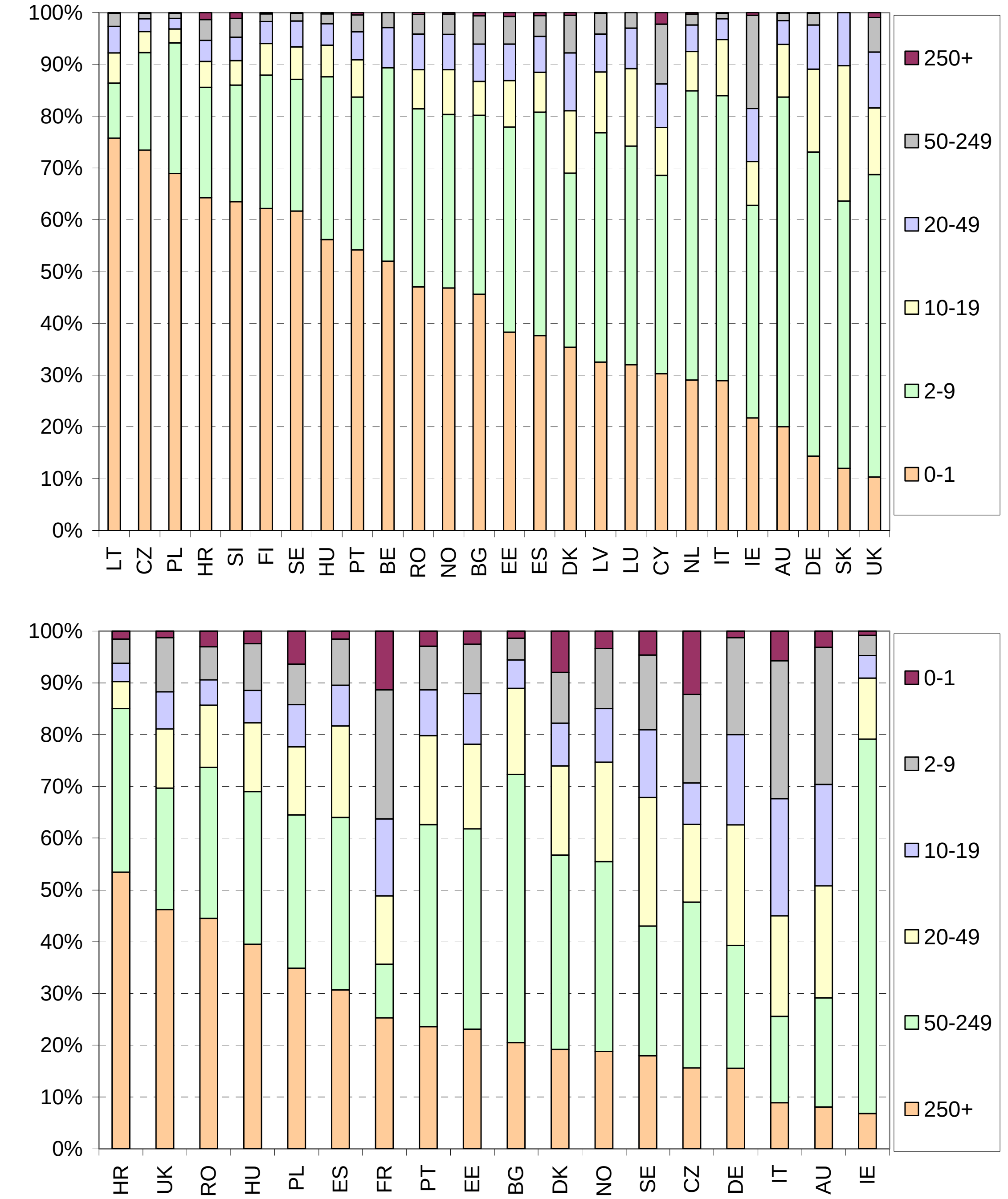


Source: Eurostat (2010).

Figure 1.1: Share of value added and persons employed by enterprise size class in the EU-27, for the non-financial business (NFB) economy and for the hotel and restaurant (hospitality) sector

The importance of SMEs is even higher in the accommodation sub-sector, where micro-enterprises employing 1 to 9 employees dominate (Figure 1.2). In all Member States except for the UK, Netherlands and Denmark, micro-enterpirses represent at least 75 % of the total number of enterprises in the industry. In certain countries like the Czech Republic, Poland and Greece, the share of micro-enterprises in the total number of enterprises exceeds 90 %. In all countries, the share of medium (more than 50 but fewer than 250 employees) and large companies (more than 250 employees) is below 10 % of enterpirses. In some countries like France, Italy and Greece, the proportion of these medium and large companies is very small.

Nonetheless, medium and large enterprises account for over half of the total number of employees in a number of countries. Large integrated hotel chains account for 25 % of the EU accommodation market, ranging from 10 % in Slovenia, Italy and Greece to 55 % in the Netherlands (ECORYS, 2009). Five major hotel groups account for over 70 % of the chain hotel market. Nonetheless, overall the accommodation is highly fragmented, with the top ten largest players in the industry estimated to account for less than 5 % of the total bed stock in Europe (ECORYS, 2009).



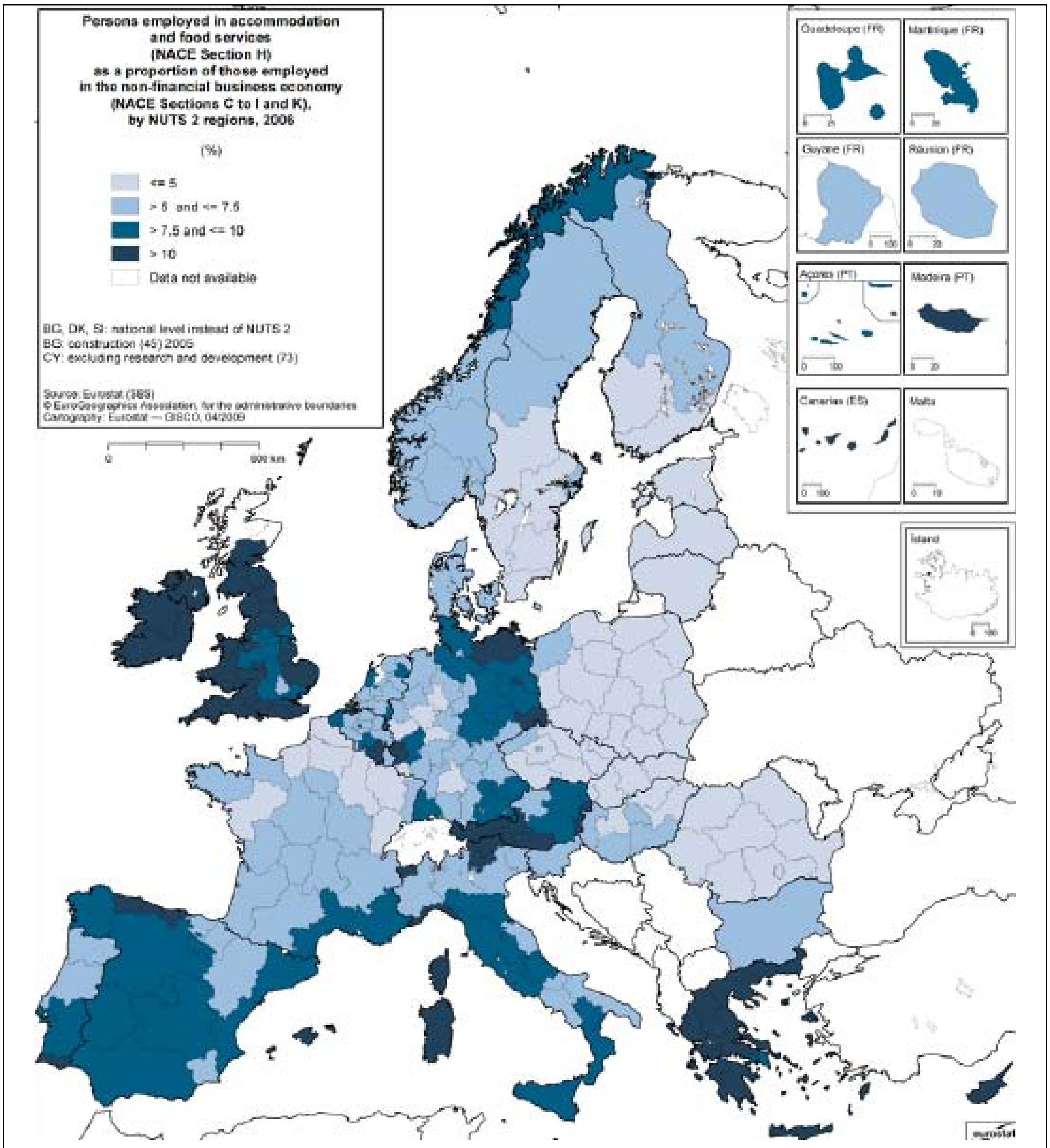
NB: Data for 2008.
Source: Eurostat (2012).

Figure 1.2: Size distribution of accommodation enterprises in the EU-27, by number of enterprises (top figure) and by gross-value-addedd (bottom figure)

1.1.3 Geography of EU-27 Tourism

Tourism activity is highly concentrated in destinations centred around climate, natural or man-made attractions (beaches, mountains, castles etc.), and often defined by their proximity to a critical mass of potential customers.

As Figure 1.3 shows, the highest proportions of non-financial business economy employment within the hotels and restaurants sector are recorded in the Mediterranean region. Hotel and restaurant employment proportions are highest in several regions of Greece, followed by regions in Portugal, Spain and Italy (often holiday islands). The sector also provided 15% or more of employment in a few regions of the UK, Ireland, Austria and Germany, as well as Cyprus.



Source: Eurostat (2010).

Figure 1.3: Regional employment in hotels and restaurants

Details for the member states, as presented in Table 1.4, show that the hotels and restaurant sector in the UK is the largest in the EU. With a value added of EUR 41.7 billion, the UK contributed over a fifth of the EU-27 total. The UK also reported the largest workforce with 1.9 million people working in the hotel and restaurant sector. The average personnel costs per employee are among the lowest recorded in the non-financial business economy. This reflects the high use of part-time and seasonal labour, and the relatively low or unskilled workforce. The contribution of the hotels and restaurants sector to non-financial business economy value added was consistently lower than the corresponding share of employment, reflecting the labour-intensive nature of these activities (Eurostat, 2010).

Table 1.4: Hotels and restaurants in the EU Member States, 2008

	No. of persons employed	Turnover	Value added	Average personnel costs	Apparent labour productivity	No. of hotels & similar	Average no. of bed places per establishment	Nights spent	Tourism intensity
	(1000)	(EUR million)		(EUR million)		Units		(1000)	Per inhabitant
				(per employee)	(per employee)				
EU-27	**9 266**	**433 696**	**181 912**	**15.6**	**19.6**	**202 353**	**58**	**1 578 148**	**3.2**
Austria	243	13 143	6 390	21.0	26.3	14 204	40	79 167	9.6
Belgium	166	10 179	3 723	18.1	22.4	2 013	62	16 197	1.5
Bulgaria	115	1 077	328	1.6	2.9	1 526	152	16 736	2.2
Cyprus	38	1 683	919	17.8	23.9	735	119	14 298	18.4
Czech Republic	158	3 969	1 259	6.7	7.9	4 559	54	27 044	2.6
Denmark	105	5 352	2 298	16.8	22.0	477	154	11 080	2.0
Estonia	19	434	160	5.7	8.6	346	83	3 843	2.9
France	915	66 493	28 529	26.9	31.2	18 135	69	204 269	3.2
Finland	55	4 855	1 806	27.1	32.8	909	131	15 817	3.0
Germany	1 316	48 989	23 225	12.6	17.7	35 941	46	214 675	2.6
Greece	304	9 475	3 457	14.3	11.4	9 207	76	64 086	5.7
Hungary	127	2 569	702	5.3	5.5	1 999	77	16 297	1.6
Ireland	149	8 531	3 407	18.0	22.9	4 087	38	28 282	6.6
Italy	1 115	60 364	21 993	19.5	19.7	34 058	63	254 329	4.3
Latvia	31	509	225	3.3	7.4	318	65	2 759	1.2
Lithuania	39	476	165	3.3	4.3	348	63	2 591	0.8
Luxembourg	16	1 027	492	24.6	31.7	273	53	1 438	3.0
Malta	-	-	-	-	-	160	250	7 917	19.4
Netherlands	345	15 578	6 610	12.9	19.2	3 196	63	34 159	2.1
Poland	231	4 504	1 518	5.1	6.6	2 443	78	24 307	0.6
Portugal	276	8 880	3 072	8.9	11.1	2 031	130	39 737	3.7
Romania	122	2 030	564	2.6	4.6	4 163	55	19 756	0.9
Slovakia	22	453	174	5.2	8.0	1 249	54	7 233	1.3
Slovenia	32	1 228	462	12.8	14.4	396	83	5 546	2.8
Spain	1 259	58 406	25 172	17.6	20.0	17 827	92	271 689	6.1
Sweden	124	8 688	3 294	24.9	26.5	1 893	110	15 817	3.0
United Kingdom	1 927	94 309	41 710	13.5	21.6	39 860	31	169 484	2.8

Source: Eurostat (2010).

The largest number of hotels and similar establishments in 2007 were in the UK, Germany and Italy. Malta had the highest result in average number of bed places, with Spain, Germany and Italy recording the highest overnight figures.

Tourism intensity is a ratio of the number of overnights per inhabitant. This figure is highest for the island destinations of Malta and Cyprus, as well as Austria, Ireland and Spain. In terms of average length of stay, the popular summer destinations (Bulgaria, Cyprus, Malta and Greece) were notably higher at five days or more on average.

1.1.4 Reference literature

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1.2 Environmental Issues of the Tourism Sector

1.2.1 Environmental aspects, pressures and impacts

Reducing the environmental impact of tourism is key to ensuring it remains a major source of economic activity. ECORYS (2009) note: 'Given the importance of human capital and the strong dependency of tourism on natural resources, further development of the industry in a sustainable way is key to remaining competitive. This has also been recognised at the EU policy level and underlined in the European Commission Communication 'Agenda for a sustainable and competitive European tourism' (COM (2007) 621 final'.

The tourism services within the sectors that are the focus of this reference document – accommodation, food and beverage and tour operators and travel agents – involve a wide range of activities that give rise to various environmental pressures, and, ultimately, impacts (Figure 1.4).

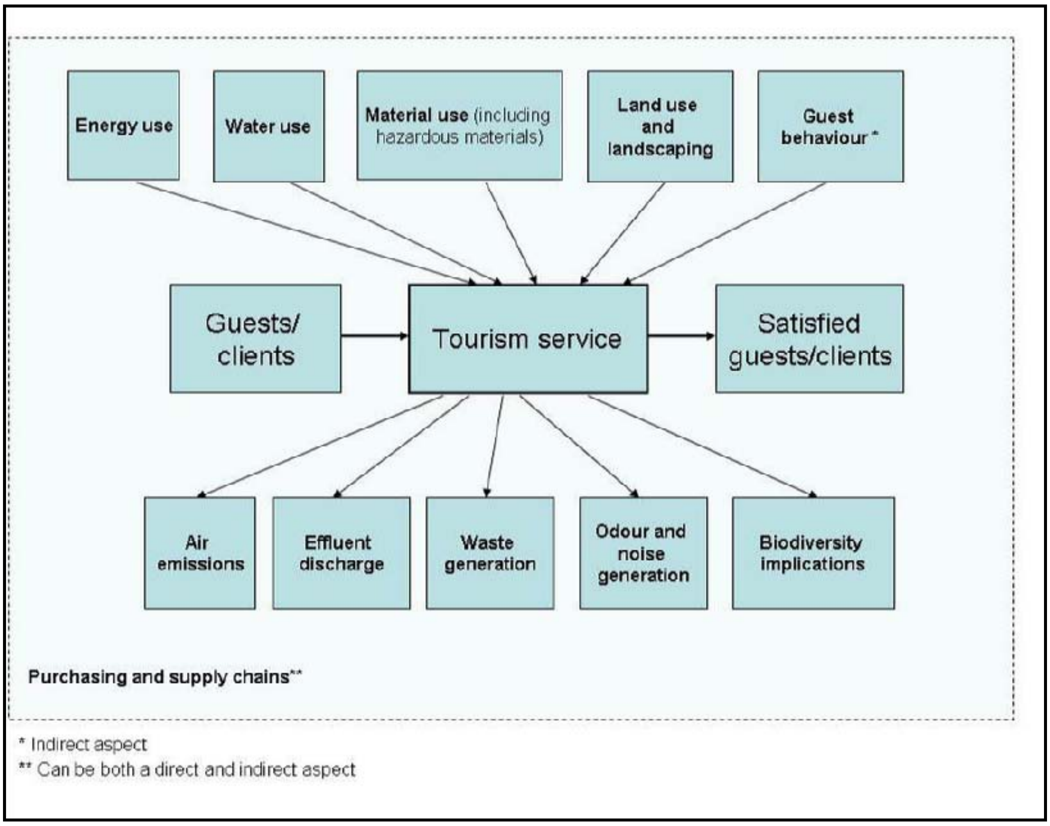


Figure 1.4: Tourism service inputs and outputs

According to EMAS Regulation (EC 1221/2009), an 'environmental aspect' is an element of an organisation’s activities, products or services that has or can incur an impact on the environment, both the natural environment and people. Environmental impacts arise from pressures generated by environmental aspects, such as the emission of greenhouse gases or air pollution (Table 1.5). Environmental aspects may be classified accordingly:

- **Direct environmental aspects** are elements of an organisation’s activities, products or services over which the organisation has full management control, and can thus influence directly.

- **Indirect environmental aspects** are elements of an organisation's activities, products or services over which the organisation does not have full management control, and thus cannot influence directly. These may include aspects related to products used, transportation, and other factors in the supply chain. Although these aspects may not be within direct control of the accommodation facility operators, they can still have significant implications for the environmental impacts of the services, seen from a lifecycle perspective. Tourist behaviour, including customer choice, is an important indirect aspect over which tourism actors may have some control (e.g. through provision of information, incentives, facilities, etc.). Indirect aspects can be addressed via dialogue with the responsible actors.

Figure 1.5 provides examples of direct and indirect environmental aspects arising from two important processes within the tourism sector: laundry and food preparation. These examples highlight how both upstream and downstream indirect effects may be greater than direct effects, thus emphasising the importance of a lifecycle perspective and implementation of management practices that influence key up- or down- stream actors.

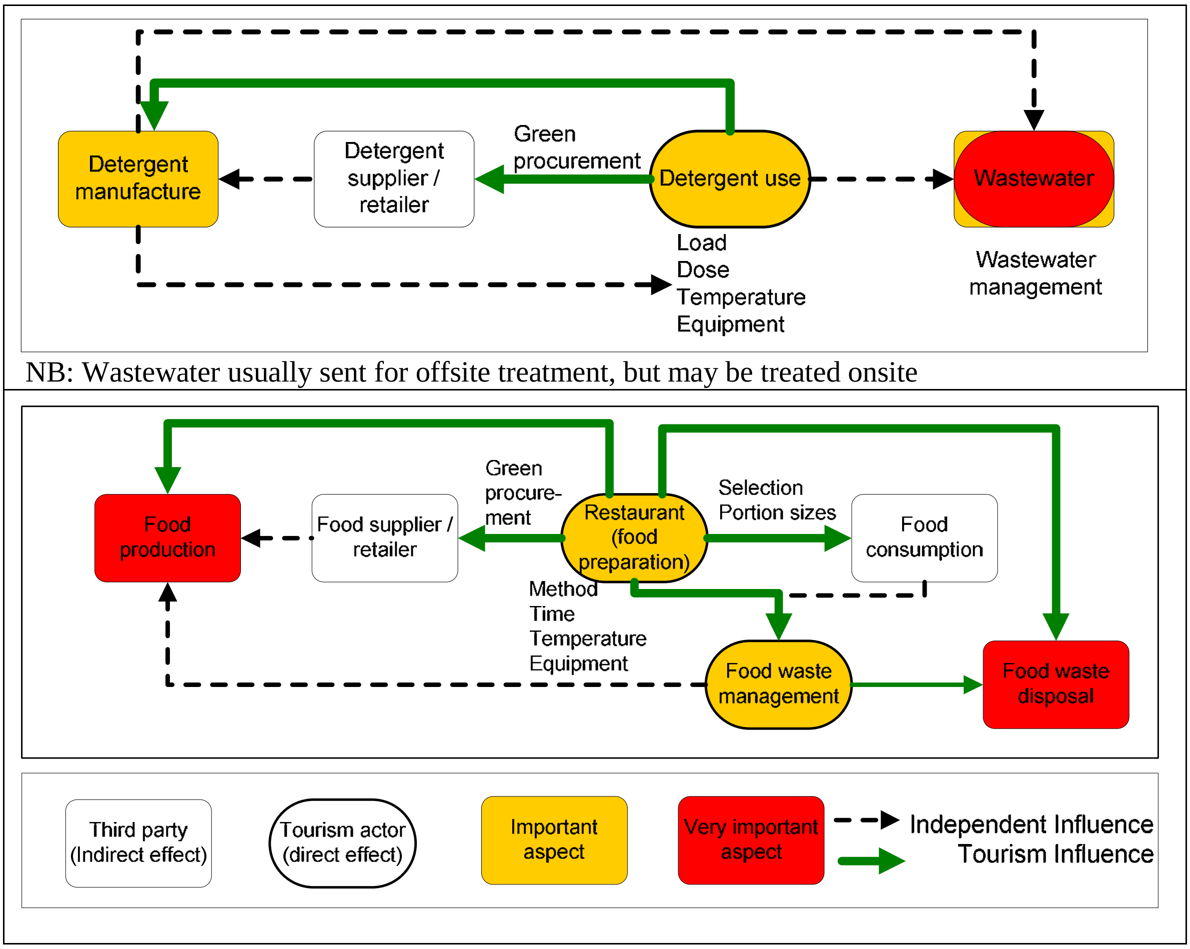


Figure 1.5: Examples of important direct (oval) and indirect (rectangular) aspects for: (top) laundry detergent use; (bottom) restaurant food preparation and waste management

Table 1.5 lists the main environmental aspects and associated environmental pressures arising from tourism services. This section provides a brief overview of environmental aspects that are important for the tourism services covered in this document. Subsequent sections address specific aspects for specific actors (destination managers, tour operators and travel agents, accommodation providers, food and drink providers, campsite managers). It is important, however, that each enterprise assesses and prioritises relevant environmental aspects and associated environmental activities, as these are highly dependent upon the specific operations performed by the enterprise.

Table 1.5: Activities in tourism enterprises (hotels, restaurants and tour operators) and associated environmental aspects and pressures

Service/ Activity	Main environmental aspects	Main environmental pressures
Administration	– Office Management – Reception of clients	– Energy, water and raw materials (mainly paper) consumption – Generation of municipal waste (large amounts of paper) and hazardous waste (e.g. toner cartridges)
Technical services	– Producing of hot water and space heating/cooling – Lighting – Elevators – Swimming pools – Green areas – Pest and rodent control – Repair and maintenance	– Energy and water consumption – Consumption of a range of hazardous products – In some cases use of CFCs and HCFCs – Air emissions – Generation of a wide range of potentially hazardous waste types such as empty chemical containers – Generation of waste-water
Restaurant/bar	– Breakfast, dinner, lunch – Beverages and snacks	– Supply chain pressures (see 'Purchasing') – Energy, water and raw materials consumption – Generation of municipal waste (especially food waste and packaging waste)
Kitchen	– Food conservation – Food preparation – Dish washing	– Supply chain pressures (see 'Purchasing') – Important consumption of energy and water – Generation of municipal waste (especially food waste and packaging waste) – Generation of vegetable oil waste – Generation of odours
Room use	– Use by guests – Products for guests' use – Housekeeping	– Energy, water and raw materials consumption – Use of a wide range of hazardous products – Generation of waste packaging and small amounts of municipal waste – Generation of wastewater
Laundry	– Washing and ironing of guests' clothes – Washing and ironing of	– Important consumption of energy and water – Use of hazardous products – Generation of waste-water
Purchasing	– Selection of products and suppliers – Storage of products	– Supply chain pressures (land occupation, degradation or destruction of ecosystems, disturbance of wildlife, energy and water consumption, air and water emissions, waste generation) – Generation of packaging waste – Hazardous substance leakages
Activities	– Indoor activities – Outdoor activities	– Energy, water and raw materials consumption – Local impacts on ecosystems – Noise – Generation of municipal waste – Infrastructure pressures (see 'Building and construction')
Transport	– Transport of guests – Transport of employees – Transport by suppliers	– Energy (fuel) consumption – Air emissions – Infrastructure pressures (see 'Building and construction')
Additional services	– E.g. medical services,	– Energy, water and raw materials consumption

Service/ Activity	Main environmental aspects	Main environmental pressures
	supermarkets, souvenir shops, spa and wellness, hairdresser, etc.	– Generation of municipal waste, and some specific hazardous waste types (e.g. sanitary waste)
Building and construction	– Construction of new areas or services – Repair of existing areas or services	– Land occupation – Degradation or destruction of ecosystems – Disturbance of wildlife – Energy and water consumption – Significant consumption of raw materials and hazardous products – Significant generation of construction waste – Generation of hazardous waste

Figure 1.6 provides an overview of the main processes giving rise to direct and indirect environmental pressures from the tourism sector. It may be noted that some key processes, such as lighting and HVAC (heating, ventilation and air conditioning) are common across many actors and activities.

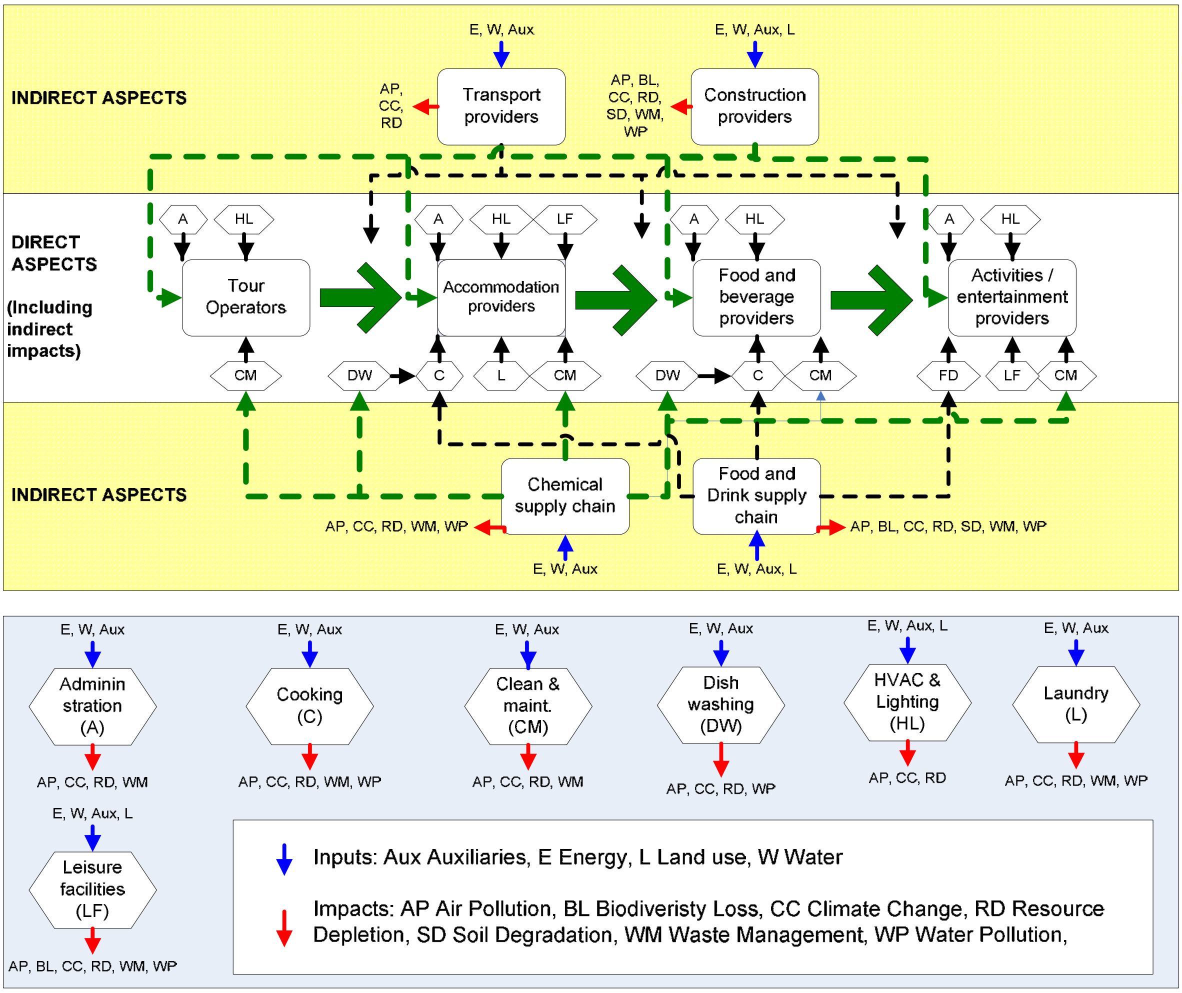


Figure 1.6: An overview of processes, aspects, inputs and impacts for the tourism sector

1.2.2 Global and local environmental burdens

Biodiversity

Tourism is concentrated in areas of high nature value, such as national parks, coastal zones and mountain regions that support rich or unique biodiversity. The Convention on Biological Diversity (CBD) define biodiversity as 'the variability among living organisms from all sources including, inter-alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (SCBD, 2010a). Biodiversity may be categorised into three levels: (i) genetic diversity; (ii) species diversity; (iii) ecosystem level diversity referring to habitats and landscapes (Haberl et al., 2009). Thus, biodiversity is integral to the ecosystems and natural features that underpin tourism, and the long-term success of many tourism destinations is critically dependent upon good planning and biodiversity conservation. Yet there are many examples of poorly managed tourism development leading to negative impacts on biodiversity via the following mechanisms:

- infrastructure-related development, mainly financed and managed at the governmental level, including roads, railways, airports, trails, water sourcing and treatment facilities, energy production and distribution, and waste management;
- construction of tourism facilities, such as accommodation and meeting structures, catering, shopping centres, marinas, and administrative facilities;
- indirect developments from tourism, such as urban development for employee housing; secondary real estate, such as tourist homes; and urban sprawl;
- indirect influences on economic trade, such as changes in trade flows and economic activity, changes in management practices, changes in conservation-related investments.

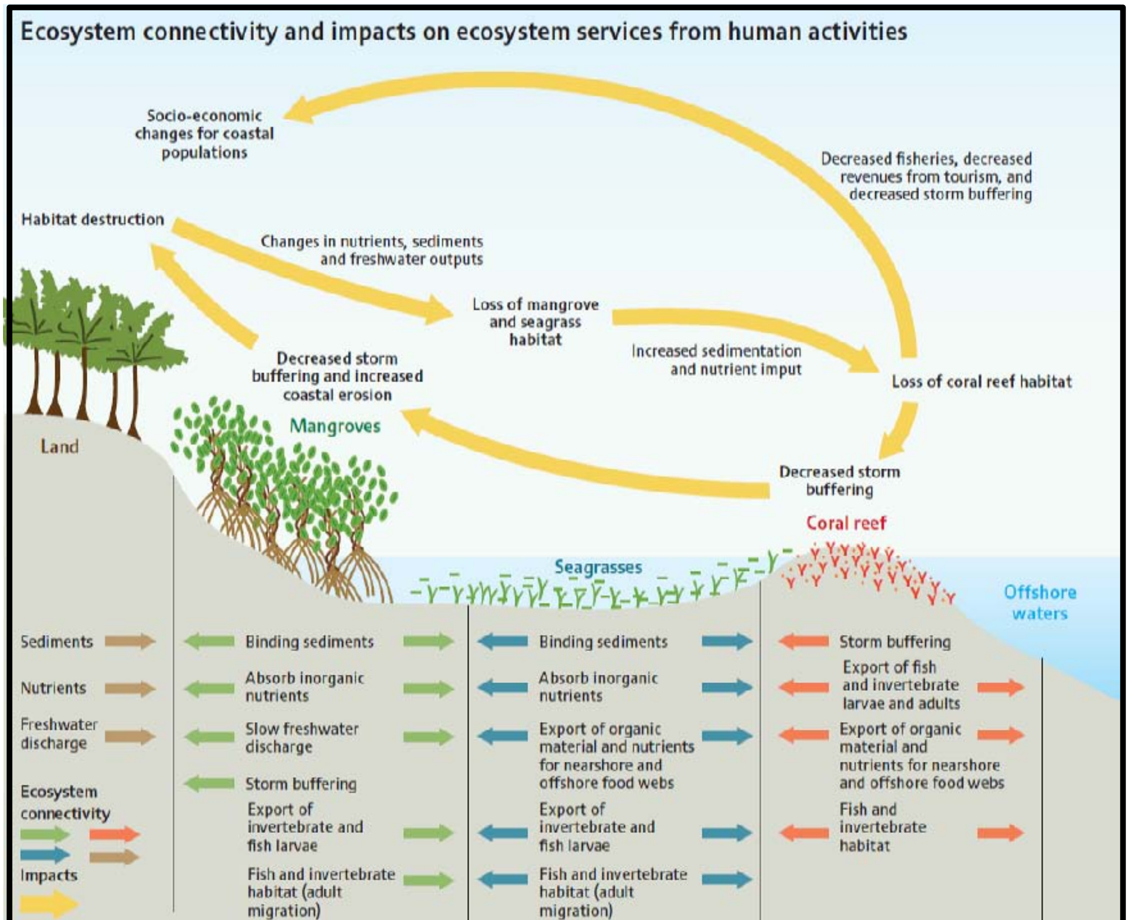
In relation to accommodation, outside of cities, luxury and resort hotels may also occupy large land areas. Gössling (2002) refers to the example of the five star Lemuria Resort hotel in the Seychelles that covers an area of 110 ha (including a golf course). This equates to more than 4 580 m2 per bed space (2 290 m2 excluding the golf course). Globally, hotels abnd campsites were estimated to occupy over 45 000 hectares each in the 1990s (Table 1.6), and this is likely to have increased substantially since. The most space demanding accommodation types, per bed space, are holiday villages and individual holiday homes, requiring 130 and 200 m2 per bed space, respectively.

Table 1.6: Estimated area requirements for different types of accommodation 1995-1999

Accomm. type	Area per bed	Beds	Total area
	m^2		hectares
Hotels	30	15 980 000	47 940
Campsites	50	9 050 000	45 250
Pensions	25	4 060 000	10 150
Self-catering	50	3 620 000	18 100
Holiday villages	130	750 000	9 750
Holiday homes	200	680 000	13 600
Total		34 140 000	144 790

Source: Gössling (2002).

Golf courses, theme parks and other tourism-related activities can occupy large land areas, and support low biodiversity. However, the areas of land affected by tourism are much greater than the land directly appropriated for tourism activities. The greatest impacts arise from fragmentation of, and disturbances within, HNV areas, in part related to supporting services.



Source: GRI (2011), from Silvestri & Kershaw (2010)

Figure 1.7: Ecosystem connectivity (arrows) across mangroves, seagrasses and coral reefs, and potential feedbacks arising from human induced impacts

Table 1.7: Research priorities recommended by the Biodiversity and Tourism working group of the European Platform for Biodiversity Research Strategy

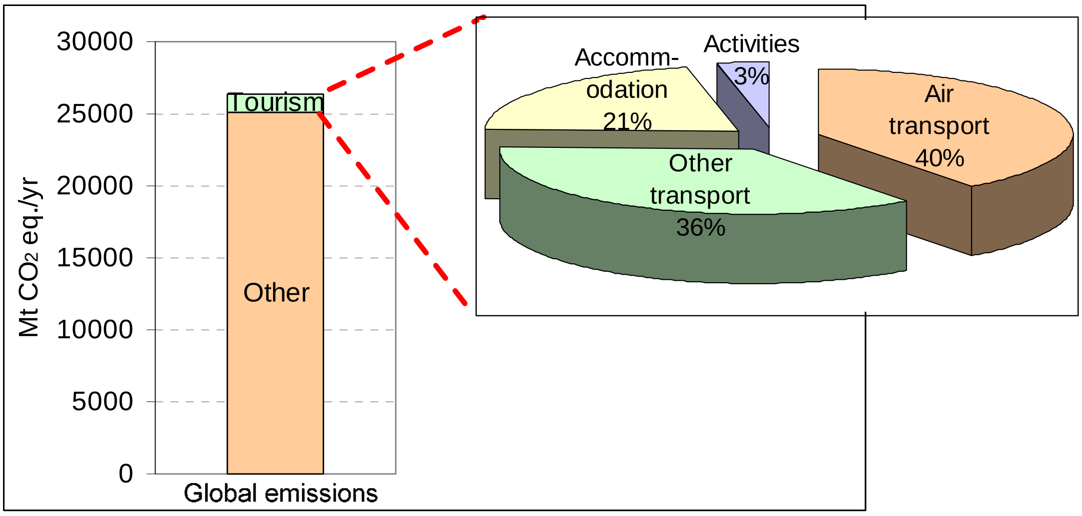
Research priorities for biodiversity in relation to tourism
– Further investigate the roles of biodiversity, climate, environmental quality and policy in determining levels and types of tourism at different destinations. – Determine the contribution of biodiversity and ecosystem functions to the economic benefits, employment and social cohesion arising from the tourism industry, using participatory methods to ensure stakeholder knowledge and values are taken fully into account. – Further develop research and indicators of biodiversity, ecosystem function and resilience in tourism areas, considering the direct and indirect pressures on biodiversity and ecosystems resulting from tourism (e.g. use of water and other natural resources, waste and sewage, infrastructure and habitat fragmentation, transport-related infrastructure and emissions). – Model changes in tourism pressures in relation to changes in components of biodiversity, ecosystem function and resilience. – Develop and implement techniques for estimating limits of acceptable change for different tourism areas and ecosystems. – Assess effectiveness of different policies and management practices in moderating the effects

Research priorities for biodiversity in relation to tourism
of tourism on biodiversity and ecosystem function, including participatory research and management processes. – Undertake, analyse and disseminate results of case studies in the application of the Ecosystem Approach to sustainable development of tourism, from local to global scales. – Further investigate how tourists and tourism businesses respond to information provision, codes of conduct, industry accreditation and other measures aimed at influencing behaviour.
Source: EPBRS (2004).

On the other hand, by generating an income from non-destructive use of natural resources, tourism can, when well managed, contribute to the conservation of biodiversity – especially in less economically developed parts of the world where low value destructive uses would otherwise be profitable. Section 4.4 refers to this.

Climate change

Globally for 2002, it has been estimated that tourism was responsible for four to six percent of GHG emissions, and primary energy demand of 5 million MWh per year, whilst accounting for approximately 11 % of GDP (UNEP and CI, 2003). The main source of GHG emissions from the tourism sector is transport, and in particular air transport that is responsible for 517 million tonnes CO2 eq. per year globally (Figure 1.8).



Source: Derived from UNWTO and UNEP (2008).

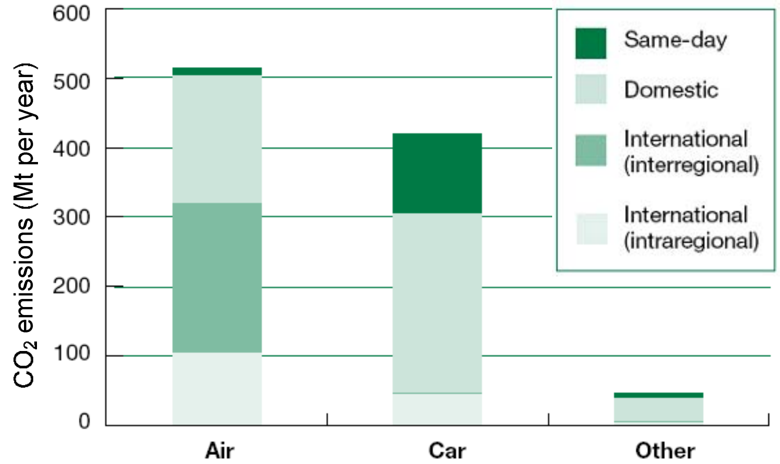
Figure 1.8: The contribution of tourism towards global GHG emissions, and the breakdown of emissions within the tourism sector (inset)

Domestic and international tourism transport for citizens of the EU-25 plus Norway and Switzerland is estimated to generate 250 million t CO2 per year, with emissions forecast to increase by 85 % between 2000 and 2020 (UNWTO and UNEP, 2008).

Figure 1.9 provides a further breakdown of global GHG emissions arising from tourism transport. Air transport is dominated by international tourism, whilst car transport is dominated by domestic and same-day tourism. Globally, passenger air transport is estimated to total 3 980 billion pkm (UNWTO and UNEP, 2008). Gössling et al. (2007) list a number of reasons why air transport is of particular concern in relation to tourism sustainability, despite its relatively small current contribution (approximately 3.5 %) towards global GHG emissions:

- air transport currently serves only 2 % of the global population, with projections for high growth in pkm;

- aircraft emissions released in the upper troposphere and lower stratosphere lead to ozone and cloud formation, resulting in radiative forcing and consequent climate effects between 1.9 and 5.1 times greater than equivalent ground-level emissions;
- technological options to improve aircraft efficiency are limited.



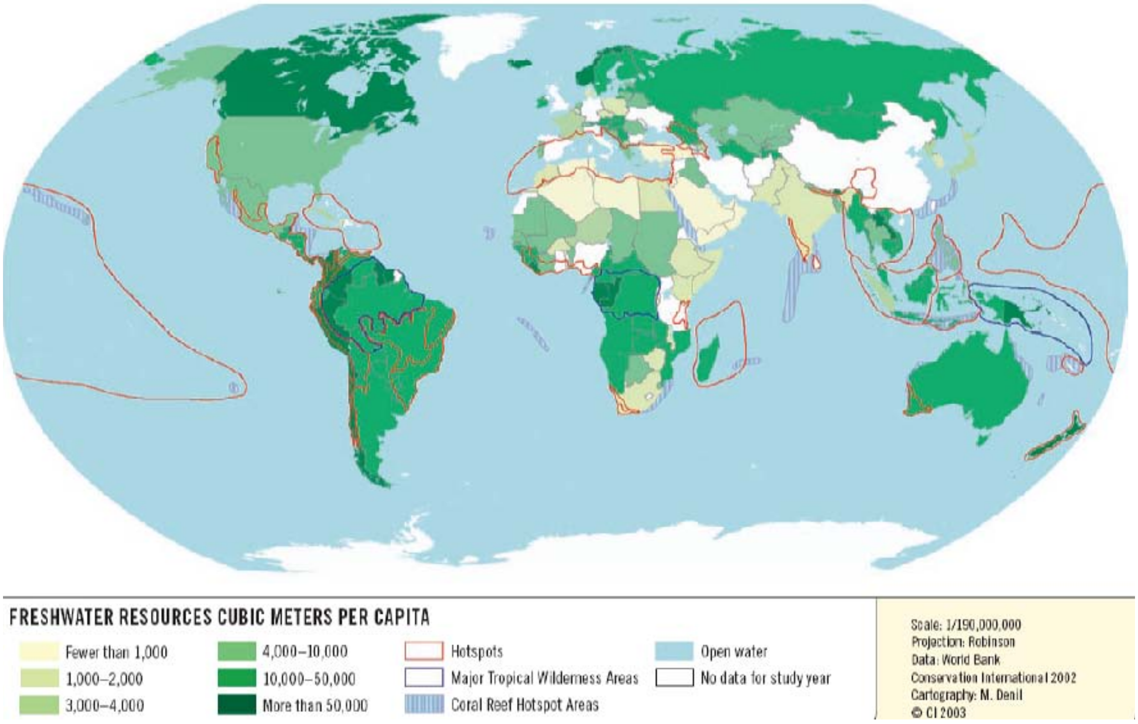
Source: UNWTO and UNEP (2008).

Figure 1.9: Estimated global GHG emissions attributable to tourism transport

Consequently, Gössling et al. (2007) note that the projected growth in aviation emissions to 2050 contrasts with projected declines for most other sectors, and that for developed countries unchecked aviation emissions alone could approach the GHG emission targets required to stabilise atmospheric GHG concentrations below 450 ppm – the threshold estimated by the IPCC for 'dangerous' climate change.

<u>Water stress</u>

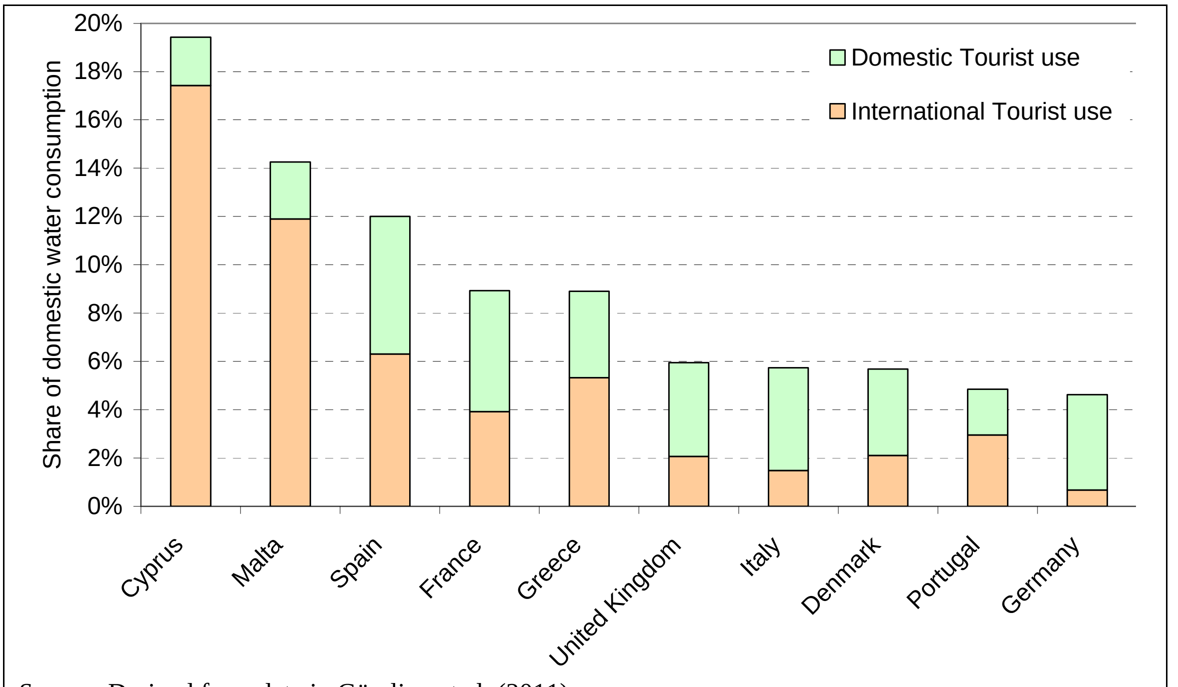
Gössling et al. (2011) estimated that direct water consumption for tourism in 2000 amounted to 9 274 million m^3 globally, representing 3.4 % of domestic water consumption and 0.3 % of total water consumption. This consumption is concentrated in tourism destinations that may be vulnerable to water stress. For example the Mediterranean region has low renewable freshwater resources per capita, but is a tourism, and therefore water-stress, 'hotspot' (Figure 1.10). Tourism hotspot areas in Figure 1.10 are also vulnerable to other environmental impacts that may arise from e.g. infrastructure being overwhelmed, including water stress, water pollution, biodiversity loss, etc.



Source: Conservation International (2003).

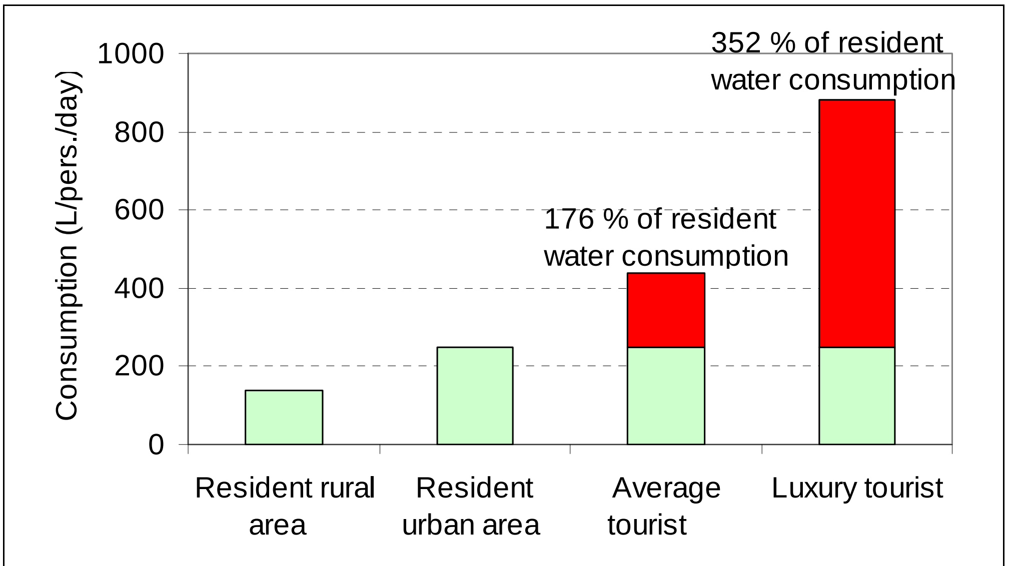
Figure 1.10: Freshwater resources per capita and tourism 'hotspots' based on arrivals per inhabitant

Water stress is a function of renewable freshwater availability, abstraction rates, and the proportion of consumptive use. Because a significant portion of tourism is concentrated in areas where renewable water resources are comparatively small and water stress is high, tourism can account for relatively high proportions of domestic (potable) water consumption in some localities, regions and even countries (Figure 1.11). Hof and Scmitt (2011) report average water consumption of over 700 L per person per day in the Calvià municipality of Mallorca that hosts a high density of tourism. Peak tourism demand often occurs during summer when water availability is at its lowest, and tourist water consumption is often considerably higher, per capita, than resident water consumption (Figure 1.12). Furthermore, tourism demand for water is projected to increase considerably over the coming decades, while climate change will reduce the availability of freshwater in lower mid-latitude regions such as the Mediterranean and increase the frequency of sever droughts (Gössling et al., 2011). Thus, tourism can lead to significant local and regional impacts associated with water stress and with energy-intensive desalination and water importation via ship (Mallorca, Greek islands, Italy, Spain).



Source: Derived from data in Gössling et al. (2011).

Figure 1.11: Top ten European countries in terms of the share of domestic water consumption accounted for by domestic and international tourism in the year 2000



Source: Derived from UNEP (2004).

Figure 1.12: Potable water consumption by residents and tourists on Majorca

Waste and wastewater disposal

Waste management is also a challenge for hotspot tourist destinations, owing to the concentrated generation of waste in a small area during peak season. Whilst it is estimated that tourism generates 35 million tonnes of solid waste globally, the hospitality sector in the UK is responsible for 1.8 million tonnes of waste generation per year (WRAP, 2011). The majority of this is from pubs and restaurants, but UK hotels also generate almost 500 000 tonnes of waste per year.

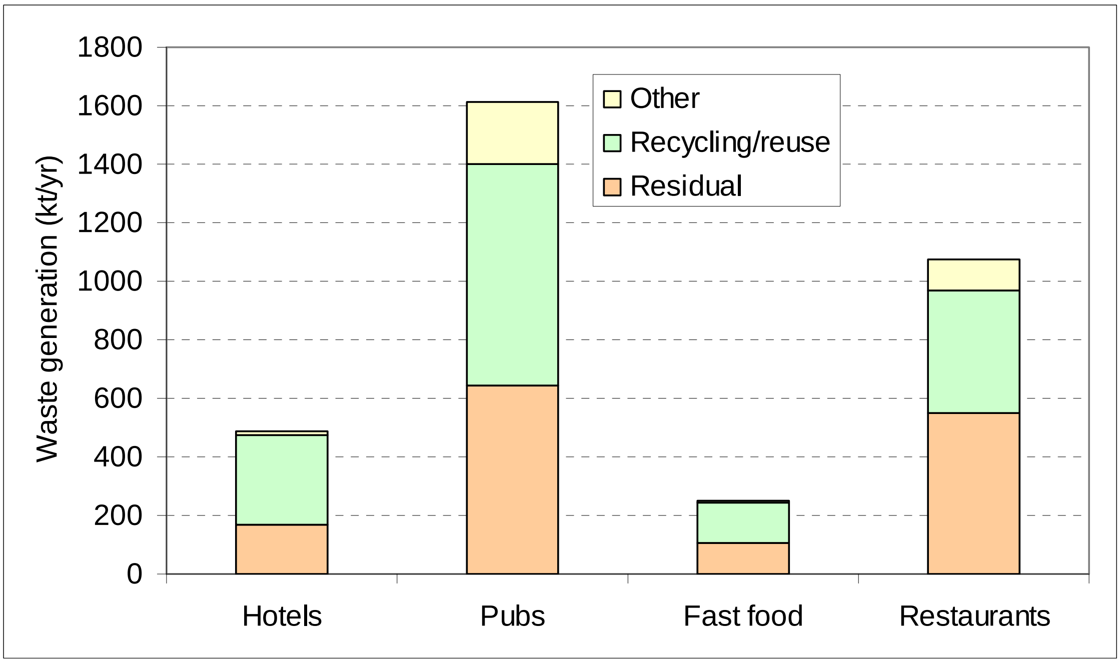


Figure 1.13: Waste generation by the UK hospitality industry

Similarly, wastewater generation can increase by multiples during peak tourism seasons in popular destinations with smaller indigenous populations. This poses a particular challenge, as treating such peaks in wastewater flows requires high capital investment in 'over sized' modular wastewater treatment plants (WWTP) and careful operational management to ensure adequate treatment under different flow rates. Unfortunately, the level of wastewater treatment is low in some popular tourism destinations, and there is particular concern about inadequate wastewater treatment on the perimeter of the Mediterranean sea.

Indirect impacts (supply chains)

The indirect environmental burden of tourism activities may be considerably greater than the direct burden, especially for water consumption (Table 1.8). Gössling (2005) found that when tourism flows out of Europe were considered, European water consumption is increased by almost 22 %.

Table 1.8: Direct and indirect sources of water consumption by tourists

	Tourist activity / consumption	Water footprint (L per tourist per day)
Direct	Accommodation	84 – 2 000
	Activities	10 – 30
Indirect	Infrastructure	n.a.
	Fossil fuels	750 (per 1 000 km by air/car)
	Biofuels	2 500 (per L biofuel)
	Food	2 000 – 5 000
Total		2 000 – 7 500
Source: Gössling (2005).		

In addition, food and drink supply chains account for approximately 30 % of the overall environmental burden within the EU-25 according to EC (2007). Food and drink provision within the tourism sector is therefore likely to give rise to a significant environmental burden in relation to eutrophication, GHG emissions, air pollution, ecotoxicity, and other impact categories.

Table 1.9 summarises the main environmental 'hotpsots' for different stages and actors within the tourism value-chain.

Table 1.9: Environmental hotspots and influencing actors across the tourism value chain

Stage		Hotspots	Main actors
Destination		– Water stress – Biodiversity loss – Air/water pollution	– Desination managers (Chapter 3) – Tour operators (Chapter 4)
Transport	 *Source:* Aviation news.eu (2012).	– GHG emissions – Resource depletion – Air pollution	– Tour operators (section 4.1 and 4.4) – Transport providers (section 4.2)
Accommodation		– Water consumption – Waste generation – Energy consumption	– Accommodation managers (Chapters 5, 6, and 7) – Campsite managers (Chapter 9) – Tour operators 9section 4.2)
Food & drink		– Food supply chains – Organic waste disposal	– Restaurant/kitchen managers (Chapter 8) – Tour operators (Chapter 4)
Activities	 *Source:* Select Spain (2012).	– Biodiversity loss – Water stress – GHG emissions	– Tour operators (Chapter 4) – Event managers (Chapter 3)

1.2.3 Reference literature

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1.3 Sector Uptake of Environmental Management Systems and Environmental Standards

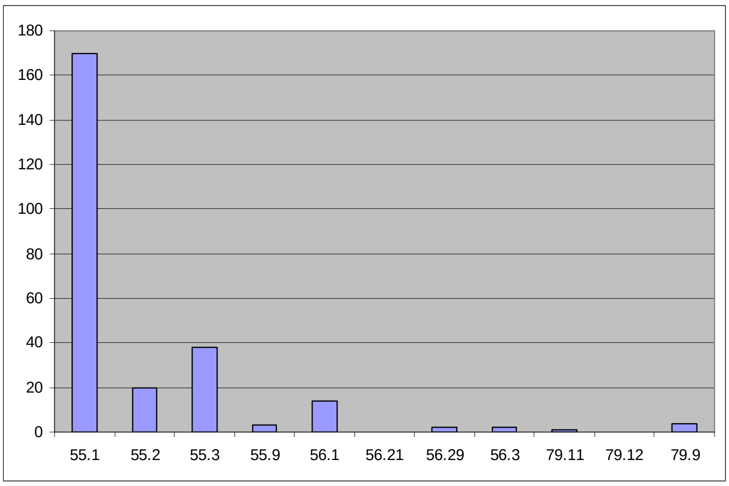
1.3.1 EMAS and ISO 14001

EMAS and ISO 14001 are the most widely recognised environmental management systems (EMS). Table 1.10 shows that, as of 2010, 254 tourism organisations had achieved EMAS registration. The 'hotels and similar accommodation' category has the largest number of EMAS registrations within the tourism sector, as shown in Figure 1.14. Three countries – Spain, Italy and Germany – account for nearly all of the EMAS registrations in the tourism sector.

Table 1.10: Overview of EMAS registrations per tourism sub-sector

NACE code	Subsector	Number of EMAS registrations	Number per subsector
55.1	Hotels and similar accommodation	170	231
55.2	Holiday and other short-stay accommodation	20	
55.3	Camping grounds, recreational vehicles and trailer parks	38	
55.9	Other accommodation	3	18
56.1	Restaurants and mobile food service activities	14	
56.21	Event catering activities	0	
56.29	Other food service activities	2	
56.3	Beverage serving activities	2	
79.11	Travel agency activities	1	5
79.12	Tour operator activities	0	
79.9	Other reservation service and related activities	4	
Total		**254**	**254**

Source: EMAS helpdesk (2010).



LEGEND

55.1 Hotels and similar accommodation

55.2 Holiday and other short-stay accommodation

55.3 Camping grounds, recreational vehicles and trailer parks

55.9 Other accommodation

56.1 Restaurants and mobile food service activities

56.21 Event catering activities

56.29 Other food service activities

56.3 Beverage serving activities

79.11 Travel agency activities

79.12 Tour operator activities

79.9 Other reservation service and related activities

Source: EMAS helpdesk (2010).

Figure 1.14: Breakdown of EMAS registrations per tourism sub-sector

Unlike EMAS, there is no requirement in the ISO 14001 standard on environmental management that national competent bodies register organisations that have been certified according to the standard. For this reason, it is not possible to obtain data at the national or European level on uptake of ISO 14001 in the tourism sector. The most recent information is from the ISO Survey of ISO 9000 and ISO 14000 Certificates (2001). According to this information, ISO 14001 certification did not have broad international uptake in 2000, with 66 certifications noted internationally in 2000.

1.3.2 Other environmental certifications and labels

There is a wide and expanding range of environmental standards relating to tourism services throughout the EU, some regional or pan-European in scope, other national. Fourteen of the most widely recognised standards are listed in Table 1.11. Thousands of tourism enterprises have been awarded some for of environmental certification or label. Labels in Table 1.11 almost exclusive relate to the accommodation sector, with the exceptions being the Austria ecolabel for gastronomy services and tour packages, Travelife certificate for Tour operators, the category in France for tourist offices, and Nature's Best in Sweden for nature tourism.

Standards listed in Table 1.11 are divided according to the ISO 14020 series definitions, which may be summarised as follows.

- Type 1 environmental labels are lifecycle multi-criteria third-party verified standards, such as the EU flower, Nordic Swan and Austrian Ecolabel. Ecolabel certification indicates front-runner environmental performance compared with alternative products or services.
- Type 2 environmental labels are self-declared environmental claims, with no third-party verification. In Table 1.11, 'other' labels refer to labels that involve basic audits to check compliance with various criteria that are less extensive that ISO Type 1 criteria and audits.
- Type 3 environmental declarations are LCA based labels with verification provided by an independent third-party, for example Environmental Product Declarations, or verified carbon footprint labels. Such labels may provide useful information which consumers can use to compare the performance of different products or service in a particular aspect. However, such labels usually only refer to one aspect of environmental performance (e.g. GHG emissions), and may be confusing for consumers.

Table 1.11: Some of the main environment-related labels for tourism companies in Europe

	Product group(s)	Regional level	National level	No. of companies labelled (2009)
Type 1				
EU Flower ecolabel http://ec.europa.eu/environment/ecolabel/	Tourist accommodation service, including campsite services	✓		80 campsites: Austria (12), Sweden (1), Denmark (20), Czech Rep (1), Finland (1), Italy (19), Spain (1), Germany (14), France (11) 397 tourist accommodations: Switzerland (29), Denmark (6), Ireland (24), Austria (12), UK (3), Czech Rep (8), Spain (8), Liechtenstein (1), Slovenia (2), France (65), Finland (3), Portugal (4), Greece (7), Northern Ireland (4), Belgium (1), Netherlands (5), Hungary (2), Latvia (3), Malta (1) Norway (2), Romania (2) Albania (4), Poland (1), Sweden (1), Cyprus (1), Turkey (1), Italy (197)
Nordic Swan ecolabel www.svanen.nu	Hotels and youth hostels	✓		219 hotels and youth hostels
Das Österreichische Umweltzeichen, Austria www.umweltzeichen.at	Tourism companies		✓	653: accommodation (504), camping (41), gastronomy (108), tours (43)
Type 2 and others				
Ecocamping http://www.ecocamping.net	Campsites	✓		250 campsites in Germany, Austria, Switzerland, Italy and Denmark
Eco-certification http://www.visitmalta.com/eco_certification	Hotels in Malta		✓	21 hotels
El Distintivo de Garantia de Calidad Ambiental, Catalonia, Spain	Service sector		✓	70: hotels (26), camping sites (16), youth hostels (20), rural farmhouses (8) (Based on 2004 data)
Green Key International www.green-key.org	Tourism facilities (hotels, youth hostels, conference- and holiday centres, campsites, holiday houses and leisure facilities)	✓		1 031: Belgium (51), Cyprus (3), Denmark (54), Estonia (23), France (527), Greece (51), Italy (10), Latvia (4), Lithuania (9), Netherlands (232), Portugal (22), Sweden (45)
Green Tourism Business Scheme, UK www.green-business.co.uk	Accommodation, attractions, activities		✓	1 952: Green places to stay (1 368), Green places to visit (453), More Green businesses (131)
Lauku Celotajs, Latvia www.eco.celotajs.lv	Rural tourism providers		✓	76 guesthouses/farmsteads
Legambiente Turismo, Italy www.legambienteturismo.it	Tourism facilities		✓	300: hotels (192), other accommodation businesses (46), bathing establishments (42) and camping sites (20) (2004 data)
Nature's Best http://www.naturesbestsweden.com/	Nature tours in Sweden		✓	307 tours
NF Mark www.marque-nf.com	Tourist office reception services		✓	77 certified facilities

	Product group(s)	Regional level	National level	No. of companies labelled (2009)
Steinbock Label, Switzerland www.steinbock-label.ch	Hotels and restaurants		✓	15 facilities in 6 cantons (2004 data)
Travelife www.travelife.org	Travelife Sustainability System. Certification system for tour operators and travel agencies and their suppliers.	✓		Travelife for Hotels 654 facilities certified in bronze, silver and gold system Travelife for Tour operators – 245 facilities certified
Viabono http://www.viabono.de/	Tourism accommodation		✓	90 hotels, 10 guest houses, 49 holiday houses, 19 camp sites, 21 youth hostels

ISO Type 1 labels provide the most rigorous indication of good environmental performance, and require third-party verification that products or services achieve specified environmental performance levels and comply with specific criteria. Meanwhile, EMS are organisation-level requirements for monitoring and reporting of environmental aspects and performance, and do not reflect specific environmental performance levels.

The DestiNet 'Atlas of Excellence' may be used to search for different types of tourism orgnaisation (accommodation providers, tour operators, destination managers) that have been awarded various environment-related labels (DestiNet, 2012).

Organisation level labels and best environmental management practice techniques

It is important to clarify the position of this document with respect to ecolabels and environmental management systems. This document is focussed on best environmental management practice at the **process level**, where possible associated with benchmarks of excellence supported by data indicating the top ~10 % performance level. An **organisaiton** that has been awarded an **environmental label**, or certified according to an **EMS**, should demonstrate better **overall environmental performance** and/or **environmental management** than average, but may not necessarily demonstrate **best practice** for any **particular process** as defined in this document. Therefore, ecolabels and EMS are rarely referred to in best practice techniques, except where specific criteria may provide useful indicators of best practice, or where they may inform **green procurement** or supplier improvement for organisations higher up the tourism value chain (e.g. accommodation ecolabels may inform tour operators in accommodation selection or improvement). **ISO Type 1 labels for products** may be useful indicators of best practice in **green procurement** at the process level (e.g. purchase of ecolabelled detergents for laundry).

1.4 Reference Literature

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2 CROSS CUTTING BEST ENVIRONMENTAL MANAGEMENT PRACTICE

Chapter structure

This chapter is targeted at all tourism actors, and focuses on the prerequisites for successful implementation of BEMPs referred to subsequently in this document. Specifically, guidance is provided the following two cros-cutting themes.

- Environmental management system (EMS) implementation (section 2.1). This section focuses on the environmental performance related aspects of EMS implementation, in particular the identification of relevant environmental aspects, effective performance monitoring and benchmarking, and targeted BEMP prioritisation. It provides users of this document with guidance on how to identify the most relevant BEMPs and associated benchmarks of excellence. Readers are referred to existing guidance documentation for specific cross-sectoral compliance requirements of EMAS and other EMS schemes.

- Supply chain management (section 2.2). This section focuses on the identification of priority supply chains and improvement options across tourism actors and operations. It provides a framework for supply chain improvement, and cross-refers to relevant sections of this document where specific green procurement criteria are referred to for various products and services.

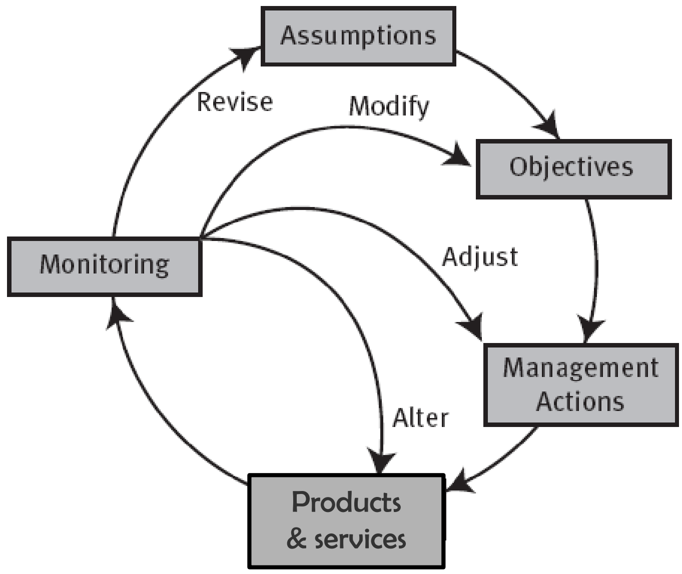
Biodiversity conservation

Of particular note here, owing to hitherto less quantitative assessment and less riogorous integration into EMS accounting, is the issue of biodiversity conservation and management by tourism actors. As referred to in section 1.2.2, tourism is often based on natural heritage and concentrated in areas of high nature value (HNV). Impacts on biodiversity may be direct, arising from construction of tourism infrastructure and the undertaking of tourist activities in sensitive areas, and indirect via extensive supply chains providing food, water, energy, chemicals and other products, and services. Tourism may also generate a positive effect on biodiversity conservation through the realisation of income from nature appreciation. Therefore, the monitoring of biodiversity and direct and indirect measures to protect it, including via supply chain management, are particularly important cross-cutting issues for tourism actors.

2.1 Environmental management system implementation

Description

An Environmental Management System (EMS) provides an organisation with a framework for managing its environmental responsibilities efficiently, with respect to reporting and performance improvement. Implementation of an effective EMS should lead to continuous improvement in management actions, informed by monitoring key performance indicators related to those actions (Figure 2.1).



Source: Modified from SCBD (2007).

Figure 2.1: The continuous planning and improvement cycle

The majority of tourism businesses are not directly regulated by environmental authorities and any decision to adopt an environmental management is voluntary. However, there are numerous potential advantages of implementing an EMS, as listed under the 'Driving forces for implementation' section, below. In addition, successful implementation of visible best environmental management practices can promote the uptake of these practices by customers. Destination management organisations may also implement EMSs, for their own operations but more importantly to account for aggregate environmental impact attributable specifically to the tourism sector. For example, Turismo de Portugal (2010) report on energy consumption across hotels and restaurants, environmental awards issued in the sector, and measures to reduce the impact of tourism on biodiversity. The Abu Dhabi Tourism Authority introduced an Environment, Health and Safety Management Scheme (EHSMS) for the entire tourism industry. In the first instance, all hotels are obliged to apply environmental management according to EHSMS criteria, and the Authority has established targets for redcutions in energy and water consumption and waste generation across the sector (ADTA, 2010).

Environmental management systems may be informal organisation systems, or internationally recognised systems certified by a third-party, such as ISO 14001 and EMAS. This sectoral reference document for EMAS provides guidance on sector-specific best practice measures and indicators, and proposes 'benchmarks of excellence', as specified under article 46 of EC 1221/2009. This section therefore focuses on best practice in EMS implementation with respect to monitoring and reporting appropriate environmental indictors. For more comprehensive guidance on specific EMAS certification requirements, readers are referred to EMAS requirements in EC 1221/2009 and guidance documents provided by competent bodies in member states.

Table 2.1 summarises EMS implementation in relation to the Plan-Do-Check-Act approach, and highlights the relevant aspects of this document for each stage. Key points are the establishment of an organisation level environmental policy, followed by the development of action plans with specific targets. These should be informed by an awareness of what is commercially achievable, as described in best environmental management practice (BEMP) techniques and quantified by associated benchmarks of excellence in subsequent sections of this document.

The identification of significant environmental aspects is the first stage of environmental management, and as part of accredited EMS requirements enterprises must perform an environmental review. The European Commission is working on separate guidance on how to calculate 'corporate environmental footprints' that may be of relevance for the environmental review. Following the environmental review, the monitoring of relevant environmental performance indicators forms a reference point for implementation of best practice in sustainable sourcing (section 2.1), water minimisation (section 5.1), waste minimisation (section 6.1), energy minimisation (section 7.1).

Table 2.1: Stages of the Plan-Do-Check-Act cycle, with reference to relevant use of this document (highlighted in red)

Cycle stage	Management activities/steps	Relevant environmental management tool (use of this document)
Plan	• Identify priority issues (significant environmental aspects) • Establish a policy to address these issues • Identify performance standards and improvement opportunities (best practice) • Allocate specific responsibilities • Set objectives and targets • Prepare action plans, programmes and procedures for achieving (performance) objectives	Environmental review (refer to relevant best practice techniques and 'benchmarks of excellence' for particular processes)
Do	• Responsible persons implement plans, programmes and procedures	Standards and procedures (implement best practice techniques)
Check	• Monitor results • Evaluate performance against objectives and targets • Determine reasons for deviations and non-conformances	Environmental monitoring and management audit (use appropriate indicators, compare with 'benchmarks of excellence')
Act	• Take corrective action for non-conformances • Consider performance and adequacy of system elements in relation to targets • Identify changing circumstances • Modify system elements, including policy, objectives, targets, responsibilities, plans, programmes, procedures	Management review (re-assess relevance of particular best practice techniques and 'benchmarks of excellence' for particular processes)

Guidelines for generic EMS implementation and best environmental management have been produced for tourism organisations from various sources. A selection of sources for EMS and best practice guidance are listed below.

- Ecocamping (Ecocamping, 2011): an association of campsites in Europe that implement EMS, promote environmental practices, and advertise environmentally-aware camping. Encourage EMAS registration (see Figure 2.2).
- Hostelling International (2012): a non-profit organisation that promotes sustainable development of hostels around the world, and awards HI-Q accreditation. The HI-Q Quality Management System relates to service and environment related objectives.
- Tour Operators' Initiative for Sustainable Tourism Development (TOI, 2011): an international association of tour operators facilitated by the UNWTO, which currently hosts the TOI Secretariat, the UNEP and UNESCO to identify and disseminated best environmental, social and economic management practices across the industry. Members include TUI plc, REWE, Aurinkomatkat and Kuoni.
- Travel Foundation (Travel Foundation, 2011): a UK charity established to provide support for implementation of EMS and best environmental practice across tour operators and their supply chains. Provides extensive best practice information and case studies to accommodation and acts as intermediary between tour operators and destination mangers (section 4.1).
- Travelife (Travelife, 2011a): an initiative that provides training and certification on EMS implementation for tour operators, travel agents and suppliers including accommodation. Awards for hotels include bronze, silver, and gold standards, whilst a goal for participating tour operators and travel agents is to move towards EMAS through a step-by-step approach. Best practice for tour operators to leverage environmental management across suppliers is detailed in a training and management guide (Travelife, 2011b).

Figure 2.2: Stated goals of EMS implementation for Ecocamping certified campsites

A note on biodiversity

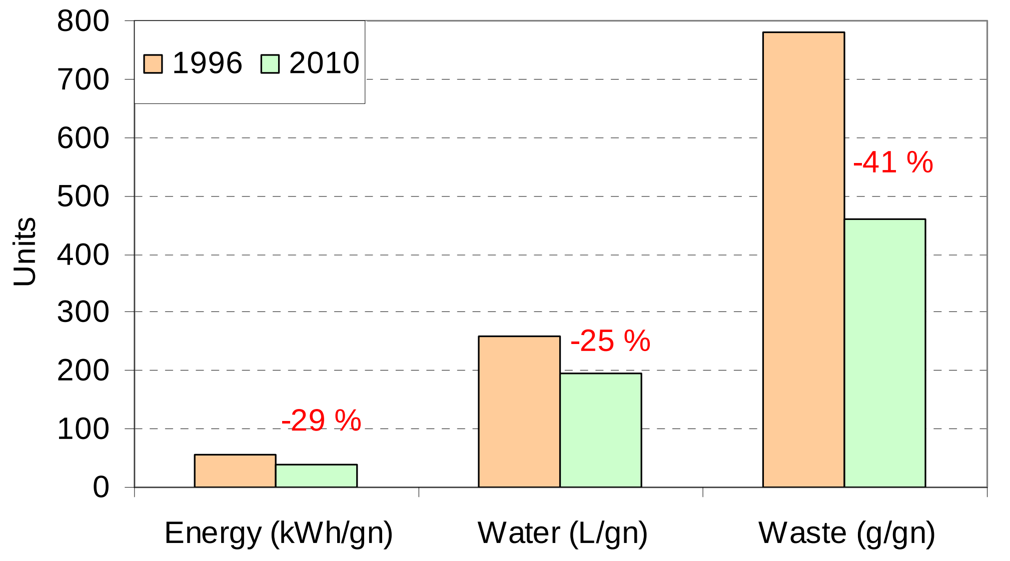
Biodiversity has been identified as a new environmental aspect with high relevance within EMAS. The main drivers of loss of biodiversity are degradation /destruction of habitats, overexploitation of natural resources, climate change, emissions/pollution and invasive species (neobiota). Emissions are traditionally managed within EMS, along with aspects contributing to climate change (energy, transport), but degradation or destruction of habitats, overexploitation of natural resources and invasive species are often new items for EMS coordinators and for staff. Particular attention is therefore required to integrate these aspects into EMS, codes of conduct and procurement guidelines. Staff training on biodiversity issues, and provision of information on biodiversity to customers is important. Annex 1 of this document contains a copy of the biodiversity check indicators devised by the European Business and Biodiversity Campiagn (EBBC).

Achieved environmental benefit

Effective implementation of some form of EMS (at a minimum monitoring) is a prerequisite for, and often directly leads to, the realisation of continuous improvement across key environmental pressures. It is the starting point from which to realise environmental benefits associated with BEMP techniques described throughout this document. Front-runners in EMS implementation are also front-runners in environmental performance.

The Scandic Hotels group has been monitoring and reporting energy consumption, water consumption and waste generation, amongst other KPIs, since 1996. Consequently, Scandic is able to demonstrate significant improvements in KPIs (Figure 2.3). On a daily operational level, an EMS can lead to the early detection of leaks that can account for up to 50 % of hotel water consumption, as described in section 5.1.

Ecocamping certification requires implementation of environmental management on campsites, and has been awarded to around 250 campsites throughout Europe (Ecocamping, 2011). Following implementation of an environmental management system in accordance with Ecocamping certification, the Jesolo International Club campsite achieved reductions of 50 % and 72 % in water and gas consumption, respectively, between 2008 and 2010. Other examples of water, energy and waste reductions and biodiversity management across Ecocamping campsites are referred to in Chapter 9.



Source: Scandic (2011).

Figure 2.3: Organisation-level environmental performance improvements documented by Scandic following implementation of a comprehensive EMS

Appropriate environmental indicators

Appropriate environmental indicators are measured at the process level and associated with best practice techniques described subsequently. Best practice is for tourism enterprises to systematically identify the indicators and best practice techniques relevant to them, in terms of their direct operations and their sphere of influence (Table 2.2). Of particular importance for EMS reporting are organisation-level key performance indicators, such as total energy or water consumption for accommodation providers – kWh/m2yr and L/guest-night, respectively (Table 2.2).

Note that all indicators are potentially relevant to tour operators and destination managers, to manage their own service providers and to monitor and influence aggregate environmental performance within destinations, respectively.

Table 2.2: Relevant environmental performance indicators for different tourism actors (key organisation level indicators highlighted)

	Tour operators	Destination managers	Built accommodation managers	Campsite managers	Kitchen managers	Laundry managers
Energy						
kWh/m^2/yr	✓		✓			
kWh/guest-night				✓		
kWh/cover					✓	
kWh/kg laundry						✓
% efficient products			✓	✓	✓	✓
% renewable energy	✓	✓	✓	✓		
CO_2/km	✓	✓				
CO_2/gn	✓	✓	✓			
Water						
L/guest-night	✓	✓	✓	✓		
L/cover					✓	
L/kg laundry						✓
Wastewater treatment standards	✓	✓		✓		
Waste						
Kg/guest-night (or L/guest-night)	✓	✓	✓	✓		
Kg/cover					✓	
% recycled	✓	✓	✓	✓	✓	
Biodiversity						
% natural area		✓				
% protected area		✓				
Number of native species		✓				
Provision of biodiversity education		✓	✓	✓		
BioD included in procurement criteria	✓	✓	✓	✓	✓	
Plan for onsite biodiversity management			✓	✓		
% outdoor area that is green			✓	✓		
Consumables						
See waste						
% ecolabelled products	✓		✓	✓	✓	✓
% organic products	✓			✓	✓	
% relevant certified products (e.g. MSC)	✓		✓	✓	✓	
% local products	✓		✓	✓	✓	

<u>Benchmarks of excellence</u>
The following benchmarks of excellence are proposed, the third with reference to subsequent sections of this document:

BM: appropriate indicators are used to continuously monitor all relevant aspects of environmental performance, including less easily measured and indirect aspects such as biodiversity impacts.

BM: all staff are provided with information on environmental objectives and training on relevant environmental management actions.

BM: best environmental management practice measures are implemented where applicable.

Cross-media effects

Cross-media effects associated with implementation of specific techniques are described in subsequent sections. Successful implementation of an EMS involves assessment of all major environmental aspects and processes, so that actions are targeted to minimise negative environmental (and social and economic) consequences. Often, efficiency measures have multiple benefits. For example, installation of low-flow water fittings in guest areas (section 5.2 and section 9.3), efficient dishwashers in kitchens (section 8.3), and efficient washer extractors in laundries (section 5.4), reduces water and energy consumption. For every m3 reduction in hot water consumption, approximately 52 kWh of energy is saved, assuming water is heated by 45 ºC (section 5.1).

Operational data

Staff training

It is recommended that sustainability issues are included in basic training for all levels of staff. This includes induction training, where environmental objectives and the rationale behind them can be explained alongside practical actions. Meanwhile, managers need to develop the knowledge and skills to deal with future challenges and opportunities associated with environmental issues. It is particularly important to establish a link between individual actions and aggregate environmental benefits, ideally expressed in tangible forms. For example, 'unnecessary second flushes during toilet cleaning in this hotel add up to enough water to fill an Olympic sized swimming pool every two years'. A sequence of key principles for effective staff training are suggested in the box below.

- Clarify definitions to ensure that objectives and actions are understood by everyone.
- Include practical experience at all levels of training, and include study visits to demonstrate best practice in action where possible.
- Motivate staff with competitive objectives, including those for the organisation, to become environmental front-runners.
- Ensure that responsibilities are clearly defined.
- Encourage staff feedback and suggestions for environmental management.
- Analyse and evaluate reasons why best practices are not applied and improve training through review-loops to improve performance (including staff feedback).

For biodiversity training involving complex direct and indirect impacts, environmental organisations and scientific institutes can help organisations to design and implement tailor made programmes that relate to the mitigation of direct impacts on local biodiversity as well as the indirect impacts via supply chains.

NH Hoteles bases annual bonus payments for managers partly on environmental performance targets. All staff are offered prizes for identifying opportunities to reduce energy or water consumption, or reduce waste generation (NH Hoteles, 2011).

Systematic implementation of best practice measures

Managers of tourism establishments or organisations may refer to the index of this tourism SRD and identify BEMP techniques relevant to their business. Managers and relevant staff may then compare their establishment or organisation level performance with the proposed benchmarks of excellence to identify the improvement potential, and any associated economic implications. Where there appears to be significant improvement potential, the possibility to apply proposed best practice measures can be assessed. Best practice is to perform this systematically across relevant departments and processes.

Applicability

All types of organisation can implement an EMS. This document refers to tour operators, destination managers (national, regional and local governments), accommodation providers, food and drink providers, laundry service providers. The level of complexity may increase as the scope of influence increases (e.g. tour operators and destination managers have wide spheres of influence (Table 2.2, Chapter 3 and Chapter 4).

Economics

Implementation of an EMS leads to the identification of efficiency savings detailed for best practice techniques in subsequent sections. For example, implementation of efficient lighting in a luxury 65-room hotel reduced electricity and maintenance costs by EUR 120 000 per year (section 7.6).

Driving forces for implementation

A range of factors encourage tourism organisations to implement an EMS. Objectives of EMS implementation, certified or not, include:

- identify and implement opportunities to improve operational efficiency (e.g. reduce energy and water consumption, reduced waste generation)
- manage environment-related risks and liabilities
- demonstrate environmental commitment to customers and other stakeholders
- increase access to business with customers requiring environmental management or information standards
- demonstrate a commitment to achieving legal and regulatory compliance to regulators and government.

Reference organisations

Ecocamping, Hostelling International, NH Hoteles, Scandic Hotels, Travelife

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2.2 Supply chain management

Description

All tourism organisations depend on external suppliers to provide materials and services. The environmental impacts arising from the production and delivery of these materials and services can be substantial compared with environmental impacts directly arising from activities occurring within, or directly managed by, tourism organisations (e.g. see Figure 2.4, below). Meanwhile, the environmental impact of use and disposal can vary considerably across different products depending on their design. Thus, there is potential for all tourism organisations to significantly reduce the total – direct and indirect – environmental impact arising from their operations through the selection of buildings, equipment, consumables and services associated with better environmental performance. The focus of this technique is to provide an overview of supply chain management with some examples of best practice. As indicated in Table 2.4, subsequent sections of the document address specific green procurement and supply chain management. In particular:

- Chapter 4 addresses tour operator supply chain management
- section 5.3 addresses green procurement of textiles and cleaning products
- section 5.5 addresses green procurement of laundry services
- section 6.1 addresses procurement to minimise waste
- section 8.1 addresses green sourcing of food.

In all cases, it is important that a lifecycle approach is taken to assess products and services, considering production, use and end-of-life stages, so that environmental hotspots and improvement options can be identified and environmental impacts efficiently minimised. Supply chain management requires involvement of all departments, and requires high-level direction and management within organisations. The following sequence of measures is necessary (Table 2.3).

Table 2.3: Sequence of best practice measures for environmental management of supply chains

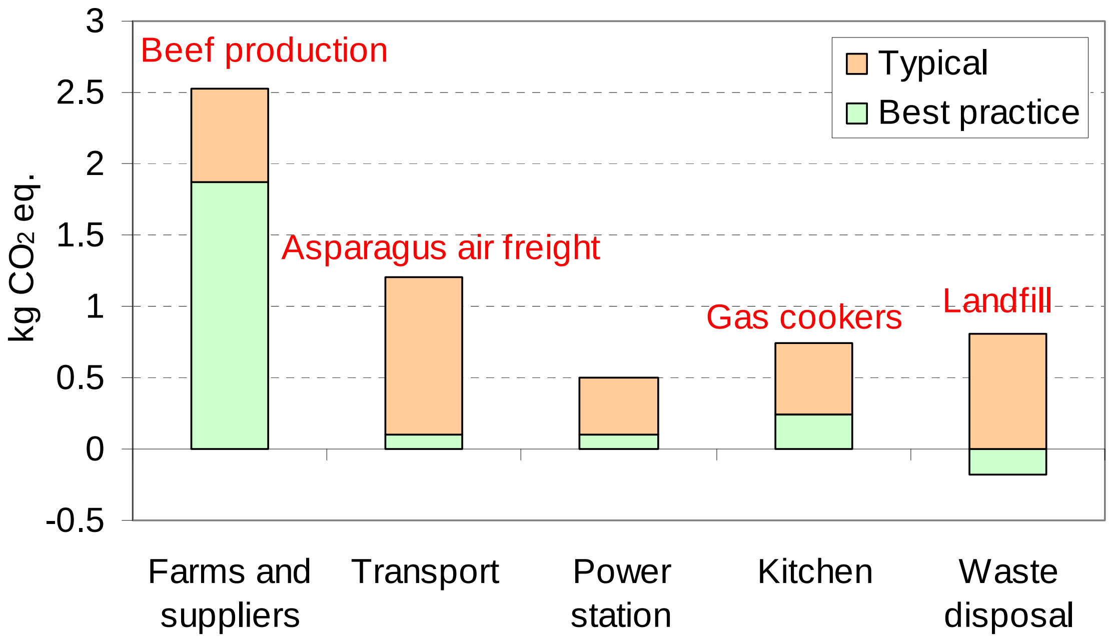
Order	Measure
1	Evaluate major products, services and suppliers used by the organisation
2	Identify priority products and services for improvement based on environmental impact (e.g. transport for tour operators, air-freighted food products for restaurants)
3	Identify improvement options (e.g. more efficient planes, seasonal asparagus offer
4	Implement improvement options (green procurement, benchmarking, etc.)

Figure 2.4 provides an example of the carbon footprint of a meal provided in a restaurant, broken down into supply chain stages and with reference to hotspot processes. The farm production stage gives rise to the largest share of GHG emissions, dominated by beef production, followed by air-freight transport of asparagus, landfill emissions, emissions from gas cookers and emissions from power generation. Good supply chain management can reduce GHG emissions and other environmental impacts at all stages.

- The quantity of beef in the offer may be reduced, and sourced from a known (e.g. local) or certified (e.g. Global Gap or national certification standard) responsible supplier (section 8.1).
- Air-freighted fruit and vegetables can be avoided through seasonal menu offers.
- Genuine renewable electricity can be purchased (section 7.6).

- Efficient gas cookers with pot sensors, or electric-induction cookers, can be installed (section 8.4).
- Waste contractors that bring organic waste for anaerobic digestion may be contracted (section 8.2).

It is important to note that GHG emissions are just one aspect of environmental pressure. In this example, other important pressures will be acidifying gas emissions from farm systems and power stations, eutrophying emissions to water from farm systems, resource depletion at all stages, and ecotoxicity emissions arising from farming systems and power stations. Biodiversity pressures arise across many supply chains, particularly those involving food production or harvesting of natural resources (e.g. wood), but can be difficult to measure and account for.



Source: ITP (2008), Climatop (2009), SRA (2010), DEFRA (2011), EC (2011).

Figure 2.4: Typical and best practice carbon footprint and hotspot sources for a meal of 0.2 kg beef, 0.1 kg asparagus, and 0.4 kg potato

Social considerations should also inform purchasing decisions. The authenticity of local products may be an important marketing feature for tourism enterprises, and the host community benefits from local purchasing. Such purchasing avoids long transport distances and should ensure greater transparency within the supply chain, and greater opportunity to influence the production process. However, these features should be considered from a lifecycle perspective. In some cases, products from further afield may be more eco-efficient, as a consequence of production in more appropriate bioclimatic region (e.g. cane sugar compared with beet sugar), or owing to certification according to relevant environmental standards (see section 8.1). Table 2.4 summarises some of the main supply chain options across tourism products and services.

Table 2.4: A summary of main priority products and services, and improvement options, for different tourism actors

Actor	Priority products and services	Supply chain options	Environmental hotspots
Tour operators	Transport	Select more efficient vehicles Encourage use of efficient transport modes (section 4.1) Encourage shift in holiday choices (section 4.4)	Air pollution, climate change, resource depletion, ecotoxicity
	Accommodation	Require EMS or ecolabel Benchmark performance Disseminate BEMPs (section 4.2)	See below
Accommodation providers	Electricity supply	Purchase verifiable renewable electricity Generate renewable electricity onsite (section 7.5)	Air pollution, climate change, resource depletion, ecotoxicity
	Waste services	Procurement selection to minimise waste (section 6.1) Purchase of products with recyclable packaging materials (section 6.2) Contract waste recycling services	Resource depletion, climate change
	Laundry services	Purchase efficient washer-extractors (section 5.4) Purchase ecolabelled detergents (section 5.4 and section 5.5) Purchase ecolabelled outsourced laundry services (section 5.5)	Air pollution, climate change, resource depletion, ecotoxicity, water scarcity, water pollution
	Food and drink	See below	See below
	Cleaning agents	Staff training to minimise use Use of microfibre cloths Purchase ecolabelled cleaning agents (section 5.3)	Resource depletion, water pollution, ecotoxicity
	Textiles	Purchase poly-cotton or linen sheets Purchase ecolabelled textiles (section 5.3)	Resource depletion, water scarcity, water pollution, ecotoxicity
Food and beverage providers	Food and drink	Reduce high-impact products on menu (e.g. meat, endangered fish species) Purchase organic food Purchase certified food (e.g. MSC, Fairtrade) Purchase local and seasonal food (section 8.1)	Air pollution, climate change, resource depletion, water scarcity, water pollution, soil degradation, ecotoxicity, biodiversity loss
	Waste services	Appropriate (on demand) portion sizing Purchase planning Select products with minimum or returnable packaging Contract waste recycling services (e.g. anaerobic digestion)	Resource depletion, climate change
	Electricity	See above	See above
	Cleaning agents	See above	See above

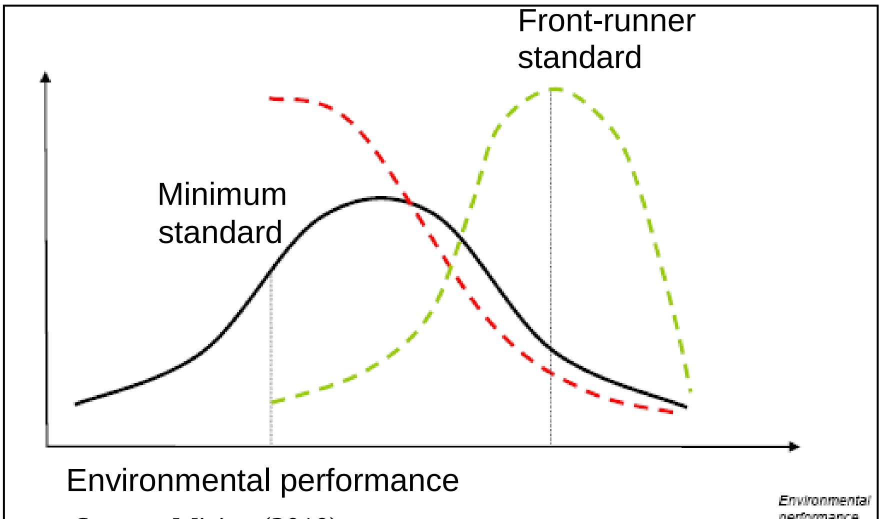
Achieved environmental benefit

The environmental benefits arising from effective supply chain management can exceed the entire environmental impact directly attributable to an enterprise's operations. In Figure 2.4 above, offsite (indirect) GHG emissions accounted for 87 % of the carbon footprint of a restaurant meal, and can be reduced through green procurement of food and waste management services. Section 8.1 and section 8.2 refer to achievable environmental benefits from these actions in more detail. Furthermore, green procurement of efficient cookers and hobs with pot sensors is an important option to reduce the remaining 13 % of onsite GHG emissions.

As another example, the environmental impact attributable to the operations of transport and accommodation providers considerably exceeds the environmental impact of tour operators who procure those services (at least where those tour operators do not operate their own airlines), and tour operators can leverage large environmental benefits through management of these providers (section 4.2 and 4.2).

Ecoproducts are associated with considerably lower lifecycle environmental impacts than average conventional products (Figure 2.5). In addition to direct benefits, ecoproducts are associated with important indirect environmental benefits, especially if they become accepted as benchmarks by other suppliers (Figure 2.5). Consequently, stimulating demand for ecoproducts has three main environmental benefits:

- the avoided (excess) environmental impact associated with consumption of the substituted conventional product
- reduced consumption owing to higher expenditure on ecoproducts
- mass market commercialisation of environmentally superior production processes (innovation).



Source: Misiga (2010)

Figure 2.5: Ecoproducts can exert an environmental performance 'pull' effect on entire product groups if they become benchmarks for environmental performance

The main features and achieved environmental benefits for ecolabelled and organic products are summarised in section 8.1. Other factors such as seasonal and local sourcing are also important criteria to reduce the environmental impact of supply chains (section 8.1).

Table 2.5: The two main types of standard representing front-runner ecoproducts promoted via labelling in this technique

Standard type	Features	Main environmental benefits
Ecolabel (Blue Angel, EU Flower, Nordic Swan)	The listed Ecolabels are independent of one another but represent equivalent exemplary environmental standards for non-food products. Certified product categories include chemical and cleaning products, electronic equipment, furniture, paints and varnishes, soaps and shampoos, textiles, tissue paper. Essentially, product performance across relevant environmental hotspots must be in the top 10–20 % for the product category.	Considerable reduction in **lifecycle** environmental impact relative to average products within the same group
Organic	Organic product certification is awarded by a number of certification organisations, with some differences in specific requirements, but within the EU these are all in compliance with Commission Regulation (EC) No 889/2008. Foods may only be labelled 'organic' if at least 95 % of their agricultural ingredients are organic. Detailed requirements and restrictions prioritise the use of internal resources in closed cycles rather than the use of external resources in open cycles. External resources should be from other organic farms, natural materials, and low soluble mineral fertilisers. Chemical synthetic resources are permitted only in exceptional cases.	Enhanced agricultural biodiversity Improved soil quality Lower resource consumption Agricultural innovation

Appropriate environmental indicator

Product lifecycle indicators

Table 2.6 summarised some key indicators used for LCA, as may be required when assessing supply chains and products. For initial assessment, it is important to consider the range of environmental pressures, and not to just focus on one pressure, such as GHG emissions. If a hotspot pressure is identified, or is seen to correlate strongly with other pressures, then it may be relevant to use an indicator for this pressure when comparing supply chain options.

Table 2.6: Common indicators and potential data sources for assessing the environmental impact of products and services

Impact	LCA indicators	Data sources
Air pollution	kg air emissions of NO_x, SO_x, NH_3, PM, VOCs, expressed as acid or VOC or ethylene equivalent	Process technology emission factors, exhaust gas concentrations
Biodiversity loss	Ha high-conservation-value land area lost	Land-use records and Geographic Information Systems (GIS)
Climate change	kg GHG emissions, expressed as CO_2 equivalent	Mass balance accounting, process emission factors (IPCC)
Ecotoxicity	kg toxic substance released to environmental compartments, expressed as 1,4-dichlorobenzene (DCB) equivalent	Mass balance accounting of substances used in processes, chemical analysis to identify toxic substances used
Resource depletion	kg of finite or over-harvested renewable resource extraction, expressed as kg antimony equivalent	Mass balance accounting
Water use	m^3 water used	Farm records, estimates based on cropping system and climate. See Water Footprint Network (2010) and Alliance for Water Stewardship (2010)
Water quality	kg water pollutants (COD, N, P expressed as PO_4 eq., toxic substances expressed as 1,4-DCB eq.)	Mass balance accounting of substances used in processes, chemical analysis of wastewater concentrations
Source: EC (2011).		

<u>Organisation performance indicators</u>

The environmental performance of tourism organisations with respect to supply chain management can be assessed according to:

- the percentage of a particular group of environmentally-important products or services certified according to relevant environmental standards
- the percentage of a particular group of environmentally-important products or services that comply with a specified level of environmental performance
- the percentage of a particular group of environmentally-important products or services that originate from suppliers who are improving their environmental performance.

Percentages are usually most conveniently, and appropriately, expressed in relation to value. However, in some cases, indicators are based on alternative measures, such as active-ingredients for detergents and other types of chemical product (e.g. EU Flower criteria). The latter case ensures more accurate comparison across different products where functional units can vary significantly from value (e.g. according to active ingredient concentration).

The second indicator may include local production, and the third indicator may include products from suppliers participating in a formal or informal environmental management programme – preferably one that involves performance benchmarking. Specific standards and criteria for supply chain management are referred to in relevant sections of this document.

<u>Benchmark of excellence</u>

Front-runner accommodation providers use supplier codes and questionnaires to assess and select suppliers according to environmental management criteria – e.g. Scandic's Supplier Declarion. The first component of best practice is represented by the identification of priority products and services for improvement, based on environmental impact and improvement potential. The following benchmark of excellence is proposed to reflect this:

BM: the organisation has applied lifecycle thinking to identify improvement options for all major supply chains that address environmental hotspots.

Best practice may then be measured across product categories. Section 5.3 refers to benchmarks of excellence for room textiles, section 5.4 and section 5.5 refer to benchmarks for green procurement of laundry equipment, laundry detergents and laundry services, and section 8.1 refers to benchmarks for green procurement of food and drink products.

Figure 2.6 presents performance in chemical procurement across a mid-range European hotel chain, expressed as the percentage by weight of **all chemicals** used in individual hotels that are certified according to an ISO type-1 ecolabel (e.g. EU Flower, Blue Angel, Nordic Swan). Based on the 10 % best performing hotels, the following benchmark of excellence is proposed for chemical procurement:

BM: ≥97 % of chemicals, measured by weight of active ingredient, used in accommodation and restaurant premises are ecolabelled (or can be demonstrated to be the most environmentally friendly available option).

Paper, cardboard and wood represent a large source of material consumption and waste in accommodation. Selecting recycled, ecolabelled or environmentally certified wood and paper can avoid the worst upstream environmental impacts, such as unsustainable wood harvesting and polluting paper processing. Appropriate certification schemes are Forest Stewardship Council (FSC) and Programme for the Endorsement of Forestry Certification (PEFC). The following benchmark of excellence is proposed:

BM: ≥97 % of all wood, paper and cardboard purchased by accommodation and restaurant enterprises are recycled or environmentally certified (ecolabelled, FSC, PEFC).

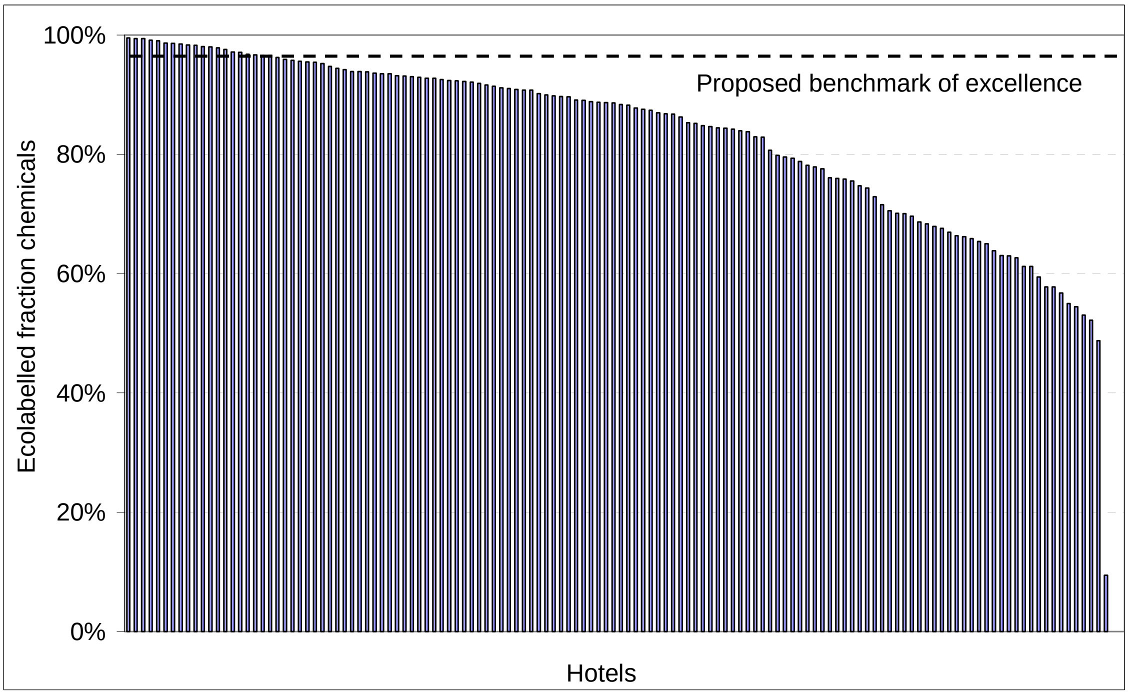


Figure 2.6: The average percentage of chemicals used by individual hotels within a mid-range European hotel chain that were certified according to an ISO type-1 ecolabel in 2010

For products and services not referred to in subsequent sections of this document, it is proposed to use a similar high percentage to represent benchmarks of excellence.

Cross-media effects

Environmental objectives within supply chain management are secondary to any relevant legal and health and safety criteria. To achieve sustainable supply chains, supply chain management should also consider social criteria. In some cases, social and environmental objectives are concordant (e.g. Fairtrade certification); in other cases, social and environmental objectives diverge and compromises or trade-offs are required.

Eco products certified with an ISO Type-I label have been assessed as ecological front-runners across a range of relevant environmental criteria, and are not associated with significant cross-media effects.

Operational data

Correct ordering of goods and services

In the first instance, supply chain management objectives and achievements should be communicated to suppliers, staff and customers. Procurers and supply chain managers must ensure that all products and services comply with relevant legal criteria, and health and safety criteria.

Buying the correct quantities of perishable goods is an important first step that avoids environmental impact arising from unnecessary production and waste generation. Buying products in bulk and concentrated form (e.g. detergents) can reduce packaging and associated impact. However, it is important to ensure that staff are trained to avoid excessive use, for example by ensuring correct dilution of concentrated cleaning chemicals (see 'Efficient housekeeping' in section 5.3).

Selecting more sustainable suppliers

It may be possible to quickly improve supply chain sustainability by identifying and contracting more sustainable suppliers, especially where the environmental performance of suppliers is verified through relevant and rigorous third-party certification. In other cases, it may not be possible to contract other suppliers, especially on a large-scale, and the establishment of supplier standards and programmes to improve supplier environmental performance may be more appropriate (Travelife, 2011). In such cases, a step-wise approach is recommended, with graded standards to incentivise continuous improvement. When moving to local suppliers, it may be necessary to contract a larger number of smaller suppliers.

The Travel Foundation (2011) is developing lists of suppliers for environmentally friendly products (e.g. EU Flower labelled products, low-flow faucet aerators, etc.) for different countries, although these lists are so far not comprehensive. Local enquiries or internet searches are the best way to identify relevant local suppliers of more sustainable products.

Large enterprises such as hotel or hostel chains can introduce environmental requirements into contracts, or ask suppliers to sign legally binding codes of conduct that specify minimum environmental criteria and/or give permission to be environmentally audited. Two examples are provided below.

Scandic Hotels suppliers declaration. The declaration comprises a declaration and series of detailed questions on environmental management and reporting systems that suppliers must complete and sign. The declaration comprises the following. • We shall, to the best of our ability, guarantee that we do not offer Scandic products or services which oppose the development towards an ecologically and socially sustainable company and society. • We agree to work together to stop the systematic increase in substances taken from the earth's crust and man-made substances deriving from our society's production. • We shall not contribute to our ecological systems being subjected to over-abstraction or other manipulation. • We shall work to achieve a fair society in which human needs are met everywhere. • We shall work with Scandic to achieve a sustainable society. Questions relate to: actions to reduce environmental impacts; dedicated environmental staff; staff environmental training; the number of ecolabelled products offered; proportion fair-trade products; green electricity purchase (% share of electricity consumed); renewable fuel use in vehicles (% share). *Source:* Scandic Hotels (2006).
Accor procurement sustainable development charter Accor ask suppliers to sign and commit to comply with a charter, and to ensure that their (secondary) suppliers and subcontractors also comply with the charter. Signing the charter represents agreement to participate in Accor's sustainability assessment process and to implement action plans where required, including authorization for third parties to perform sustainability audits and implement action plans on behalf of Accor. *Source:* Accor Group (2010).

Large accommodation providers may also specify standards for construction of new buildings and renovations, including product specifications. In such cases, the use phase of the product lifecycle is particularly important, to minimise energy and water consumption. End-of-life phases may also be important with regard to hazardous waste generation and recyclability. One example is Scandic's Environmental Refurbishment Equipment and Construction Standard (Scandic Hotels, 2003) that helps Scandic to ensure new and refurbished hotels are energy and water efficient, and comply with Nordic Swan ecolabel criteria for hotels and hostels.

Accounting for biodiversity pressures

So far only a few environmental certification schemes (labels) for products include explicit biodiversity criteria, including the Marine Stewardship Council label for fish, the Rainforest Alliance label, and various organic food labels. The Forest Stewardship Council is among those labeling schemes currently working to integrate biodiversity criteria.

Biodiversity protection should be included in the code of conduct or procurement rules of destination management, tour operators, accommodations, campsites and enterprises offering recreational activities. And all organizations should identify products and services representing a high risk to biodiversity, and delist those to which significant negative impacts can be attributed – e.g. souvenirs from protected /rare species, visits of dophinariums, excursions with motorized vehicles into ecologically sensitive areas, wildlife observation not respecting international rules of animal welfare etc.

Destination managers and tourism enterprises should inform suppliers about the importance of biodiversity for the destination or enterprise, and request or demand their engagement with biodiversity management. Feedback from suppliers can be a source for more concretely defined procurement rules. Also, large organizations may offer training on biodiversity protection to their suppliers.

Within the European Business and Biodiversity Campaign, a Biodiversity Check for the tourism sector has been developed to analyze the inter-relationships and biodiversity impacts of tourism actors. See: www.business-biodiversity.eu

Ecolabel criteria

ISO Type 1 ecolabels for specific products include product rules related to relevant environmental hotspots that vary across product groups. Meanwhile, the EU Flower and Nordic Swan ecolabels for accommodation provide a useful selection of key products and criteria that should be targeted for green procurement (Table 2.7) .

Table 2.7: A selection of mandatory and optional criteria related to green procurement contained in the EU Flower and Nordic Swan ecolabels for accommodation

	Ecolabel criteria
Construction and refurbishment materials	Floors, wallpapers, skirtings etc. used for renovation/new construction must not contain halogenated plastics (e.g. PVC).
	Newly purchased textiles may not be treated with halogenated flame retardants.
	At least 50 % of the indoor and/or outdoor painting of the tourist accommodation shall be done with indoor and/or outdoor paints and varnishes awarded the Community ecolabel or other national or regional ISO Type I ecolabels.
	If a new heat generating capacity is installed within the duration of the ecolabel award, it shall be a high efficiency cogeneration unit, a heat pump or an efficient boiler. In the latter case, the efficiency of such a boiler shall be of 4 stars (ca. 92 % at 50 °C and 95 % at 70 °C).
	The tourist accommodation shall have a photovoltaic (solar panel) or local hydroelectric system, geothermal, biomass or wind power electricity generation that supplies or will supply at least 20 % of the overall electricity consumption per year.
	Rainwater shall be collected and used for non-sanitary and non-drinking purposes.
	Recycled water shall be collected and used for non-sanitary and non-drinking purposes.
	The average water flow of the taps and showerheads, excluding kitchen and bath tub taps, shall not exceed 9 litres/ minute.
	At least 95 % of WCs shall consume six litres per full flush or less.
	All urinals shall be fitted with either automatic (timed) or manual flushing systems so that there is no continuous flushing.
Consumable goods	At least two locally sourced and not out of season (for fresh fruit and vegetables) food products shall be offered at each meal, including breakfast.
	The main ingredients of at least two dishes or the whole menu including breakfast shall have been produced by organic farming methods, as laid down in Regulation (EC) No 834/2007 or produced according to an ISO type I eco label.
	Disinfectants shall be used only where they are necessary in order to comply with legal hygiene requirements.
	Unless required by law, disposable toiletries (not refillable) such as shampoo and soap, and other products (not reusable), such as shower caps, brushes, nail files, etc. shall not be used. Where such disposable products are requested by law the applicant shall offer to guests both solutions and encourage them with appropriate communication to use the non-disposable products.
	Disposable drinking systems (cups and glasses), plates and cutlery shall only be used if they made out of renewable raw materials and are biodegradable and compostable according to EN 13432.
	Except where required by law, no single dose packages shall be used for breakfast or other food service, with the exception of dairy fat spreads (such as butter, margarine and soft cheese), chocolate and peanut butter spreads, and diet or diabetic jams and preserves.

	Ecolabel criteria
	90% of the volume of purchased tissue products, i.e kitchen rolls, paper towels and toilet paper, must be ecolabelled.
	At least 80 % by weight of hand dish washing detergents and/or detergents for dishwashers and/or laundry detergent and/or all purpose cleaners and/or sanitary detergents and/or soaps and shampoos used by the tourist accommodation shall have been awarded the Community ecolabel or other national or regional ISO Type I ecolabels.
	Ecolabel products: Photocopying paper ≥90 %, Napkins ≥50 %, Fabric hand towel rolls ≥50 %, Microfibre cloths ≥50 %, Batteries ≥90 %, Toner cartridges ≥90 %, Candles ≥50 %, Floor care agents ≥50 %, Rinsing agents ≥50 %, Soaking agents ≥50 %, Other ≥50 %
	The tourist accommodation shall offer beverages in returnable/refillable bottles
Durable goods	At least 30 % of any category of durable goods (such as bed-linen, towels, table linen, PCs, portables, TVs, mattresses, furniture, washing machines, dishwashers, refrigerators, vacuum cleaners, floor coverings, light bulbs) present in the tourist accommodation, including rental accommodation, shall have been awarded the Community ecolabel or other national or regional ISO Type I ecolabels
	Purchase ecolabelled durable goods. Office machines (PC, computer, copier, etc.) ≥50 % of requirements, TV in guest rooms ≥10 % of requirements, TV in common rooms ≥10 % of requirements, Furniture per category, bed, table, etc. ≥10 % of requirements, Textiles (including towels and napkins) ≥10 % of requirements, Flooring ≥10 % of the surface area, Work clothes, at least one personnel category, at least one garment, Other
	Any household air conditioner bought within the duration of the ecolabel award shall have at least Class A energy efficiency as laid down in Commission Directive 2002/31/EC (4), or have corresponding energy efficiency.
	The tourist accommodation shall have a heat pump providing heat and/or air conditioning (1,5 points). The tourist accommodation shall have a heat pump with the Community ecolabel or another ISO type I ecolabel.
	The tourist accommodation shall have a heat recovery system for 1 or 2 of the following categories: refrigeration systems, ventilators, washing machines, dishwashers, swimming pool(s), sanitary wastewater.
	At least 80 % of all light bulbs in the tourist accommodation shall have an energy efficiency of Class A and 100 % of light bulbs that are situated where they are likely to be turned on for more than five hours a day shall have an energy efficiency of Class A as defined by Directive 98/11/EC.
	All household refrigerators shall be of Class A + or A++ efficiency according to Commission Directive 94/2/EC, and all frigo- or mini-bars shall be at least class B efficiency.
	All household electric ovens shall be of class A energy efficiency as laid down in Commission Directive 2002/40/EC.
	All household dishwashers shall be of class A energy efficiency as laid down in Commission Directive 97/17/EC.
	At least 80 % of office equipment (PCs, monitors, faxes, printers, scanners, photocopying machines) shall qualify for the energy star as laid down in Regulation (EC) No 106/2008 of the European Parliament and of the Council and in Commission Decision 2003/168/EC.
	All electric tumble driers shall be class A energy efficiency as laid down in Commission Directive 95/13/EC.
	All electric hand and hair driers shall be fitted with proximity sensors or have been awarded an ISO Type I ecolabel.
	Any planting of outdoor areas with trees and hedges shall be composed of indigenous species of vegetation.

	Ecolabel criteria
Services	Purchase ecolabelled services. Alternative dry-cleaning (1), Cleaning (1), Car wash (1), Other (1 per service, max. 2)
	At least 50 % of the electricity used for all purposes shall come from renewable energy sources, as defined in Directive 2001/77/EC of the European Parliament and of the Council (1).
	The tourist accommodation shall offer guests travelling with public transport pick up service at arrival with environmentally friendly means of transportation such as electric cars or horse sleds.
	At least 70 % of the total energy used to heat or cool the rooms and to heat the sanitary water shall come from renewable energy sources.

Source: EC (2009); Nordic Ecolabelling (2007).

Applicability
All sizes and types of tourism organisation can implement supply chain management, especially green procurement. Large enterprises have greater potential to leverage influence over supply chains, but SMEs may exert considerable influence over local supply chains. For example, Hotel Gavarni is a small 25 room hotel in Paris that has implemented green procurement extensively, and even influenced local suppliers to change their processes.

Economics
In some cases supply chain management may incur additional costs through, for example, the procurement of ecolabelled products. In other cases, costs may be reduced, for example by shifting to local and seasonal produce offers on menus. It is important that cost implications are considered alongside possible marketing benefits. Product price premiums may also be offset by more efficient purchasing planning to minimise waste.

Driving force for implementation
The main driving forces for improving supply chain sustainability are listed below:

- corporate social responsibility
- expectations of stakeholders, including customers, shareholders and tour operators
- risk aversion with respect to dependence on unsustainable supply chains (future cost and reputation)
- business security through the establishment of long-term viable suppliers
- economic benefits for the enterprise from product and service rationalisation
- destination level scio-economic benefits
- improved community relations and reputation arising from use of local suppliers
- marketing benefits arising from more authentic local experiences.

Reference companies
Accor Group; Hotel Gavarni; Scandic Hotels

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3 DESTINATION MANAGEMENT

Chapter structure

An EMAS SRD is under preparation for the public administration, and will cover many aspects of best practice relevant to destination management. Meanwhile, Chapter 4 addresses the role of tour operators in destination improvement, including through influence over destination managers (section 4.3). Nonetheless, given the broad scope and potential strength of influence exerted by destination managers over environmental management of tourism (described below), it is important to include a brief chapter targeted at destination managers in this SRD. In this chapter, best practice for management of tourism destinations is described under four main themes.

Implementation of a Destination Plan, involving coordination of all relevant government and private actors, to coordinate sustainable tourism development and minimise environmental burdens arising from tourism activities within the destination (section 3.1).
Biodiversity management and conservation, addressing appropriate zoning and activity management with an emphasis on the protection of high nature conservation value areas (section 3.2).

- Infrastructure and service provision, addressing the provision or regulation of services that minimise environmental impact and facilitate eco-efficient tourism (section 3.3).
- Event management, summarising how the environmental impact of events can be assessed and minimised (section 3.4).

Owing to the scope of the themes involved, BEMP descriptions in sections 3.2 and 3.3 represent compendiums of best practice measures and key supporting information.

What is a destination?

UNEP and UNWTO (2005) refer to the WTO working group on destination management's definition of a destination as *'a physical space in which a visitor spends at least one overnight. It includes tourism products such as support services and attractions, and tourism resources within one day's return travel time. It has physical and administrative boundaries defining its management, and images and perceptions defining its market competitiveness. Local destinations incorporate various stakeholders often including a host community, and can nest and network to form larger destinations'*. SCBD (2010) define a tourism destination as *'a complex of attractions, equipment, infrastructure, facilities, businesses, resources, and local communities, which combine to offer tourists products and experiences they seek.'*

Local destinations may be cities, towns, resorts or rural areas, or groupings of these. According to UNEP and UNWTO (2005), factors defining a functional destination include:

- whether the area is coterminous with municipal boundaries or other forms of designation such as a national park;
- whether it is unified by certain images and intrinsic features and qualities that can contribute to a clearly identifiable brand;
- whether it is an area towards which local stakeholders feel a natural affinity and within which it is practicable for them to work together.

Environmental impact

In relation to the potential benefits and costs that tourism development can impose upon a destination, it has been stated that *'Tourism is like fire: you can cook your food with it, but if you are not careful, it could also burn your house down!'*[4]. The success of tourism destinations depends on a number of factors including climatic, cultural and natural features, accessibility, services and the built environment. The concentration of tourism on sites of high nature and

[4] Quote from a Foreword to SCBD (2007) by Jochen Flasbarth, Director General of nature Conservation

cultural value increases the risk of environmental degradation, as demonstrated in numerous popular destinations (SCBD, 2004). Furthermore, major tourist destinations experience large population increases during peak season, and this can exert addition environmental pressure through capacity exceedence for various infrastructures and services. Such factors can reduce the attractiveness of major tourism destinations, whose continued success depends on sustainable management that:

- preserves the ecosystems that support local populations and attract tourists
- ensures sustainable rates of resource consumption
- provides efficient services that have the capacity to accommodate peak-season visitor numbers.

Globally, 15 of 24 ecosystem services essential to environmental, social and economic wellbeing are in decline according to the Millenium Ecosystem Assessment report (MEA, 2005). It is estimated that 71 % of the dune landscapes that existed in the Mediterranean region in 1990 have now disappeared, compared with an equivalent figure of 15 % to 20 % for Germany's north coasts (SCBD, 2007). Biodiversity loss is continuing at an unprecedented rate, with a 30 % decline in the global abundance of 2 500 species of vertebrate monitored in the Living Planet Index between 1970 and 2007, driven by a 60 % decline in the abundance of tropical vertebrate species (WWF, 2011). The target established by parties to the Convention on Biological Diversity (CBD) in 2002, to significantly reduce the rate of biodiversity loss at a global level by 2010, has not been met (SCBD, 2010).

Decisions about the siting, design and development of tourism products within destinations are often based on commercial considerations, and disregard the conservation of local and regional biodiversity (Hawkins et al., 2002). Unsustainable tourism growth in the municipality of Calvia in Majorca, culminating in 1.6 million annual tourist visits and a peak season population density of 3 000 inhabitants per km2, led to local environmental degradation and a subsequent decline of 20 % in tourist visitors between 1988 and 1991 (SCBD, 2009).

Poorly regulated tourism development can result in excess accommodation capacity and uncontrolled competition that undermines profitability for the sector and leads to environmental degradation (too many visitors and no investment in environmental management). Conversely, well managed tourism can contribute to environmental protection, by generating income that can be directed towards key services and by extracting financial value from, and thus safeguarding the integrity of, areas of high nature value (see section 3.2). Destination managers at various levels can stimulate more sustainable tourism through implementation of best practice in land use planning, the provision of adequate infrastructure and services, and other mechanisms such as allocating a portion of tourism income towards biodiversity conservation. Destination managers can also influence the performance of tourism enterprises within their jurisdiction, and require or encourage best practice as described in subsequent chapters of this document.

Responsibility for tourism impacts

In a recent online survey of almost 4 000 holiday makers, 62 % of respondents thought that tourism had a relatively high impact on the environment, compared with other sectors (TUI Travel PLC, 2010). The government of the destination country was identified as having the greatest responsibility to deal with the environmental impact of holidays involving flights (Figure 3.1). Notably, only 20 % of respondents ranked holiday makers (i.e. themselves) as most responsible for dealing with environmental impacts. Meanwhile, the Word Wildlife Fund (WWF) attribute primary responsibility for sustainable coastal tourism development to the following factors and actors.

Land use development decisions for tourism made by governments at the national and/or local level. These are accompanied by investment in infrastructure to support development which is financed through both public institutions and private investors, who can be influenced at the national, regional, and/or global levels.

Real estate development industry, including financial institutions and real estate developers who can operate at any level from local to global and are primarily private sector.

Tourism operators such as hotel chains and cruise lines, and tourism consumers, are considered as secondary players with regard to influence over tourism development. The WWF posit that these secondary players are of lesser importance, and that changing consumer demand 'will not be a useful point of intervention' (CESD, 2007). Thus, national and local governments have an important role to play in managing the environmental performance and condition of destinations.

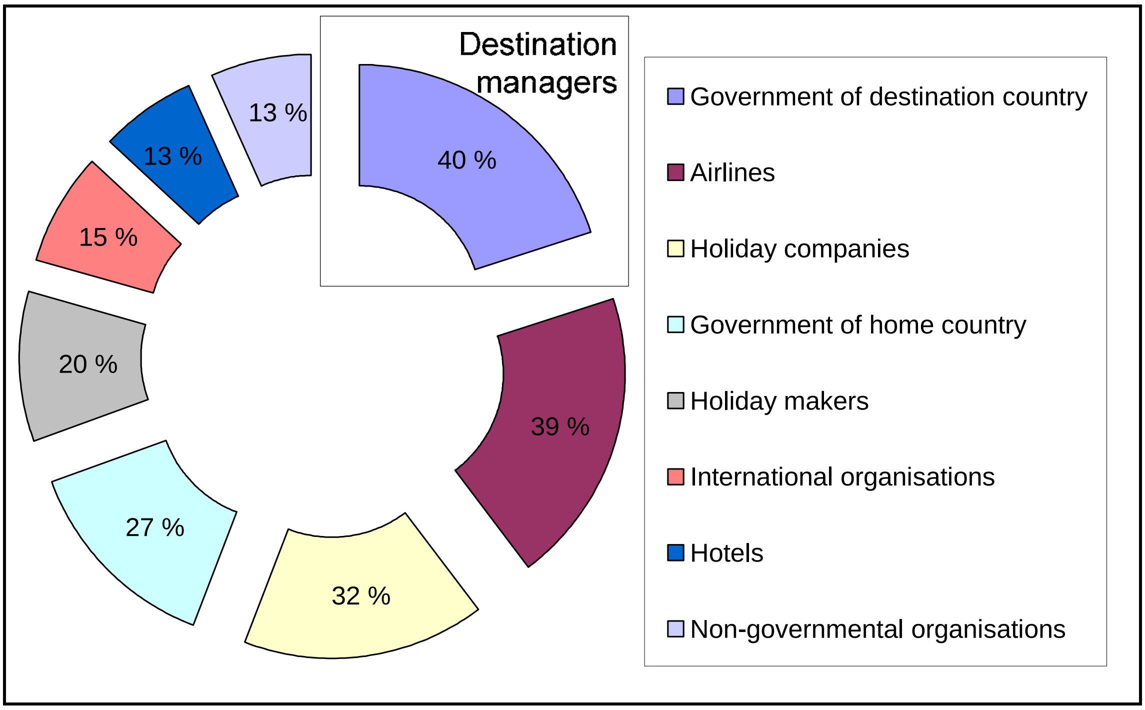
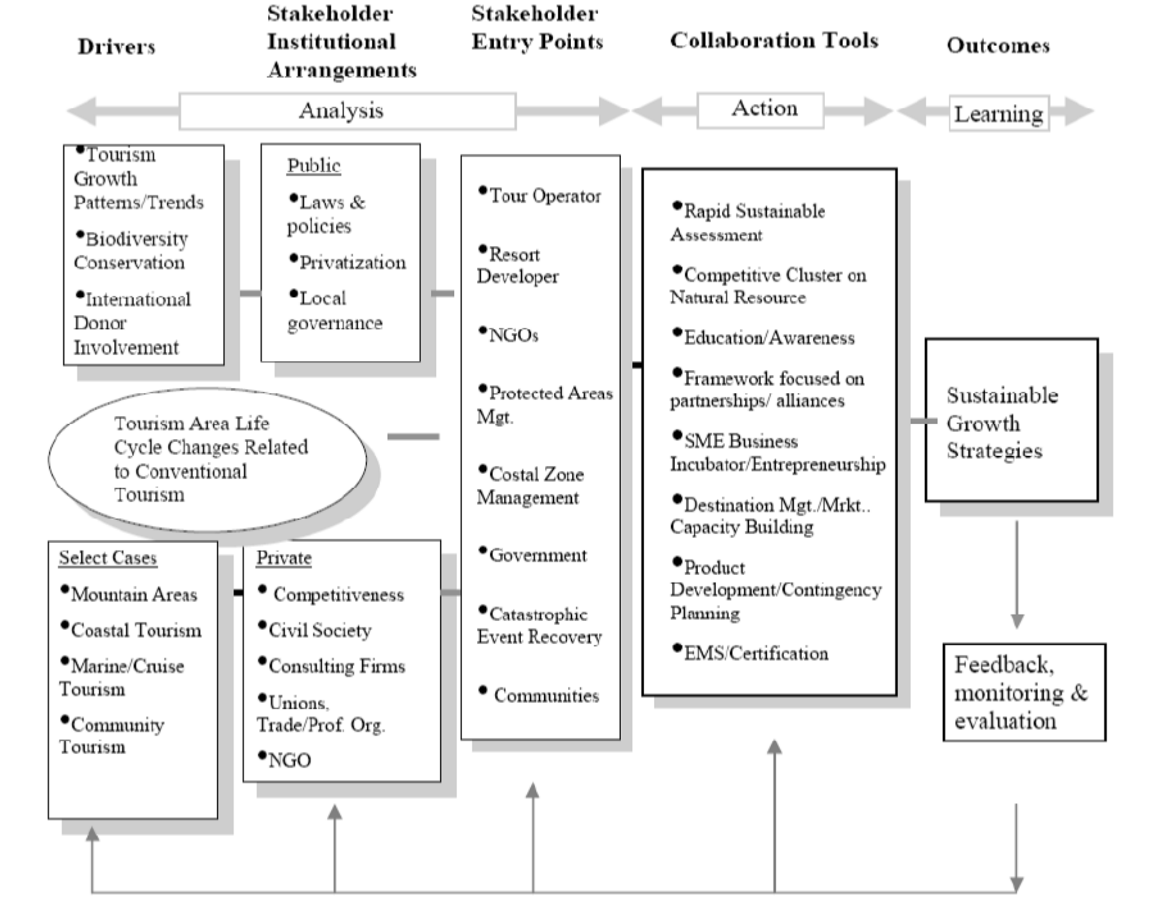


Figure 3.1: Percentage of holiday makers ranking each of eight entities as either first or second most responsible for dealing with the environmental impacts of flying holidays in a TUI survey

Destination managers

According to SCBD (2010), *'Sustainable governance of tourism development in a destination is a complex process involving the private sector as its main engine (developers, financers, landowners, managing companies, franchisees, and operators), all levels of government and a number of public agencies, interest groups of residents (including indigenous and local communities), and NGOs from local to global.'* However, there is no widely accepted definition of the geographic scope of a destination (see GRI, 2002). Many stakeholders contribute towards the sustainability of tourism within a particular destination (Figure 3.2). For the purpose of this document, destination managers are defined as public administration (eg. local authorities) and related agencies whose remit includes management of tourism or tourism-related services.



Source: Hawkins et al. (2002).

Figure 3.2: The sustainable tourism stakeholder management framework proposed by Hawkins et al. (2002) in relation to sustainable tourism development

Destination managers can play a crucial role in maintaining or enhancing environmental conditions at the destination level. They usually have either direct control or strong influence over the policies, planning decisions, infrastructure and services that influence environmental pressures (Figure 3.3). For example, local authorities have a mandate to implement regional and national regulations related to tourism, and have various degrees of power to influence and supplement such regulations. SCBD (2010) note that biodiversity conservation and sustainable tourism development requires management at the destination level, and that the central tool for the sustainable development of tourism is the **'Destination Plan'**. They refer to **Destination Management Organizations (DMO)**, in which local authorities play the lead role, with input from destination stakeholders, to manage sustainable tourism development based on a Destination Plan.

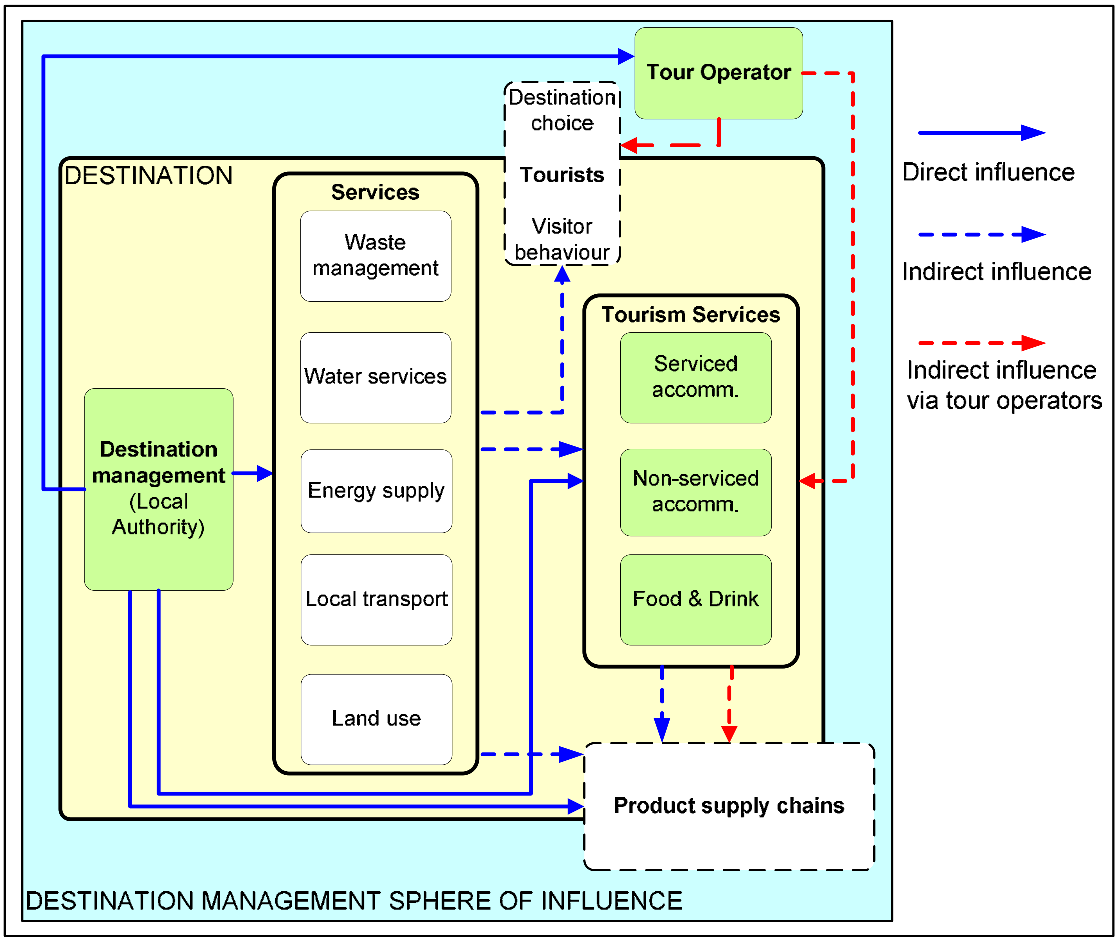


Figure 3.3: Major pathways of influence exerted by destination managers relevant to the environmental performance of tourists, tourism service providers, and their suppliers

Destination Management Organisations

Destination Management Organisations have a specific tourism and destination remit, are usually sub-national structures, may be funded by the public sector with or without input from the private sector, and collaborate with government at the local and national level. Local authorities may continue to support tourism development alongside DMOs, especially where tourism is important within the local economy (Visit England, 2012). However, DMOs play a coordinating role to avoid conflict and duplication across local authorities within their jurisdiction. An important role for DMOs is to raise revenue for tourism-related projects. They may also provide low interest loans to tourism enterprises to implement improvement measures, including sustainability investment. In England, five DMOs (Bath, Peak District, Derbyshire, The Broads, and Manchester) are sharing their experiences in relation to:

- developing new funding models
- establishing relationships with emerging local enterprise partnerships
- engaging the private sector to contribute to destination marketing activity
- developing mutually beneficial activity with Business Improvement Districts
- widening their business membership to non-tourism businesses and taking on wider roles such as place marketing and attracting inward investment.

Sustainable tourism development

Peter Mansfield, Chair of the Cornwall (UK) Area of Outstanding Natural Beauty (AONB) Partnership, provided the following definition of sustainable destination management: *'Cornish landscapes face many challenges which need to be met in ways which future generations will judge to have been far-sighted and unselfish'* (Cornwall AONB, 2011).

Table 3.1 contrasts typical characteristics of sustainable and non-sustainable tourism according to current mainstream thinking on the definition of sustainable tourism, compiled from a literature review by Perrat (2010). The importance of planning and development at the destination level is evident from this list.

Table 3.1: Some typical features of sustainable and unsustaibale tourism

Sustainable	Non-sustainable
General concepts	
– Slow development – Controlled development – Appropriate scale – Long term – Local control	– Rapid development – Uncontrolled development – Inappropriate scale – Short term – Remote control
Development strategies	
– Plan, then develop – Concept-led schemes – All five landscapes concerned – Pressures and benefits diffused – Local developers – Locals employed – Vernacular architecture	– Develop without planning – Project-led scheme – Concentrating on 'honey pots' – Increase capacity – Outside developers – Imported labour – Non-vernacular architecture
Tourist behaviour	
– Low value – Some mental preparation – Learning of local traditions and language Sensitive to destinations and hosts – Repeat visits	– Little or no mental preparation – No learning of local traditions and language – Intensive and insensitive – Unlikely to return
Source: Perrat (2010).	

Various organisations and tools are available to assist destination managers with sustainable tourism development. The Global Sustainable Tourism Council (GSTC) comprises UN agencies, leading travel companies, hotels, country tourism boards and tour operators and acts to promote increased knowledge, understanding and adoption of sustainable tourism practices. The GSTC compiles and provides tools and training to encourage sustainable tourism. The primary output from the GSTC is a list of 37 Global Sustainable Tourism Criteria, representing the minimum requirements for realisation of sustainable tourism within destinations, and distilled from a review of over 4 500 pre-existing sustainable tourism criteria. The draft list of criteria may be found in GSTC (2012). Meanwhile, the EC Tourism Sustainability Group (TSG) has developed an 'indicator system for sustainable tourism destinations' that includes a core set of 75 destination level sustainability indicators (EC TSG, 2011). In addition, the European Destinations of Excellence project promotes sustainable management of destinations, and provides a list of good practice case studies online (EDEN, 2012).

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3.1 Strategic destination development plans

Description

Good destination management maximises the net contribution of tourism to a destination in terms of maintaining or improving economic, social and environmental conditions. This requires planning for projected service demand whilst minimising negative pressures arising from development, both tourism related and indigenous. Spatial (e.g. resort or city centre) and temporal (e.g. seasonal) concentrations of tourism can give rise to particular pressures, and need to be both controlled and planned for. For example, over 12 million visitors stayed overnight in Barcelona in 2009, leading to 27 million overnight stays (Ajuntament de Barcelona, 2010), compared with a city population of approximately 1.6 million inhabitants.

Development of tourism and supporting services should be integrated into a strategic **Destination Plan** based on an assessment of local carrying capacity and vulnerabilities. For example, water use and extraction plans should be informed by local or regional water capacity assessments (Gössling et al., 2011). In summary, planning should ensure that the carrying capacities of infrastructure and services within a destination, **natural and man-made**, are not exceeded.

Destination Plans may be developed at the national, regional or local scales, and should:

- balance environmental, social and economic considerations
- integrate tourism sectors with surrounding sectors and activities
- foster coordination across all relevant government departments and agencies
- be integrated with relevant regional, national and international strategies and legal frameworks.

Destination Plans are most effective when implemented during initial tourism development, but can also be implemented to revitalise degraded destinations. For example, following overdevelopment in the Spanish resort of Calvia, local authorities rezoned land, demolished hotels, landscaped previously sealed areas, and established new protected areas (Conservation International, 2003).

Destination planning requires coordination across multiple organisations and/or departments and levels within local, regional and national administration. One component of best practice is therefore to establish a destination management organisation (DMO) – an administrative department or a private, or public-private organisation – specifically responsible for coordinating and implmeneting Destination Plans. Best practice in implementation of a Destination Plans involves best practice in biodiversity management (section 3.2), service provision (section 3.3) and event management (section 3.4).

Finally, another aspect of best practice in the development of Destination Plans is to ensure that environmental pressures arising from the provision (operation) of tourism services are minimised. Local authorities and/or DMOs can have a strong influence over the environmental performance of tourism enterprises within the destination. This can be achieved through:

- regulations requiring minimum levels of environmental performance/protection
- award schemes to promote more sustainable tourism services
- fiscal incentives (subsidies) to encourage uptake of efficient technologies and techniques
- fiscal instruments such as environmental taxation and stepped charges to encourage greater resource efficiency.

Implementation of these latter measures reflects more general best practice by public administration. More information on these measures may be provided in the SRD for public administration (EC, 2012). Table 3.12 in section 3.2 summarises the main types of regulatory instruments available to destination managers.

Achieved environmental benefit

Destination plans that lead to more sustainable development of tourism destinations will give rise to multiple benefits. UNEP (2009) lists the economic, social and environmental benefits attributable to integrated planning for the example of integrated coastal zone management (Table 3.2). Similar benefits will arise from the implementation of destination plans in coastal areas and other settings.

Table 3.2: Social, economic and environmental benefits of integrated coastal zone management

Social benefits	Economic benefits	Environmental benefits
Provides diverse opportunities for recreation, leisure and cultural activities and thus improves the quality of life	Supports sustainable economic activities and thereby ensures income in the long run	Ensures integrity of the coastal environment and biodiversity as a natural system
Helps resolve conflicts	Allows better zoning and use allocation	Ensures the sustainable use of natural resources
Strengthens institutional frameworks and enforces cooperation among stakeholders on the basis of shared objectives	Improves management (legal framework, risks, help to the decision-making process) and thus permits gains in efficiency and time	Preserves and improves natural areas (habitats, species and biodiversity)
Provides security from natural hazards and risks	Develops new economic instruments to finance environmental protection	Improves pollution control
Raises public awareness and favours information exchange on sustainable development and environmental issues	Promotes environmentally friendly technologies and cleaner production for the markets of tomorrow	Improves beachfronts and soil alteration management
Encourages broader public Participation	Adds value to products through ecolabelling schemes	Integrates river basin management
Source: UNEP (2009).		

More information on environmental benefits in relation to biodiversity, water stress, water pollution, waste management, air pollution and traffic congestion is provided in section 3.2 and section 3.3.

Appropriate environmental indicator

<u>Standardised international indicator sets</u>

A number of projects are working to develop standardised European and global indicator sets for destination sustainability. The EC Tourism Sustainability Group (TSG) finalised a list of key sustainability indicators for destinations in 2011. Indicators from this list particularly relevant to planning and biodiversity are presented in Table 3.15. These indicators aim to provide a comprehensive overview of tourism management within a destination, including influence over indirect aspects, for example through the prevalence of green procurement (Table 3.15). TSG indicators therefore provide a useful framework to guide continuous improvement within destinations. Other indicators proposed by the EC TSG directly relevant to biodiversity and the provision of services (e.g. water consumption and water treatment) are reported in section 3.2 and section 3.3, respectively.

Table 3.3: Environmental indicators relevant to biodiversity management in destinations proposed by the EC Tourism Sustainability Group

Aspect	TSG indicators	Data sources
Inclusive Management Practices	– Percentage of the destination covered by a destination management organization or institutional arrangements involving public and private stakeholders in decision making processes for tourism development and promotion – Percentage of residents satisfied with their **i**nvolvement and their influence in the planning and development of tourism – Percentage of the destination with a sustainable tourism strategy/ action plan (with agreed monitoring and evaluation arrangement) – Percentage of official tourism information with a specific section about sustainability issues	Resident and business surveys
Sustainable tourism management practices in tourism enterprises	– Percentage of tourism enterprises/ establishments in the destination with externally verified certification/ labelling for environmental/sustainability and/ or CSR measures – Number of tourism enterprises /establishments with sustainability report in accordance with Global Reporting Initiative (GRI)	Business survey
Lights & Noise management	– Percentage of the destination and population covered by local strategy and plans to reduce noise and light pollution – Percentage of visitors and residents complaining about noise and light pollution	Visitor and resident surveys
Inclusive Management Practices	– Percentage of the destination covered by a destination management organization or institutional arrangements involving public and private stakeholders in decision making processes for tourism development and promotion – Percentage of residents satisfied with their **i**nvolvement and their influence in the planning and development of tourism – Percentage of the destination with a sustainable tourism strategy/ action plan (with agreed monitoring and evaluation arrangement) – Percentage of official tourism information with a specific section about sustainability issues	Resident and business surveys
Development Control	– Percentage of the destination with land use or development planning including evaluation of tourism impact and detailing the development and constraint issues in relation to tourism – Percentage of the destination with visitor management plan with capacity limits and analysis of current position (% of max capacity)	Public administration records
Tourism Supply Chain	– Percentage of tourism enterprises sourcing a minimum of 25% of food and drink produced locally /regionally – Percentage of local services and goods sourced locally in tourism enterprises – Percentage local tour handlers and guides used within the destination	Business surveys

NB: These indicators are subject to further revision, with a finalised list due in 2013.
Source: EC TSG (2011).

The Global Sustainable Tourism Council (GSTC) criteria have been developed through worldwide consultation with tourism stakeholders, and build upon decades of experience and existing guidelines and standards for sustainable tourism from around the world. They relate to:

- sustainable management
- socioeconomic impacts
- cultural impacts
- environmental impacts (including consumption of resources, reducing pollution, and conserving biodiversity and landscapes).

GSTC criteria are intended to provide a baseline of sustainability performance across environmental, socioeconomic and cultural aspects at the destination level, and may be adapted to local specificities (cultures, traditions, etc.) (GSTC, 2012). Draft criteria published for consultation in April 2012 will be updated, but may be used as an initial guide. Draft GSTC criteria particularly relevant to environmental aspects of destination planning are listed in Table 3.4.

Table 3.4: Draft Global Sustainable Tourism Council criteria partiuclarly relevant to implementation of Destination Plans

Criteria	Description
A1 Sustainable tourism strategy	The destination has established and is implementing a multi-year sustainable tourism strategy that is publicly available, suited to its scale, and that considers environmental, sociocultural, quality, health and safety issues, including cumulative impacts.
A2 Tourism management organization	The destination has a functioning organization responsible for a coordinated approach to sustainable tourism with involvement by the tourism sector, local government and community stakeholders with assigned responsibilities to accountable parties for managing environmental, socio-cultural, and sustainable tourism issues.
A3 Sustainable tourism monitoring	The destination has a program to monitor, publicly report and support response to the cumulative environmental, socio-cultural, and sustainable tourism issues at the destination level.
A4 Tourism seasonality management	The destination has programs designed to reduce the effects of seasonal variability of tourism where appropriate, while recognizing the ecological and cultural impacts of such programs.
A5 Climate change adaptation	The destination has a program to identify risks associated with climate change and to encourage adaptation in development, siting, design and management that will contribute to the sustainability and robustness of the destination in the face of potential changes
A6 Inventory of attraction sites	The destination has an ongoing process to identify its key tourism assets and attractions, as well as the key potential impacts (positive and negative) on them.
A11 Private sector sustainability	The tourism sector in the destination has implemented specific sustainable tourism policies or credible certification programs and quality assurance programs.
A14 Marketing for sustainable tourism	The destination has a program to develop and promote sustainable products and services compatible with its ecological, social, and cultural circumstances.
A15 Promotional materials	Promotional materials are accurate and complete with regard to the destination and its products and services, including sustainability claims. They do not promise more than is being delivered.
B9 Fair trade Principles	The destination has a program in place to support local small entrepreneurs and promote local sustainable products and services and fair-trade principles that are based on the area’s nature, history and culture (including food and beverages, crafts, performance arts, agricultural products, etc.).
D1 Environmental Assessment	The destination has identified its key environmental challenges and has policies and processes in place to address these.
D3 Energy conservation	The destination has a program to promote energy conservation, measure and reduce reliance on fossil fuels and encourage tourism enterprises to monitor and conserve energy and use renewable energy sources.
D4 Greenhouse Gas Reduction	The destination has a program in place to assist tourism operators to measure and reduce greenhouse gas emissions and encourage the tourism sector to participate in local carbon offset and abatement initiatives.
D10 Pollution reduction	The destination implements practices to minimize pollution from wastewater, run-off, erosion, noise, light, harmful substances, ozone-depleting compounds, and air, water and soil contaminants and requires tourism enterprises to adhere to these practices.
D12 Environmental management	The destination requires tourism enterprises to have an environmental management plan which includes vegetation, run-off, avoidance of the introduction of invasive species and other pollution control measures.

NB: Check GSTC (2012) for updated criteria.
Source: GSTC (2011).

Indicators relating to biodiversity conservation and management referred to in section 3.2, and indicators relating to infrastructure and service provision referred to in section 3.3, are also important components of Destination Plans.

Influencing tourism enterprises

The performance of destination managers in influencing the tourism destination can be represented by number of indicators, ideally relating to final performance across enterprises and tourist behaviour. For example, water (L) and energy consumption (kWh) per visitor day – the former is referred to in section 3.3. Other indicators of performance for which data may already be in existence include:

- percentage of accommodation enterprises that have been awarded an ecolabel (preferably an ISO Type 1 ecolabel such as the EU Flower)
- percentage of food and drink enterprises that have been awarded an ecolabel (preferably an ISO Type 1 ecolabel such as the Nordic Swan)
- percentage of beaches that have been awarded the Blue Flag ecolabel.

Indicators for sustainable food sourcing referred to in section 8.1 may also be used to indicate destination managers' performance in encouraging local and more sustainable supply chains.

Benchmark of excellence

Two benchmarks of excellence are proposed:

BM: implement a Destination Plan that: (i) covers the entire destination area; (ii) involves coordination across all relevant government and private actors; (iii) addresses key environmental challenges within the destination.

BM: destination managers report on all applicable indicators developed by the Tourism Sustainability Group and/or the Global Sustainable Tourism Council, at least every two years.

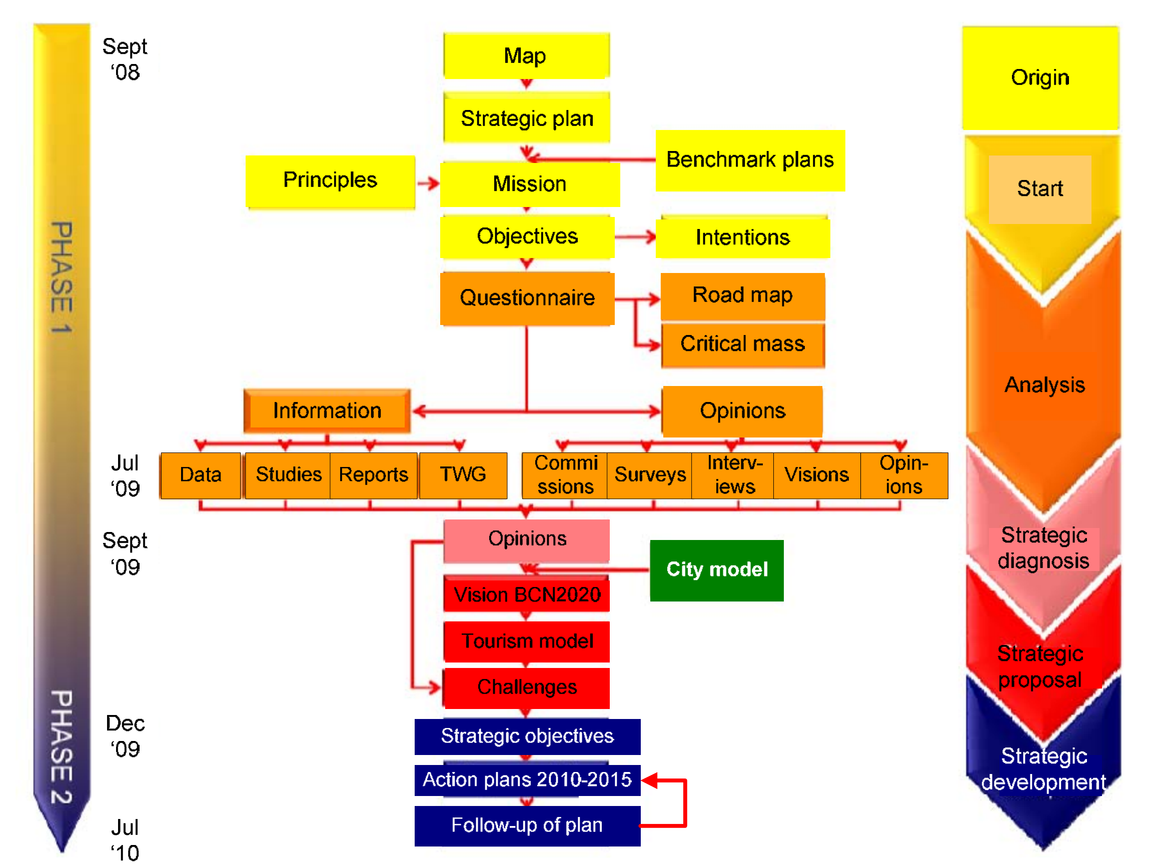
Cross-media effects

There are no significant cross-media effects associated with effective implementation of a Destination Plan. Correctly implemented, such plans should minimise the overall environmental burden generated by the destinaiton.

Operational data

Destination Management Organisation examples

The Turisme de Barcelona consortium is a DMO that was established from an agreement between Barcelona City Council and the Barcelona Chamber of Commerce to develop guidelines and operational organisation for Barcelona’s growth as a tourist destination, following the 1992 Olympic Games. Barcelona City Council commissioned a Strategic Plan from the Turisme de Barcelona consortium who coordinated an ad-hoc working group called 'the Plan Office'. The managerial structure of the Plan is organised around three main bodies: the Technical Committee, the Advisory Committee and the Board of Directors (Ajuntament de Barcelona, 2010). Figure 3.4 provides an overview of the Brcelona strategic tourism plan.



Source: Adapted from Ajuntament de Barcelona (2010).

Figure 3.4: Schematic summary of the strategic tourism plan for Barcelona

Fifteen programmes are included within the plan, all of which have some bearing on tourism sustainability. Three programmes that are of particular interest in relation to environmentally sustainable tourism development are referred to in Table 3.5. The plan involves a wide range of actors and a high level of strategic coordination. For example, a key component referred to in Table 3.5 is decentralisation of tourism, away from the traditional tourism centre (Ciutat Vella) towards other less visited neighbourhoods of potential interest to tourists. This requires coordinated actions to encourage both supply and demand in those areas (e.g. incentives for businesses to establish, marketing), and to accommodate associated pressures on e.g. public transport.

Table 3.5: Three of the 15 programmes contained within Barcelona's Strategic Tourism Plan

Programme	Main objectives	Actions
Neighbourhoods and districts	– To foster tourism in districts currently less well populated by tourists – To reduce pressure on tourism hotspot districts (e.g. Ciutat Vella) – To decentralise tourism and spread its effects across the city and wider area	– Neighbourhoods identify 'stories' and themes to attract tourists – Support for local tourism business initiatives – Promotion of less well known products and icons – Integrate new potential touristic neighbourhoods into district tourism plan
Ciutat Vella	– Preservation of this highly visited district – Minimisation of negative effects on residents and the local environmental – Restricting further tourism growth in this district	– Monitor tourist activities (accommodation, services) – Regulate tourism services (e.g. restrict permits) – Develop attractions on the periphery of the district – Stimulate debate on future management within the district
Environmental sustainability	– Include sustainability in the city's tourist and resident 'identity' – Protect the quality of life of current and future inhabitants – Identify key environmental indicators	– Assess and promote environmental assets within Barcelona – Disseminate good practices – Promote certification schemes
Source: Ajuntament de Barcelona (2010).		

Another example of DMO is the Cornwall AONB Partnership and Unit. County Cornwall is a popular tourist destination in the southwest of England where over 4.5 million visitors each year considerably increase the environmental pressures generated by the 540 000 residents of this rural county. Area of Outstanding Natural Beauty (AONB) designation identifies areas of the UK where natural landscape beauty must be conserved and enhanced by local authorities. The designation gives a formal recognition to an area's landscape importance and promotes the development of communities and economic activity in ways that enhance the landscape character of the AONB (Cornwall AONB, 2012). Twelve separate geographical areas covering a total of 958 km2 are designated as AONB in county Cornwall. These areas are managed through a multi-stakeholder management unit, the Cornwall AONB Partnership and Unit, comprising:

- Cornwall agri-food council
- Cornwall association of local councils
- Cornwall council
- Cornwall rural community council
- Cornwall sustainable tourism project (COAST)
- Cornwall Wildlife Trust
- Country land and business association
- English heritage
- Environment Agency
- Farming and wildlife advisory group (FWAG)
- National Farmers Union
- National Trust
- Natural England
- Rural Cornwall & isles of Scilly partnership (RCP)
- Visit Cornwall.

The AONB Partnership is constituted by a Memorandum of Understanding and a Statement of Intent, and is responsible for the design and application of the AONB Management Plan. The Partnership meets three times a year to discuss the prioritisation of actions and the implementation of the AONB Management Plan. The Partnership also has an advisory role, providing advice to Cornwall Council and other organisations on issues such as planning and development and project development. The individual AONB Partners lead and co-ordinate management within their own organisations (Cornwall AONB, 2012).

A small team of officers in the Cornwall AONB Unit includes staff with a wide range of expertise – ecology, landscape architecture, landscape planning, communications, project management and administration. The Unit administers the Partnership and supports organisations in delivery of the Management Plan. The AONB Unit also has specific advisory roles regarding monitoring, communications, planning & development and landscape character and also administers the Cornwall AONB Sustainable Development Fund (SDF) providing funds for specific projects (AONB, 2012).

The AONB Partnership and Unit Delivery Plan for 2011 – 2016 summarises the main actions undertaken as part destination management, and specifies associated progress indicators and responsible partners. These actions span the three BEMP sections included in this chapter for destination management. Table 3.6 summarises overarching actions particularly relevant with respect to implementation of an effective Destination Plan.

Table 3.6: Target actions, progress, responsible partners and role of Area of Outstanding natural Beauty (AONB) Unit identified in Cornwall's AONB Delivery Plan

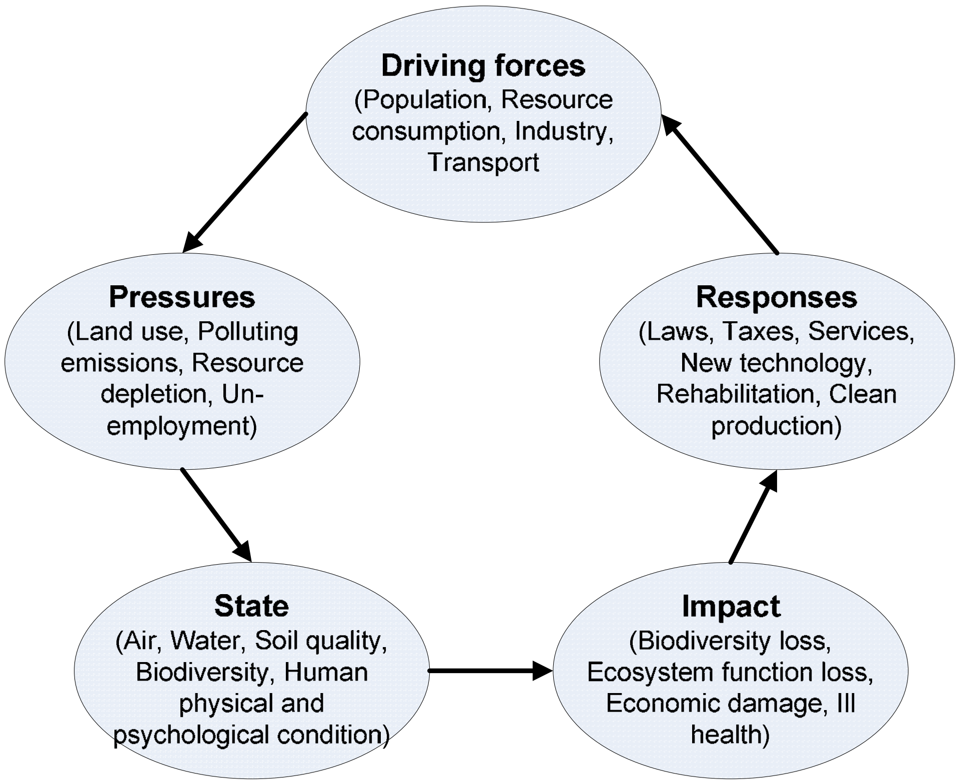
Aspect	Actions	Progress	Main partners	AONB Unit role
Climate change and energy	Identify best practice examples of energy conservation measures and renewable energy generation such as geothermal, solar thermal and photovoltaic panels that conserves the character of buildings and surrounding landscape. Develop associated general guidance for energy conservation and a demonstration project within the Cornwall AONB.	– Best practice example documents published to the web and promoted.	– Community – Energy Plus – Low Carbon Cornwall – Cornwall Council Environment Service	– Collate examples provided – Publish to AONB website
	Identify opportunities within the AONB for the adaptation of land to climate change, utilising ecosystem goods and services/valuing the environment approach (to locate habitats and features), as part of a wider Cornwall Green Infrastructure Strategy.	– A report on the opportunities for land adaptation in the AONB to inform the GI Strategy.	– Cornwall Council – Environment Service	– Support and encourage – Funding application
	Input into the Shoreline Management Plan (SMP) Action Plan to ensure the coastal character of the AONB is enhanced through any proposed action; engage in early discussions with Parish Councils and local communities regarding its implications and ensure the SMP is embedded within the Core Strategy.	– AONB input into the SMP Action Plan Project initiated with communities on planning for coastal change	– Cornwall AONB Unit – Environment Agency – Cornwall Council Environment Service – Cornwall Council Planning and Regeneration	– Project initiation – Steering group – Funding application
Community and Economy	Undertake an audit of the economic, social and environmental value of the AONB's in Cornwall in conjunction with a wider 'Valuing the Environment Study' and use this to ensure that the economic value of the AONB is recognised within the future Economic Strategy and by the Local Enterprise Partnership.	– Audit report produced – Meetings held with LEP – LEP and economic strategy focus in landscape	– Cornwall Economic Forum – Cornwall Council Environment Service – Cornwall AONB Unit	– Support and encourage – Funding application
	Collate and highlight best practice examples of businesses which directly rely on landscape and strengthen local distinctiveness and landscape character.	– Best practice examples collated and published to web and highlighted to relevant parties	– Cornwall Economic Forum – Cornwall AONB Unit	– Collate – Publish on AONB website – Publicise
	Input AONB and landscape objectives into the review of the Sustainable Communities Strategy.	– Meetings with Cornwall Strategic Partnership officers held – AONB objectives included in the review of the SCS	– Cornwall AONB Unit	– Advice provision – Consultation response
	Establish an annual Cornwall AONB forum, involving Parish Councils and Community Network Areas	– Forum initiated and held annually	– Cornwall AONB Unit – Cornwall Association of Local Councils	– Organisation and co-ordination

Aspect	Actions	Progress	Main partners	AONB Unit role
	Develop a project to trial approaches to self sustaining and low carbon rural communities within the AONB, where local people can live and work affordably, supported by landscape goods and services and an integrated 'total place' approach to the delivery of public services.	– Project initiated Parish(es) identified – Approaches trialled – Learning disseminated	– Rural Cornwall and Isles of Scilly Partnership	– Support and encourage – Assist project development – Funding application
	Develop training and skills in sustainable management practices for community volunteers and volunteer leaders within Cornwall AONB.	– Identify potential partners – Initiate steering group – Develop programme – Run training sessions	– Cornwall – AONB Unit	– Steering group – Training development – Advice and assistance
	Develop a project to produce community led, local level Parish Plans and Landscape / Village Design Statements for identified parishes within the AONB and embed within the Local Development Framework	– Project initiated – Parishes identified – Plans produced	– Cornwall Council – Planning and Regeneration – Cornwall Rural Communities – Council	– Project development – Support and encourage – Funding application
Sustainable tourism	Produce a yearly business plan to implement the Cornwall AONB Sustainable Tourism Strategy and Action Plan, ensuring integration with the Cornwall Tourism Strategy	– Meeting held AONB Strategy and Cornwall Tourism Strategy mutually supportive Actions into Cornwall AONB Partnership Action Plan	– Cornwall AONB – Unit – VisitCornwall – CoaST	– Lead – Produce Action Plan – Support and encourage implementation
	Undertake a pilot project to understand the carrying capacity of popular AONB tourist destinations. Monitor landscape quality and visitor numbers in these areas and target marketing efforts to ensure they remain in good condition	– AONB Honeypot sites identified – Carry capacity study/ survey undertaken – Condition monitoring – Marketing strategy – produced	– VisitCornwall	– Support and encourage
	Identify within the TRAC project opportunities to alleviate pressure on overused AONB tourist destinations and facilities	– Opportunities identified and actioned	– Cornwall Council – Environment – Service	– Support and encourage – Advice on AONB – destinations
	Establish a working group to co-ordinate the marketing efforts of VisitCornwall and the RDPE Sustainable Tourism Programme projects and other initiatives in order to ensure effective and joined up interpretation, marketing and signage (See Transport and Access)	– Working group established – Marketing plan produced – Design strategy produced	– Visit Cornwall	– Advice and guidance – Co-ordination
	Undertake a feasibility study on an AONB marketing scheme for sustainable/ GTBS tourism businesses and implement the results	– Survey undertaken – Feasibility study produced with recommendations	– VisitCornwall, CoaST and Cornwall AONB Unit	– Joint lead

Aspect	Actions	Progress	Main partners	AONB Unit role
		– Follow on project if required		
	Ensure representation from the Cornwall AONB Partnership on the VisitCornwall Partnership	– Representative on Partnership	– Cornwall AONB Unit and VisitCornwall	– Lead
	Initiate an interpretation/visitor information project for the Cornwall AONB which establishes local groupings of Tourism businesses and uses innovative tools such as Geocaching to interpret and provide information about the AONB	– Project initiated – AONB interpreted by AONB businesses	– VisitCornwall and Cornwall AONB Unit	– Project development – Funding application
	Adopt the Green Start programme and Green Edge training, incorporating information about the Cornwall AONB	– AONB information within programmes – Tourism businesses trained	– VisitCornwall and Cornwall AONB Unit	– Advice and guidance – Support and encourage
	Develop and run a programme of training in the tourism sector, building upon the BTEC in Sustainable Tourism and linking in with Green Start and Green Edge initiatives	– Training programme developed	– CoaST and VisitCornwall	– Support and encourage
Source: Cornwall AONB (2011)				

The DPSIR cycle

Effective destination management requires an understanding of the **driving forces** that generate **pressures** that affect the **state** of the destination's environment and population and may give rise to **impacts** that lead to **responses** – the DPSIR cycle (Figure 3.5). The compilation of information describing each of these stages, in the form of appropriate indicators, is critical to inform effective destination management. In addition, destination management requires the integration of tourism management with management of other sectors of the economy, and with sustainable development planning at the destination (local, regional and national) level.



Source: Adapted from EC (2007).

Figure 3.5: The DPSIR framework for assessing destination sustainability

Stages of destination plans

According to SCBD (2007) a Destination Plan comprises a number of features that may be categroised into four main stages (Table 3.7).

Destination Plans may involve multiple discreet projects with independent management, to assist management and financing, and should be regularly updated (at least every 3 – 5 years). Where possible, plans should be developed in a sequence, from the general (e.g. national and regional tourism plans focusing on policy, building standards and institutions) to the specific (local destination plans). The planning process should be continuous, transparent and flexible (UNEP, 2009). At the national level, UNWTO (2005) list the following key requirements for tourism to be integrated into sustainable development strategies:

- tourism should be given a clear, strong voice, with a direct link to top-level cabinet decision makers;
- there should be a formal structure and process for inter-ministerial cooperation on tourism;

- such relationships should be also reflected within and between lower level public agencies, such as tourist boards and environment agencies.

Table 3.7: Features of a Destination Plan according to SCBD (2007)

Stage	Features
1. Assessment of current situation	– an inventory of attractions, equipment, and other factors affecting a destination – an examination of the circumstances that mold and influence future development – a strategic analysis of bottlenecks, strengths, weaknesses, threats and opportunities in relation to the destination's competition
2. Identification of needs	– an examination of market trends and resident needs/expectations; – an assessment of the status and future needs in human resources and labour at all levels
3. Development of proposals	– an assessment of all existing and potential social, economic and environmental impacts from tourism, and mitigating and outreach strategies – proposed design and architectural guidelines for desired future development (defining priorities in terms of sites and investment attraction, building requirements and design principles, scale of development and tourism hubs, infrastructure requirements, products and marketing plans)
4. Identification of financing options	– consideration of payback mechanisms for maintenance (or restoration) of ecosystem services

Beyond inter-ministerial structures, ministries should collaborate to support or implement specific initiatives – e.g. agreements with local government, collaboration between government agencies. The formalisation of collaborative structures, agreements and actions through protocols or memoranda of understanding can enhance their effectiveness (see example of memorandum between tour operator and local tourism agencies in section 4.3).

<u>Stakeholder involvement</u>

At all levels, it is important for a wide range of relevant stakeholders to be engaged in the process (Table 3.8), preferably through formal or semi-formal groups, so that momentum and direction is maintained through political changes (especially following elections). Extensive consultation is also required to develop the understanding of resources, social and political dynamics, and the relative influence of different interest groups within a destination, necessary to devise durable and realistic plans.

Table 3.8: Potential stakeholders who may participate in the development of Destination Plans

Public sector	Private sector	NGOs	Communities	Tourists
Municipal authorities Regional authorities Various levels of government responsible for tourism and its key assets Other ministries and agencies in areas affecting tourism	Tour operators and travel agents Accommodation, restaurants and attractions, and their associates Transportation and other service providers Guides, interpreters and outfitters Suppliers to the industry Tourism and trade organizations Business development organizations	Environmental groups Conservation groups Other interest groups (hunters, fishers and sports/adventure associations)	Indigenous and local communities Local community groups Native and cultural groups Traditional leaders	Organizations representing tourists in the region and point(s) of origin International tourism organizations
Source: SCBD (2007).				

Applicability

Destination management may be implemented at multiple levels of public administration and by private-public partnerships. The most relevant levels of public administration involvement in relation to specific types of policy instrument are listed in Table 3.9. Areas of government relevant to different aspects of tourism management are listed in Table 3.10.

Table 3.9: Tools applicable at different management levels (most relevant level highlighted)

Tools	Applicable management level
Land use planning (including designation of protected areas)	National government, regional government, **local government**, local competent authorities
Policies related to sustainable development and/or tourism	**National government**, regional government, local government
Financial incentives or levies	National government, regional government, **local government**
Protected area access restrictions	Local government and **local competent authorities**
Provision of infrastructure and services	**Local government**

Table 3.10: Tourism management issues related to government area

Government area	Applicable management issues related to sustainable tourism
Tourism	– Overall development, coordination and implementation of tourism policy. Support for tourism development, management and marketing.
Prime Ministerial office	– Tourism's position within the overall balance of policies and priorities.
Finance	– Level of budgetary resources allocated to tourism. – Tax policy.
Trade	– Trade Terms of trade negotiations. – Export and investment promotion.
Economic	– Development Sustainable development policies. – Support for enterprise.
Environment and Natural Resources	– Regulation and control of environmental impact. – Conservation of biodiversity. – Protected area management. – Management of resources for ecotourism.
Transport	– Accessibility, traffic management and sustainable transport issues.
Culture	– Management and preservation of historic sites and cultural heritage.
Agriculture	– Rural development and supply chain issues.
Education	– Tourism training.
Health	– Safety and social security issues, for visitors and employees.
Sport and Recreation	– Promotion of attractions, activities, events, etc. Elements of domestic market.
Internal Affairs	– Crime and security. – Child protection.
Foreign Affairs	– Source country-destination relationships. – Visa requirements.

Source: UNEP and UNWTO (2005).

Economics
Costs associated with establishing a Destination Plan and DMOs vary depending on the size of the destination and the complexity of management structures, but are always small compared with possible benefits arising from:
- greater efficiency in the delivery of tourism services arising from coordination across relevant departments;
- avoided market and external costs associated with ecosystem damage and other environmental and health effects;
- increased tourism revenue arising from the development of a high quality tourism destination with protected natural resources.

Driving forces for implementation
Benefits of regional tourism planning listed by UNEP (2009) are:

- indefinite maintenance of natural and cultural resources upon which tourism is based
- optimisation of economic, social and environmental outcomes
- provision of a rational basis for decision making.

The first point is particularly important from an economic perspective: e.g. 50 % of Germans claim that they select tourism destinations based on the presence of a clean and intact natural environment.

Various legislation may require or encourage implementation of a destination plan, especially to protect HNV areas. For example, in the UK Local Authorities have a statutory duty under the Countryside and Rights of Way Act 2000 to produce a plan which sets out policies for managing the AONB.

Reference organisations

Reference organisations include Turisme de Barcelona and the Cornwall AONB Unit (described above), and organisations responsible for implementation of management examples referred to in Table 3.11.

Table 3.11: Case studies of possible best practice in sustainable tourism management

Location	Description
Bulgaria	Following two years of extensive consultation with stakeholders the Bulgarian government developed Bulgaria’s ten-year National Ecotourism Strategy, and associated five-year Action Plan (NESAP). The objective of the NESAP is to stimulate economic growth for communities situated near protected areas, strengthen local support for conservation and contribute to rural sustainable development. Crucially, the Bulgarian government ensured that the NESAP was integrated into relevant policies and agency remits, and engaged relevant stakeholders, by: • Establishing a National Ecotourism Working Group, composed of Environment, Water and Economy ministries, national, regional and local tourism associations and conservation NGOs, within the National Tourism Council. • Making it conditional on municipalities that they take the ecotourism strategy into account in preparing regional and local plans, and linking the spending of EU funds on priorities in these local plans. • Integrating ecotourism into the work of Regional Tourism Associations. • Involving the influential and respected Foundation for Local Government Reform at key stages in the formulation of the strategy and action plan. • Seeking to pave the way for ecotourism and sustainable tourism in the wider Balkans region, including close involvement with the Regional Environment Centre. Twelve ecotourism regions are defined based on geography and protected areas/cultural heritage sites, each of which has a regional ecotourism action programme. Six thematic working groups were established at national level to address information technology, production development and marking, funding and financial mechanisms, enterprise development, institutional development, and regional development. Instruments supporting NESAP implementation include a guidance manual for ecotourism development and a system of indicators to measure the impact of ecotourism products. Legislative changes made in support of NESAP implementation include: (i) the ability to award contracts to small tourism operators within protected areas, with earned revenue contributing to protected area management; (ii) modification of local government laws to enable hypothecation of tax revenue from tourism for local tourism-related infrastructure. *Source:* SCBD (2009), UNEP and UNWTO (2005).

Location	Description
Calvià, Majorca (ES)	Following a 20% decline in tourism in the Majorcan resort of Calvià between 1988 and 1991 as a consequence of environmental degradation, a forum of industry, government and community representatives initiated a local action plan for integrated sustainable development in the region, with an emphasis on tourism, that culminated in the Calvià Local Agenda 21 Action Plan being approved in 1997. The plan contained 40 initiatives under ten strategic lines: 1. To contain human pressure, limit growth and foster complete restoration of the territory and its coastal area. 2. To foster the resident population's integration, coexistence and quality of life. 3. To protect the natural and marine heritage and promote the establishment of a regional tourist tax to be used for the environment. 4. To restore the historical, cultural and natural heritage. 5. To promote the complete rehabilitation of residential and tourist areas. 6. To improve Calvià as a tourist destination, replacing growth with sustainable quality, increasing expenditure per visitor and seeking a more balanced tourist season. 7. To improve public transport and encourage people to walk or cycle in town centres or from one centre to another. 8. To introduce sustainable management into the key environmental sectors: water, energy and waste. 9. To invest in human and knowledge resources, to diversify the financial system. 10. To innovate municipal management and increase the capacity of public/private The plan resulted in growth regulating policy tools and an environmental protection measures such as: • the de-classification of 1700 hectares of land previously allocated for urban development, and removal unsustainable resort buildings; • creation of a marine park and terrestrial protected areas; • cessation of sea dredging, previously used to regenerate beaches; • implementation of recycling and urban waste reduction plans; • Creation of boulevards and pedestrian zones planted with trees. Plans to implement an environmental airport fee were scaled back due to resistance from local tourism enterprises and residents. By 2004, 13 500 m2 of buildings had been demolished and 50 000 m^2 of urban land had been saved from development. However, it has been noted that such improvement schemes cannot fully reverse the damage caused by lack of planning at the initial development phase. *Source:* UNEP and UNWTO (2005), SCBD (2009).
Croatia	Croatia has a large and expanding tourism sector, with 10 935 000 tourist arrivals in 2009 (RCCBS, 2009) attracted to Croatia's rich natural and cultural heritage. In order o manage this tourism, the Croatian Government developed a state-level tourism strategic framework, while local municipalities have produced tourism development master plans with medium term targets. Croatia's tourism master planning process was initiated in 2000, and has incorporated four key principles that are important for any tourism plans that incorporate environmental protection: • Local focus: many localities situated on the Adriatic coast (the most important tourist region of the country) developed their own master plans; • Stakeholder involvement: local master plans were developed with the involvement of a broad network of stakeholders, using workshops in cities, towns and villages ; • Structure and focus: master plans have focused on means by which competitiveness can be increased (e.g. vision and positioning, product plans, investment plans and action plans); • Pragmatic orientation: master plans are highly pragmatic, with a implementation-oriented approach (e.g. the Istrian master plan realized over 50% of its investments within the first three years of its implementation). *Source:* SCBD (2009).

Location	Description
La Garrotxa Territory (ES)	Tourism Garrotxa (The Association of La Garrotxa Territory Tourist Welcome) is a private non-profit association that has as its main objective the boosting and promotion of a model of sustainable tourism development of quality and respect for the environment, while following the criteria and strategic directives of the European Charter of Sustainable Tourism. For that purpose it acts as the European Charter Forum, bringing together the protected area administration of Zona Volcánica de la Garrotxa Nature Park, the 21 town councils, protected area administration, different local associations and educational institutions. Tourism Garrotxa coordinates members' efforts to put together an extensive programme of activities, which ranges from the production of publications to assistance at workshops, including advice to employers and the promotion of training among professionals in the tourism sector. *Source:* European Charter (2012).

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3.2 Biodiversity conservation nd management

Description

Biodiversity impacts arise directly through land clearing for development and damage from tourist activities (e.g. human or vehicle trampling and noise), via habitat fragmentation, and indirectly through induced water stress and climate change, and pollution of land, air and water. Biodiversity management is important for all destinations, and especially for high nature value (HNV) and protected areas. Measures to protect biodiversity can be taken at all stages of the tourism chain and all stages of destination development (see examples in Table 3.12). Through regulation, fiscal policies, coordination and guidance, public administrations and associated agencies can manage many aspects of tourism sustainability within destinations, and prevent or reverse biodiversity loss. The UNEP and UNWTO define five complementary types of policy instrument that can be used to make tourism more sustainable, all of which are applicable for biodiversity and protected area management (Table 3.12).

Table 3.12: The main types of instrument that can be used by destination managers to protect and manage biodiversity within destinations

Instrument types	Description	Examples
Measurement	Monitoring based on relevant indicators can be used to measure the impacts of tourism and track existing or potential changes.	– Sustainability indicators – Visitor monitoring – Carrying capacity
Command and control	These are instruments through which government is able to maintain strict control on development and operation, backed by legislation.	– Land use zoning and development control – (Local) regulations – Licensing of commercial operations – Permitting or prohibition of potentially damaging activities (e.g. offroad driving, heli-skiing, jet skiing)
Economic	These are about influencing behaviour and impact through financial means and sending signals to the market.	– Visitor or user fees – Environmental taxes
Voluntary	These instruments provide frameworks or processes that encourage stakeholders voluntarily to abide by sustainable approaches and practices.	– Guidelines and codes of conduct (e.g. for organisations and visitors) – Management systems (e.g. reporting and auditing) – Voluntary certification (e.g. ecolabels)
Supporting	These are instruments through which governments can directly or indirectly influence and support enterprises in making their operations more sustainable.	– Infrastructure provision and management (providing visitor infrastructure such as trails, bicycle hire and good public transport (also section 3.2) – Capacity building (also section 3.2) – Marketing and information services
Source: UNEP and WTO (2005).		

The provision of adequate infrastructure and services is an important measure to control biodiversity impacts within a destination that is addressed in section 3.3. The improvement of socio-economic conditions that can arise from well-managed tourism can also contribute to biodiversity protection, assuming the tourism use of natural resources is itself carefully managed (discussed in section 4.4).

The focus of this section is on planning and biodiversity conservation within tourism destinations, and the target audience is European destination managers within public administration or related agencies. Biodiversity 'hotspots' in developing countries under threat from tourism development are referred to in sections 4.3 and 4.4 targeted at European tour operators with influence over destinations outside Europe. There is considerable overlap between this BEMP and the BEMP for strategic destination development planning (section 3.1), infrastructure and service provision in destinations (section 3.2) and tour operator destination improvement (section 4.3). Meanwhile, best practice for local authority management of biodiversity is described in the SRD for public administration sector (EC, 2012). Biodiversity measures should be an integral part of Destination Plans (section 3.1) that guide the sustainable development of tourism at the destination level (SCBD, 2010).

Ecosystem approach

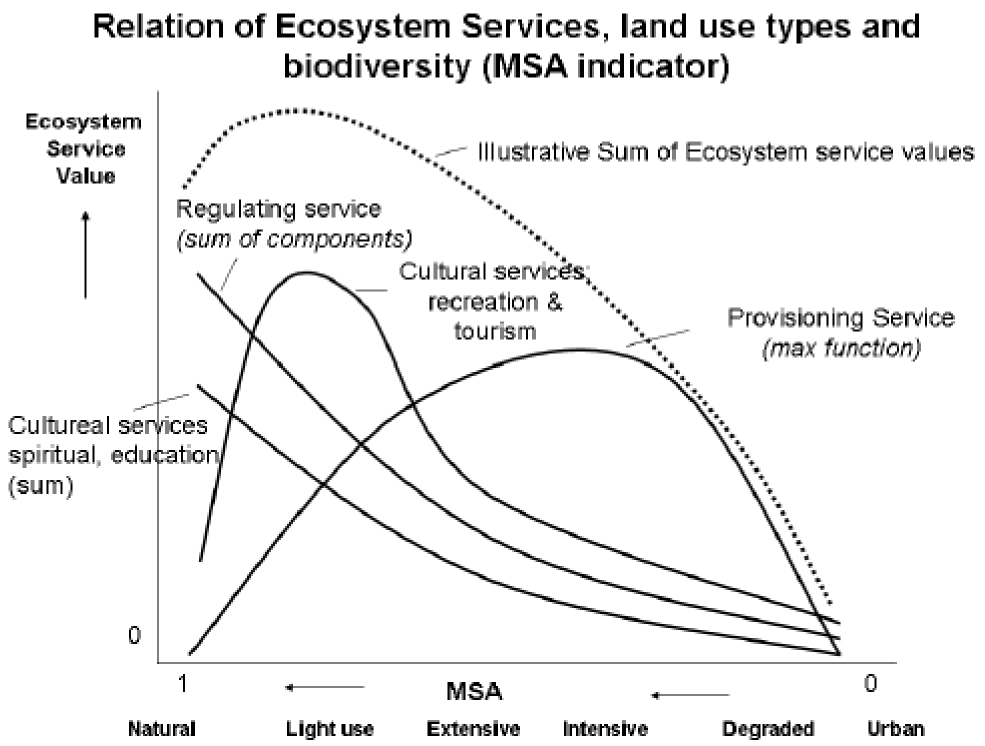
The evaluation of biodiversity condition and tourism pressures upon it within a destination is complex and often less quantitative than the evaluation of other environmental pressures such as energy and water consumption, waste generation and air or water pollution. Biodiversity is intrinsically linked with ecosystem functioning. The 24 ecosystem services defined by MEA (2005) underpin tourism and provide a possible framework for the valuation of biodiversity (Table 3.13).

Table 3.13: Ecosystem services defined by the Millenium Ecosystem Assessment report (MEA, 2005)

Provisioning services	Regulating services	Supporting services	Cultural services
– Food, fibre, fuel – Genetic resources – Biochemicals – Fresh water	– Invasion resistance – Herbivory – Pollination – Seed dispersal – Climate regulation – Pest regulation – Disease regulation – Natural hazard protection – Erosion regulation – Water purification	– Primary production – Provision of habitat – Nutrient cycling – Soil formation and retention – Production of atmospheric oxygen – Water cycling	– Spiritual and religious values – Knowledge system – Education/inspiration – Recreation and aesthetic value

Figure 3.6 shows how land appropriation results in a progressive reduction in ecosystem services such as cultural value and ecosystem regulation, but can increase ecosystem services related to human provisioning (including tourism and food production) up to a threshold of maximum use intensity. Notably, total and tourism-related service values begin to decline after only low intensity exploitation of ecosystem services.

Guidelines for managing tourism and biodiversity (SCBD, 2004 and SCBD, 2007) recommend the 'Ecosystem Approach' – defined as a strategy for the integrated management of land, water and living resources that promotes conservation and the sustainable and equitable use of natural resources. The Ecosystem Approach involves the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential processes, functions and interactions among organisms and their environment. However, the development of indicators capable of representing ecosystem service functions at a practical level is challenging, and there are currently no widely accepted indicators of ecosystem service provision (GRI, 2011). Therefore, whilst it is important for destination managers to appreciate the importance of ecosystem service provision and its dependence upon biodiversity and natural area protection, more practical biodiversity indicators are recommended to monitor and inform best practice for the time being (see below).



Source: Braat and ten Brink (2008).

Figure 3.6: General relationship between different ecosystem services, mean species abundance (MSA) and land use intensity

Whilst the development of widely accepted indicators for ecosystem services is ongoing, there is extensive literature documenting good and best practice measures with respect to biodiversity protection at the practical level (see Table 3.17, and the reference list at the end of this section). For example, International Guidelines for Sustainable Tourism developed by the secretariat of the Convention for Biological Diversity (SCBD, 2004 and SCBD, 2007) may directly inform destination managers of best practice.

Legal framework

Table 3.14 presents some legal frameworks potentially important for tourism and biodiversity planning at different levels. At the European level biodiversity strategy is summarised in the EU 2020 Biodiversity Strategy (COM (2011)244final). Environmental assessment of strategic plans at a regional level, as required under the SEA Directive and the assessment of projects under the Habitats and Birds Directive, may influence aspects of regional development related to destination management. Managers of tourism destinations falling within SACs and SPAs may have additional responsibilities to ensure adequate protection of the nature values in compliance with the provisions of the Nature Directives. Further information on the Natura 2000 network as well as several guidance and best practice documents can be found in www.ec.europa.eu/environment/nature/home.htm. Other European frameworks relevant to tourism and biodiversity planning include the European Fisheries Fund and the forestry policy.

It is important to note that best practice, by definition, goes beyond standard compliance with legislation, such as ensuring that Environmental Impact Assessments (EIAs) are produced for all relevant local plans. Specifically in relation to EIAs and SEAs, local authorities should require that all development proposals contain a comprehensive assessment of biodiversity impacts and mitigation options.

Table 3.14: International and European legal frameworks potentially important for tourism and biodiversity planning

<table>
<tr><th>Implem-entation level</th><th>Convention on Biological Diversity</th><th>Water Framework Directive (2000/60/EC)</th><th>Strategic Environmental Assessment Directive (2001/42/EC)</th><th>Environmental Impact Assessment Directive (85/337/EC)</th><th>Habitats Directive (92/43/EC & 2006/105/EC)</th><th>Birds Directive (79/409/EEC & 2009/147/EC)</th></tr>
<tr><td>Global</td><td>Conference of the Parties, Secretariat</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>EU</td><td rowspan="4">Ecosystem approach to management, promoted through European Charter for Sustainable Tourism in Protected Areas</td><td rowspan="4">Water management at level of River Basin District</td><td></td><td></td><td colspan="2">Natura 2000 Network of SACs and SPAs</td></tr>
<tr><td>National</td><td rowspan="2">Assessment of regional development plans</td><td></td><td>Special Areas of Conservation (SAC) designated by member states</td><td>Special Protection Areas (SPAs) designated by member states</td></tr>
<tr><td>Regional</td><td></td><td rowspan="2">Over 1 000 animal and plant species and over 200 habitat types protected</td><td rowspan="2">Activities subject to specific protection provisions</td></tr>
<tr><td>Local</td><td></td><td>Assessment of local project plans</td></tr>
</table>

Achieved environmental benefit

The primary environmental benefit of planning and biodiversity conservation is the conservation of natural resources, and associated biodiversity and ecosystem service provision, within the destination. This includes the absolute conservation, or enhancement, of protected and HNV areas. Best practice in biodiversity management is now defined by targeting a net gain in biodiversity (TWG, 2012).

Appropriate environmental indicators

Standardised international indicator sets

As referred to in section 3.1, the Commission's TSG and the international GSTC have developed (draft) criteria for sustainable management of tourism destinations. Relevenat criteria and indicators from these sources related to land planning and biodiversity are listed in Table 3.15 and Table 3.16, respectively.

Table 3.15: Environmental indicators relevant to biodiversity conservation and management in destinations proposed by the EC Tourism Sustainability Group

Aspect	TSG indicators	Data sources
Landscape and Biodiversity Protection	– Ecological potential index of the destination (guidance EEA) – Percentage of destination (geographical area in km^2) that is designated for protection – Percentage of local enterprises committed to actions to support local biodiversity and landscape protection, conservation and management – Percentage of visitors and residents complaining about litter and other environmental pollutions in the destination	Public administration records, visitor and resident surveys
Development Control	– Percentage of the destination with land use or development planning including evaluation of tourism impact and detailing the development and constraint issues in relation to tourism – Percentage of the destination with visitor management plan with capacity limits and analysis of current position (% of max capacity)	Public administration records
NB: These indicators are subject to further revision, with a finalised list due in 2013. *Source:* EC TSG (2011).		

Table 3.16: Draft Global Sustainable Tourism Council criteria partiuclarly relevant to land planning and biodiversity conservation

A7 Design and Construction	The destination has planning requirements and laws related to planning, siting, design, construction, materials, renovation, demolition and impact assessment to protect natural and cultural heritage.
A9 Local property rights	Property acquisitions are legal, comply with local communal and indigenous rights, including their free, prior and informed consent, and do not require involuntary resettlement.
C5 Site interpretation	Information about and interpretation of the natural surroundings , local culture and cultural heritage is provided to visitors in various languages as well as explaining appropriate behavior while visiting natural areas, living cultures, cultural heritage sites and communities.
C2 Visitor management plans	The destination has a visitor management plan for key attraction sites including measures to preserve and protect key natural and cultural assets.
C3 Visitor behavior and interpretation in sensitive sites	The destination has developed guidelines for interpretation and codes of behavior for visits to culturally or ecologically sensitive sites, in order to minimize visitor impact and maximize enjoyment.
D2 Ecosystem Protection	The destination has a system in place to measure the impact of tourism and manage intensive tourism impacts on landscapes and ecosystems, including sensitive and threatened wildlife and habitats.
D13 Conserving biodiversity, ecosystems and landscapes	The destination has in place a program to comply with international standards regarding the protection, harvesting, and captivity of wildlife (fauna and flora, habitats) and the management of impacts of tourism on wildlife.
NB: These are draft criteria. Check the web address in the text for the updated set. *Source:* GSTC (2012).	

Indicators of best practice

The baseline from which best practice should be assessed is full implementation of all relevant legislation (local, national, European) related to biodiversity protection. It is particularly important that biodiversity is adequately represented within Environmental Impact Assessments and Strategic Environmental Assessments. Beyond this, indicators of best practice include the following.

- Implementation of a destination level biodiversity conservation and management plan based on practices described in internationally recognised guidelines such as those of the SCBD (2005; 2007), including sub-indicators such as:

  - percentage of natural or protected land area within the tourism destination
  - number of native species present
  - abundance of indicator species
  - length of biotope corridors
  - integrate nature protection into green procurement criteria.

- percentage of tourism income (or tax revenue) to the destination allocated to programmes related to nature conservation
- percentage of residents and tourists reached by biodiversity public awareness campaigns.

As an example, Turismo de Portugal (2010) report that over 21 % of the surface area of mainland Portugal is classified as protected area under Natura 2000 and the National Network of Protected Area schemes.

Alternative holistic but less practical ecosystem indicators that may be used to support biodiversity protection objectives include:

- assessment of the contribution of natural resources and ecosystem functions towards the well-being of residents and the economy, including through tourism revenue
- assessment of acceptable limits of change informed by widespread consultation with destination stakeholders.

In practice, it may be difficult to isolate the effect of tourism from indigenous drivers of development and biodiversity, and the value of natural resources for tourists compared with other users. In cases where conflicts exist between recreational use, including tourism related activities, and conservation objectives, the aggregate pressure of local and tourist use may be referred to as 'visitation' pressure (STCRC, 2009).

Within cities, the percentage of green area (including green roofs), and the interconnectedness of green areas, are useful indicators of biodiversity management, as described in the SRD for Public Administration (EC, 2012). For example, in Barcelona city, 99.4 % of the population lives less than 300 metres from an open space (Ajuntament de Barcelona, 2009).

Benchmark of excellence

The benchmark referred to in section 3.1 relating to the periodic reporting on all applicable TSG or GTSC criteria is also applicable for best practice in biodiversity conservation. In addition, a specific benchmark for this technique is:

BM: minimise and compensate for any biodiversity displaced by tourism development so that destination-level biodiversity is at least maintained in high nature value areas, and increased in degraded areas.

Cross-media effects

Measures to protect biodiversity are rarely associated with significant cross-media effects. Zoning to protect high nature value areas may lead to more concentrated development that can have additional environmental benefits in relation to efficient service provision, but that may give rise to localised pressures (noise, air quality, etc.).

Operational data

Existing conservation guidance

There are a number of existing guidance documents that have been developed by various organisations to inform destination managers and other stakeholders of good and best practice in biodiversity management (Table 3.17). Destination managers should refer to these for guidance in relevant aspects.

Table 3.17: A selection of useful guidance documents to inform destination managers with respect to the management of biodiversity and ecosystem services

Documents	Summary	Target actors
Wildlife Watching and Tourism (CMS, 2006).	UNEP and CMS study on the benefits and risks of wildlife watching – a fast-growing tourism activity – and its impacts on species was released in 2006.	Any entity wishing to develop wildlife based tourism
CBD Guidelines on Biodiversity and Tourism Development user's manuals (SCBD, 2004; 2007; 2010).	The Convention on Biological Diversity (CBD), has published a number of manuals providing international guidelines and best practice advice for activities related to sustainable tourism development in vulnerable terrestrial, marine and coastal ecosystems and habitats of major importance for biological diversity and protected areas, including fragile riparian and mountain ecosystems.	Policy makers, decision makers and managers with responsibilities covering tourism and/or biodiversity
Tourism and biodiversity – mapping tourism's global footprint (Conservation International, 2003)	This UNEP publication published in 2003 shows the link between biodiversity hotspots and tourism, both in terms of threats and opportunities	Policy makers, protected area managers, local authorities, tourism managers
Linking Communities, Tourism & Conservation: A Tourism Assessment Process (CI, 2005).	Conservation International presents one of the topics addressed during its participatory workshops. It has been designed for field practitioners to perform a rapid assessment and analysis of tourism potential in a destination. It was published in 2005	Protected area managers, local or national authorities, tourism managers
Tourism Sector and Biodiversity Conservation Best Practice Benchmarking (EUBBP, 2011).	This sectoral guidance document includes examples of best-practice and provides companies with tools, methods and guidance to help them include biodiversity conservation in their strategies and operations.	Any tourism entities
Practical, profitable, protected: A starter guide to developing sustainable tourism in protected areas (Europarc Federation, 2012).	A practical manual on how to develop and manage tourism in protected areas. It is for all those responsible for the management of protected areas as tourism destinations.	Protected area managers, local or national authorities, tourism managers
Biodiversity check indicators (EBBC, 2011).	The European Business and Biodiversity Campaign produced a check list of indicators and questions to help tourism enterprises such as tour operators to manage their operations and supply chains with respect to biodiversity protection (see Annex 1).	Tourism enterprises, especially tour operators
Planning for biodiversity and geological conservation: a guide to good practice (DEFRA, 2006).	This guide provides good practice guidance, via case studies and examples, on the ways in which regional planning bodies and local planning authorities can help deliver UK national policies for biodiversity conservation and planning.	Local authorities
Integrating biodiversity into business strategies: The biodiversity accountability framework (Orée, 2008).	This document provides an overview of biodiversity pressures, and how all types of organisation can manage biodiversity. Case studies of good practice are referred to.	Any organisation
Sustainable coastal tourism: An integrated planning and management approach (UNEP, 2009).	The purpose of this handbook is to explain how the tourism sector can coordinate within the overall sustainable development of coastal zones. The document provides an introduction to the key tools for different stages of the planning process, and identifies stakeholders critical for the successful delivery of the sustainable coastal planning and development.	All tourism organisations in coastal zones

<u>Land use planning</u>

The single most effective measure to protect biodiversity within a destination is land planning, and specifically the zoning of land to designate protected areas and regulate the location, intensity and type of tourism development in accordance with ecological carrying capacities. To be most effective, land planning should be implemented continuously, and from an early stage of destination development. Land planning relates to both specific tourism developments (e.g. hotels) and infrastructure development that can increase the carrying capacity of an area (e.g. by providing adequate wastewater treatment: section 3.3) or lead to damage directly through habitat fragmentation and indirectly by facilitating access to sensitive areas (e.g. roads).

In order to fully consider and represent conservation concerns in decisions related to destination development, public consultation should be integrated into **all** levels of land use planning.

In the first instance, surveys of residents and visitors may be used to identify the main perceived threats to a destination (Table 3.18), thus informing the selection of priorities (landscape types to be protected, services to be developed) for destination development plans. Residents and visitors may also be asked for their perception on the current state of development within a destination (under developed, over developed), and the type of tourism development they would prefer (e.g. large hotels in towns, smaller hotels or lodges in small villages, etc.).

Table 3.18: An example of potential threats to visitor experience identified from a survey of visitors to the Otways region of Queensland

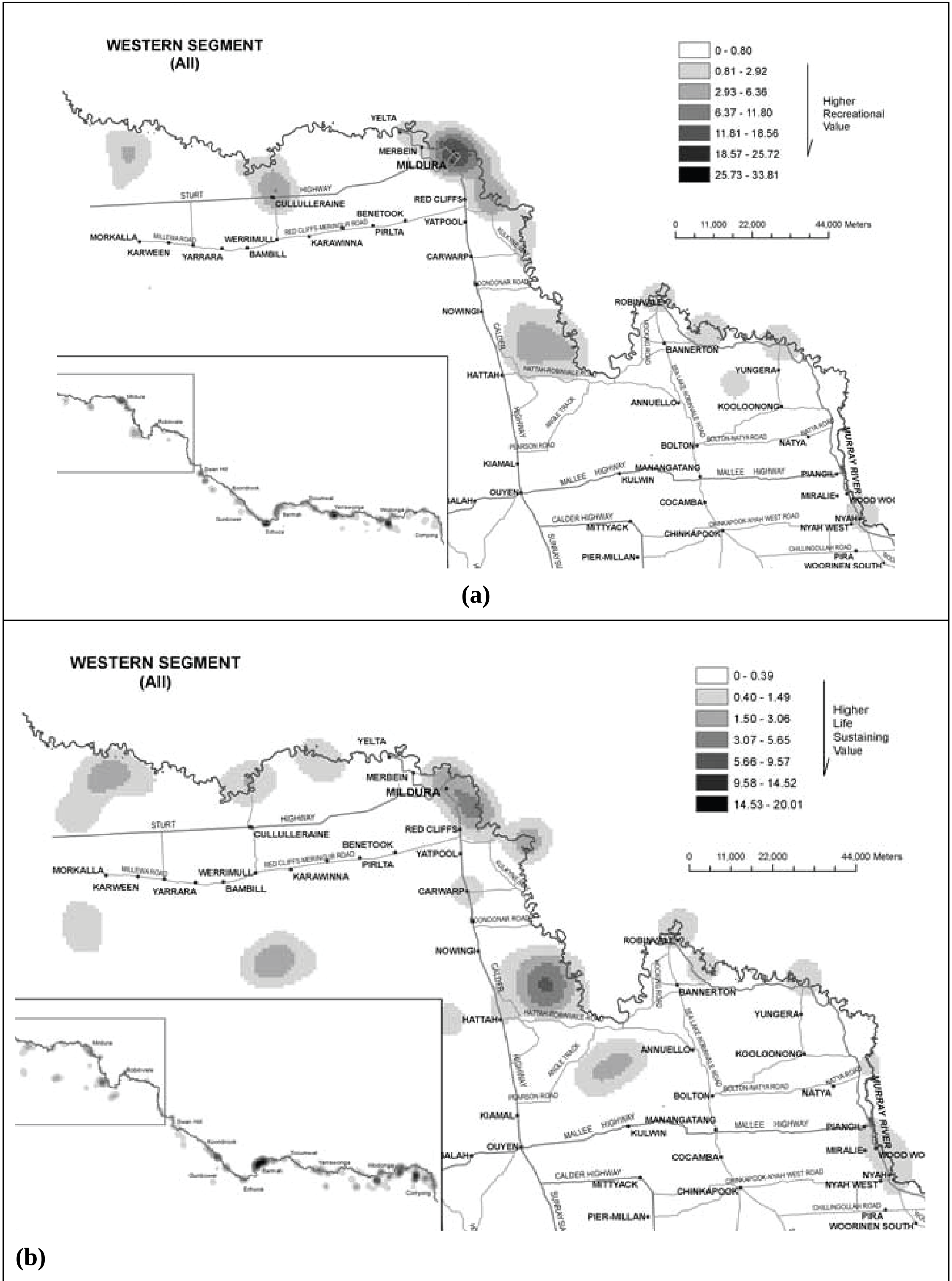
Threat	Mean((*))	Standard deviation	Rank
Loss of coastal scenery by development	1.77	0.915	1
Vegetation clearing	1.85	0.901	2
Other negative visitor/tourist behaviour	1.90	0.738	3
Poor national park management decisions	1.92	0.897	4
Commercial forestry	1.99	0.988	5
Increased number of residents	2.52	0.941	6
Poor quality of directional signage	2.53	1.042	7
Increased number of visitors	2.57	0.911	8
Poor quality of roads	2.59	1.063	9
Poor quality of tourism services	2.63	1.078	10
Prescribed burning in forest areas	2.85	1.056	11

((*))Mean values: 1 = 'Strongly Agree'; 2 = 'Agree'; 3 = 'Neither Agree or Disagree'; 4 = 'Disagree'; 5 = 'Strongly Disagree'

Source: STCRC (2009).

- Public consultation may also feed in to more detailed spatial mapping that identifies particular locations of high perceived value for conservation. STCRC (2009) described a methodology in which residents and visitors are provided with a landscape value typology and asked to classify locations they are familiar with on digital destination maps that are then statistically analysed using GIS. Some examples are provided for perceptions on recreational and life-sustaining values in Figure 3.7.

Figure 3.7: Examples of landscape mapping based on survey responses for the Murray River Reserves, Australia – recreational values (a) and life sustaining values (b)



Source: STCRC (2009).

Finally, and in accordance with existing practice in many locations, planning permissions for specific development projects should follow careful consideration of arguments arising from a transparent public consultation process.

Aspects of the Cornwall AONB Delivery Plan particularly relevant to land planning and biodiversity management are listed in Table 3.19.

Table 3.19: Land-planning related target actions, progress, responsible partners and role of Area of Outstanding natural Beauty (AONB) Unit identified in Cornwall's AONB Delivery Plan

Aspect	Actions	Progress	Main partners	AONB Unit role
Planning and Development	Support and engage in the preparation and implementation of the Green Infrastructure Strategy	– Green Infrastructure Strategy in production – Steering group meetings held	– Natural England – Cornwall Council Environment Service – Cornwall Council Planning and Regeneration	– Steering group – Advice provision
	Promote the use, and if required develop further, the methodology set down in 'Affordable Housing in Protected Landscapes: Assessing the Landscape Suitability of Potential Sites' in the selection of affordable housing sites. Consideration of landscape in affordable housing SPD.	– Methodology developed and used, within an appropriate document – Selection of appropriate sites within the AONB – Affordable Housing SPD produced that includes landscape as a consideration.	– Cornwall Council Planning and Regeneration	– Training and advice on methodology
	Consider the option recommended in the 'Taylor Review' (Recommendation 21) for the possibility, and legal basis, for trialling planning rules limiting change of use of full time homes to part time occupation (as second homes or holiday lets) in the communities that have a significant proportion of second homes.	– Paper and meeting to explore possibility – Legal investigation – Lobbying – Regulation in place	– Cornwall Council Planning and Regeneration	– Process initiation and support
	Pursue opportunities in conjunction with Western Power Distribution to 'underground' overhead lines.	– Undergrounding potential within the AONB identified and at least one scheme underway	– Cornwall AONB Unit – Cornwall Council Planning and Regeneration	– Identification of schemes – Liaison with utilities representatives, landowners and planning officers
	Support the preparation of a Cornwall Design Guide as a Supplementary Planning Document and promote the establishment of local design principles that take full account of historic character, local distinctiveness and natural quality for the 12 sections of the Cornwall AONB.	– Design guide for the 12 Sections of the Cornwall AONB produced and integrated with the Cornwall Design Guide.	– Cornwall Council Environment Service – Cornwall Council Planning and Regeneration	– Landscape and design advice – Funding application – Support and encourage
	Based on the local design principles, promote the preparation of planning guidelines for the 12 sections of the AONB in order to provide more detailed guidance in relation to the siting, design and materials for new buildings and conversions.	– Guiding principles for the Local Sections of the Cornwall AONB Management Plan further developed into planning guidelines and published with design guide.	– Cornwall Council Environment Service – Cornwall Council Planning and Regeneration	– See above

Aspect	Actions	Progress	Main partners	AONB Unit role
	Promote the adoption of the planning guidelines for the Cornwall AONB as a Supplementary Planning Document (SPD)	– Above guidance adopted	– Cornwall Council Planning and Regeneration	– See above
	Promote through the use of the ‘Cornwall Landscape Character Best Practice Guidance’ and the ‘Development Control Toolkit’ or other appropriate methodology, in the management of development in order to encourage appropriate site selection, high quality design and materials.	– Document promoted through training sessions	– Cornwall Council Planning and Regeneration	– Input into the draft document – Formulate and run training sessions
	Support, in the preparation of planning guidance for Community Infrastructure Levy/Planning Obligations, the promotion of Developers Contributions towards appropriate AONB Management Plan objectives.	– AONB contributions considered within guidance to planners	– Cornwall Council Planning and Regeneration	– Advice and guidance
	Deliver planning protocol and monitor consultation on emerging planning policy and selected planning decisions.	– Protocol signed by all relevant parties and implemented	– Cornwall Council Planning and Regeneration	– Support and encourage

Source: Cornwall AONB (2011).

An illustrative example of land zoning to protect natural areas is the land management and zoning plan for the Southern Red Sea Region of Egypt, initiated by the Tourism Development Authority in 2001, reported by UNEP and UNWTO (2005). Separate regulations for land planning, conservation and management were applied to five management zones that were classified according to their sensitivity to tourism use, following environmental surveys.

Further information on best practice in landuse planning with respect to biodiversity protection is provided in the SRDs for the building and construction sector (EC, 2012) and the public administration sector (EC, 2012). Three particularly relevant criteria for new developments referred to in those documents are:
a requirement for a minimum green area, including the incorporation of green/brown roofs and walls – see also section 9.2;

- a requirement for regeneration of an area of degraded land (e.g. abandoned industrial or agricultural land) to compensate for land occupation and biodiversity loss arising from a proposed development;
- establishment of 'blue-green networks' within heavily developed areas (i.e. interlinking corridors of semi-natural land and water bodies).

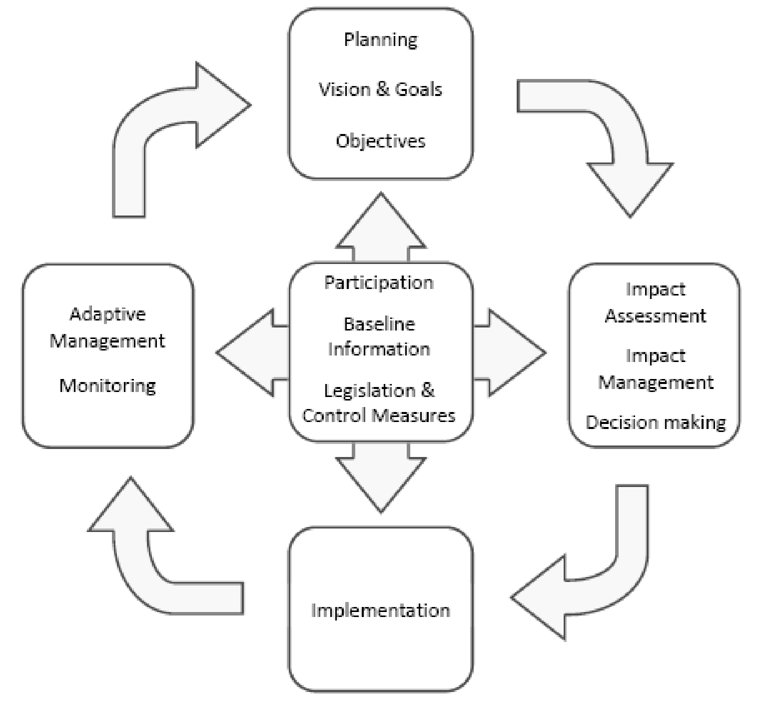
<u>Integration of biodiversity into Destination Plans</u>
The government of the Île de France region of France demonstrate best practice with respect to integration of biodiversity and conservation objectives into regional policy and planning (see case studies section). Some common pitfalls that impede full integration of biodiversity considerations into destination planning are listed in Table 3.20.

Table 3.20: Common pitfalls for the integration of biodiversity into destination management listed by SCBD (2010)

Actors	Common pitfalls
Planners	Fail to consider the motivation of local players and to engage local stakeholders in the planning process.
Managers	Do not allocate sufficient resources to ensure that project activities are successfully devolved to relevant local agencies and institutions (e.g. enterprises, government or government agencies, NGOs).
Tourism marketers	Ineffective marketing of sustainable tourism products, often owing to insufficient private-sector engagement.

Figure 3.8 and Table 3.21 summarise the planning cycle that may be used to integrate tourism and biodiversity planning. SCBD (2007) suggest that concepts such as 'carrying capacity' are difficult to define in relation to tourism, emphasising the importance of continuous monitoring and assessment of impacts, and stakeholder feedback in the planning cycle to ensure that total impacts do not exceed acceptable thresholds. New information on the state of biodiversity and associated ecosystem services, and impacts on them, should be used to revise assumptions, modify objectives, adjust management actions, and alter products as appropriate.

Objectives and associated actions in the planning cycle should be SMART: Specific (who, what, when, where and why); Measurable (using appropriate indicators); Achievable (according to professional judgement based on available resources); Results-oriented (specify end result); Time-tabled.



Source: SCBD (2010).

Figure 3.8: The planning cycle for integrated tourism and biodiversity planning

Table 3.21: Stages and tasks of CBD Guidelines for biodiversity management in tourism

Stage	Tasks
Baseline information	– Review all aspects of the baseline information (considering credibility, reliability, and all sources of knowledge and relevant information obtained) – Identify gaps that need to be filled by further research and information-gathering.
Visions and goals	– Discuss, prepare and agree on an overall vision for sustainable management of biodiversity and tourism (eg. through local level meetings and workshops).
Objectives	– Establish objectives based on the vision and goals.
Impact assessment	– Identify indigenous and local community members, experts, organizations, and relevant stakeholders – Establish the terms of reference for the conduct of the impact assessments, subject to national legislation.
Decision making	– Enable stakeholders to participate in the decision-making process.
Implementation	– Enable stakeholders to express their wishes and concerns to those managing tourism facilities and activities from the early development stage, throughout the operational stages, and during any decommissioning or closing stages. This can occur given that clear and adequate information regarding implementation is provided for review by the stakeholders, in forms that are accessible and comprehensible to them.
Monitoring and reporting	– Enable stakeholders to participate effectively in monitoring, evaluation of monitoring information, where necessary adjustment of management measures to avoid or minimise adverse impacts that may be detected.
Adaptive management	– Assist in the management and create dialogue on maintenance of the balance between tourism and biodiversity

Source: SCBD (2007).

Various specific planning methods employed to integrate biodiversity and tourism management are listed in Table 3.22. The UNEP (2009) provide guidance on sustainable coastal tourism with an emphasis on the Integrated Coastal Zone Management (ICZM) approach – this is particularly relevant for the many coastal tourism impact hotspots in Europe, especially in the Mediterranean region. The following key references provide useful guidance on biodiversity monitoring and reporting: MEA (2005); SCBD (2007); SCBD (2010); UNEP and UNWTO (2005); UNWTO (2005).

Table 3.22: Planning methods that can be used to integrate tourism and biodiversity planning

Method	Features
ROS, Recreational Opportunity Spectrum; LAC, Limits of Acceptable Change; VIM, Visitor Impact Management Model	The ROS, LAC and VIM planning methodologies operate by identifying limits to address the requirements and objectives for resource protection and conservation, and resource use. They incorporate social and environmental factors. The methodologies recognize differences in priorities of different groups that result in different judgements regarding the balance between resource conservation and use.
TOMM, Tourism Optimization Management Model	The TOMM methodology was adapted from LAC in order to put more emphasis on sustainable outcomes from the community perspective and sets acceptable ranges rather than limits, with a focus on desired outcomes from the communities' viewpoint.
PAVIM, Protected area Visitor Impact Management	PAVIM was developed for destinations that have less staffing and financial resources. PAVIM also incorporates impact problem analyses, the flexibility of multiple strategy selection and public involvement. It recognises management constraints and is quicker, easier and more cost-effective to implement.
VERP, Visitor Experience and Resource Protection	VERP was created to deal with carrying capacity in terms of the quality of the resources along with the quality of visitors experience. It addresses desired future resource and social conditions by defining what levels of use are appropriate, where, when and why. It is seen as a component of LAC.
Source: SCBD (2007).	

Indicator species can be chosen to monitor ecosystem health. The species should be chosen based on information from biodiversity surveys to represent either overall species abundance and diversity within the system, or the abundance of the most unique and/or sensitive species in the system.

Specific measures that can be taken by local authorities to reduce biodiversity impacts, or to compensate for biodiversity loss in a particular development, are described in the SRD for public administration (EC, 2012). Such measures may include the development of green-blue networks (corridors) through urban areas (EC, 2012), the construction of 'fish ladders' at hydro-power sites, the construction of wildlife crossings across roads and railways to reduce fragmentation effects.

Cornwall's AONB Delivery Plan provides a useful illustrative example of how biodiversity can be integrated into destination planning (Table 3.23). It is important that Destinaiton Plans: (i) contain specific management actions targeted at specific landscape and habitat types (see 'aspects' in Table 3.23); (ii) address all major activities within the destination that have a strong influence on biodiversity protection (Table 3.23). These include activities directly, indirectly and not related to tourism. For example, farming, food and forestry has a major influence on biodiversity, and is indirectly related to tourism (farming provides food for tourism services; forestry management may include provision of paths for walking and cycling).

Table 3.23: Biodiversity related target actions, progress, responsible partners and role of Area of Outstanding natural Beauty (AONB) Unit identified in Cornwall's AONB Delivery Plan

Aspect	Actions	Progress	Main partners	AONB Unit role
Biodiversity and Geodiversity	Building on emerging visions for Bodmin Moor and West Penwith and the South West Nature Map, identify priority biodiversity AONB areas and, with communities and land managers, develop spatial visions for landscape scale biodiversity management and habitat recreation	– Map produced showing priority – areas	– Natural England The Cornwall Biodiversity Initiative	– CBI steering group
	Develop a suite of landscape scale biodiversity projects as part of the Cornwall BAP 4 which aim to link habitats around the coast, intertidal habitats and along river valley corridors, extending these linkages beyond AONB boundaries	– Projects developed and into BAP 4 – At least 1 landscape scale project initiated	– The Cornwall Biodiversity – Initiative	– CBI steering group – Project steering group – Support and guidance
	Provide a response to consultations on Common Agricultural Policy reform to ensure that future Agripayments schemes continue to deliver biodiversity benefit	– CAP reform consultation response produced and submitted	– Cornwall Wildlife Trust	– Support and encourage
	Undertake audit and research on the perceptions and attitudes of communities and visitors on grazing animals and the issue of grazing within habitat management, applying the knowledge to demonstration sites	– Audit report produced with recommendations and widely – disseminated	– Natural England – Cornwall Wildlife Trust – The National Trust	– Support and encourage
	Continue to develop and improve an active data management partnership between biodiversity and geodiversity conservation organisations and research establishments	– Partnership meetings held	– ERCCIS – The Combined Universities of Cornwall – Cornwall Council Environment Service	– Partnership membership
	Work with partners such as the Cornwall Knotweed Forum to manage non native invasive species and their impacts	– Partnership meetings held	– Cornwall Council Environment Service	– Support and encourage
	Produce a robust and defensible Green Infrastructure Strategy that specifies and defines seminatural habitat corridors and ensure that this informs the Local Development Framework, in conjunction with the Biodiversity and Geodiversity Bes t Practice Guide	– SN habitat corridors within the AONB identified and inputted into the GI Strategy – (see A/LS2 and – A/CCE2)	– Cornwall Wildlife Trust Cornwall Council – Environment Service Cornwall Council – Planning and – Regeneration	– Support and encourage – Funding application
	Support the development and adoption of the Biodiversity and Geodiversity Best Practice Guide within the emerging Local	– Meetings held with planning officers Guidance adopted	– Cornwall Wildlife Trust – Cornwall Council Planning	– Support and encourage

Aspect	Actions	Progress	Main partners	AONB Unit role
	Development Framework		and Regeneration	
	Input into the 'Finding Sanctuary' project in order to identify a suite of marine protected areas around the AONB coastline	– Collective response to Finding – Sanctuary	– The Cornwall Biodiversity – Initiative Cornwall Council – Environment Service	– Encourage and co-ordinate
Landscape and Seascape	Improve the existing Landscape Character Assessment and undertake a Seascape Assessment of Cornwall's coast and marine environment, ensuring full integration between land and sea based assessments	– LCA Field survey repeated and – verified – Seascape assessment of Cornwall Coast initiated Improved web access	– Cornwall Council Planning and Regeneration – Cornwall Council Environment Service – English Heritage	– Initiate projectgroups and support
	Undertake an audit of the 'Ecosystem Goods and Services' provided by the landscapes of the Cornwall AONB as part of the work on the Cornwall Green Infrastructure Strategy	– A report on the value and benefits of the AONB to inform the GI Strategy	– Cornwall Council Environment Service	– Support and encourage – Funding application
	Develop a Landscape Strategy for Cornwall's landscape, as part of the Green Infrastructure Strategy, which addresses the needs of the protected landscape and develops a strong, collective vision for landscape within Cornwall.	– A section on landscape, including the management of the AONB protected landscape, within the Green Infrastructure – Strategy – Progress on achieving buy in by stakeholders	– Cornwall Council Environment Service	– Support and encourage – Provide specialist advice on the AONB landscape
	Produce landscape sensitivity and capacity studies for renewable energy and housing development; specifically a sensitivity study on wind and solar PV, including guidance on the siting and design of smaller scale wind turbines and PV panels within the protected landscape. Embed within the emerging Renewable and Low Carbon Energy Supplementary Planning Document	– Landscape Sensitivity Study on PV and wind completed and map / report produced	– Cornwall Council Planning and Regeneration	– Steering group membership and advice provision
	Further develop and finalise the 'Cornwall Landscape Best Practice Guidance' and 'Development Management Toolkit' and provide training for planners and planning committee members	– Final guidance published Training sessions held for planners and planning committee – members	– Cornwall Council Environment Service – Cornwall AONB Unit – Cornwall Council Planning and Regeneration	– Input into the draft document – Formulate and run training – sessions
	Monitor upon the set of indicators established by the Cornwall AONB Monitoring Project and the information gathered for the Cornwall AONB Atlas. Report on change from the original baseline	– Monitoring plan produced – Data on indicators analysed – Report on change produced – Cornwall AONB Atlas	– Cornwall AONB Unit – Cornwall Council Intelligence Unit	– Initiate and complete project – Liaise with consultants on – data analysis, report production and Atlas

Aspect	Actions	Progress	Main partners	AONB Unit role
		updated		update
Rivers, Coast and marine	Building on the work of the Cycleau project, undertake an audit of the condition, management and multi-use benefits of the Fal, Helford, Camel and Fowey catchments, making recommendations for improved integrated management, including guidance to farmers	– Audit undertaken and brought – together on the web – Report produced with recommendations – Working group set up to deliver – associated advice	– Environment Agency – Natural England	– Support and encourage
	Audit and monitor recreational boating and moorings, aquaculture and other operations such as dredging within AONB estuaries	– Monitoring indicators and a plan in place, within AONB monitoring – Dataset produced and added to the AONB Atlas	– Cornwall AONB Unit	– Lead
	Develop a pilot project as a case study for Integrated Coastal Zone Management and ensure ICZM is embedded within the Local Development Framework	– Case study area identified – Working groupestablished – Pilot project initiated – ICZM Plan produced for case study area	– Cornwall Council Environment Service – Environment Agency – Cornwall Council Planning and Regeneration	– Initiate steering group – Support and encourage
	Develop a pilot project for the rationalisation of beach infrastructure and signage within the AONB and produce associated design guidance, linked to the Cornwall Beach Management Plan	– Working group for pilot project – Pilot project initiated – Project recommendations – and design guidance note produced – Working group established to – implement design recommendations	– Cornwall Council Environment Service – Environment Agency	– Advice and guidance – Support and encourage
	Continue to support the work of Clean Cornwall and initiatives to reduce beach and marine litter	– Meeting held – Litter events organised	– Cornwall Council Environment Service	– Support and encourage
	Identify opportunities through the management of Marine Conservation Zones to enhance coastal character and tranquillity via The management of recreational boating and other activities.	– Management arrangements identified and implemented	– Natural England – Cornwall Council Environment Service	– Support and encourage

Aspect	Actions	Progress	Main partners	AONB Unit role
	Establish a Maritime Forum to promote collaborative working between groups and forums with an interest in the coast and marine issues	– Maritime Forum created – Meetings held – AONB Partnership represented on the Forum	– Cornwall Council Environment Service	– Support and encourage
	Produce a Cornwall Maritime Strategy in Partnership with stakeholders and communities which recognises the role of the AONB designation	– Maritime Strategy produced in draft – AONB Partnership input into the draft – AONB recognised within strategy	– Cornwall Council Environment Service	– Co-ordinate – Partnership response and submit
	Identify the priorities for the AONB for the Marine Plan and feed into its policy preparation in liaison with the Marine Management Organisation	– Report produced – Priorities fed in via appropriate channels	– Cornwall AONB Unit – Cornwall Council Environment Service – Cornwall Council Planning and Regeneration	– Lead and liaison – Produce document
Farming, Food and Forestry	Increase the take up of the entry level, organic entry level, upland entry level and higher level schemes on AONB farms, securing appropriate resources for advice providers	– Uptake increased from current levels	– Natural England	– Support and encourage
	Provide advice and guidance on the conservation and enhancement of landscape character within the Higher Level Stewardship schemes, utilising the Natural England targeting statements	– Meetings held to discuss landscape enhancement within HLS – Guidance note produced and used in discussions	– FWAG	– Advice provision – Co-ordination – Support and encourage
	Input into Common Agricultural Policy reform to ensure the continuation of support for farmers which enables landscape enhancement and climate change mitigation, building on the past successes of the Environmentally Sensitive Areas Scheme in West Penwith	– Consultation response on CAP reform submitted	– Natural England – The Cornwall Agri-food Council – The National Farmers Union	– Support and encourage
	Investigate the feasibility of using the AONB designation to sensitively market local food producers within the AONB, whose operations enhance landscape character and local distinctiveness	– Feasibility study produced and recommendations initiated	– Cornwall AONB Unit – Cornwall Agri-food Council	– Lead project development – Advice and guidance – Funding application
	Update the Miscanthus landscape sensitivity study produced by Land Use Consultants for Cornwall County Council, expanding to include other energy crops such as short rotation coppice	– Study updated	– Cornwall Council Environment Service	– Support and encourage

Aspect	Actions	Progress	Main partners	AONB Unit role
	Identify opportunities for new woodland creation including commercial plantations in appropriate locations	– Study produced – Possibility of embedding in GI Strategy investigated	– Forestry Commission – Cornwall Council Environment Service	– Support and encourage
	Develop a project with the wood products sector and The Silvanus Trust to encourage the sustainable use of the AONB's timber resource including improved access for management	– Discussions held – Funding application – Project initiated	– Cornwall Council Environment Service	– Co-ordinate – Support and encourage
	Undertake an audit of the technical and financial skills of rural businesses within the AONB and provide appropriate training to fill gaps, utilising existing funding mechanisms through the RDPE	– Audit completed – Gap analysis completed – Training developed – Training held	– The Cornwall Agri-food – Council – Duchy College	– Support and encourage
	Produce guidance and training for planners on planning and agricultural infrastructure such as anaerobic digesters, slurry storage facilities and farm building diversification with respect to the protected landscape and ensure that this is embedded within the Local Development Framework.	– Meetings held with planning officers – Project to produce guidance formulated – Guidance produced – Training delivered	– The Cornwall Agri-food Council – Environment Agency	– Advice and guidance – Support and encourage

Source: Cornwall AONB (2011).

Management of protected areas

Managers of destinations within protected areas have greater responsibilities, and may face particular challenges, in managing the biodiversity impacts of tourism. The European Charter for Sustainable Tourism in Protected Areas was developed under the leadership of the Europarc Federation following five years of research and consultation, and directly addresses a number of key principles elaborated in the CBD's sustainable tourism guidelines (SCBD, 2004 and SCBD, 2007). The Charter contains ten principles for sustainable tourism, including: (i) respect the limits of carrying capacity; (ii) contribute to heritage conservation and enhancement; (iii) preserve natural resources; (iv) make protected areas accessible to everyone; (v) encourage behaviour that respects the environment.

In 2011 the Charter Network (protected areas awarded with the Charter) comprised 440 members managing high nature value areas in 36 countries across Europe, and Charter implementation represents numerous aspects of best practice in destination management. To be awarded the Charter requires:

1. Demonstration of continuous collaboration between the protected area authority, local municipalities, conservation and community organisations and representatives of the tourism industry.

2. Development of a sustainable tourism strategy and action plan for the protected area, based on consultation with stakeholders, and containing:

- a definition of the area to be influenced by the strategy, which may extend outside the protected area
- an assessment of the area’s natural, historic and cultural heritage, tourism infrastructure, and economic and social circumstances; considering issues of capacity, need and potential opportunity
- an assessment of current visitors and potential future markets
- a set of strategic objectives for the development and management of tourism, covering:
    - conservation and enhancement of the environment and heritage
    - economic and social development
    - preservation and improvement of the quality of life of local residents
    - visitor management and enhancement of the quality of tourism offered
    - an action plan to meet these objectives
    - an indication of resources and partners to implement the strategy.
    - proposals for monitoring results.

Table 3.11 in section 3.1 and Table 3.25 below provide some examples of protected areas within the European Charter network . One partilcularly interesting application of technology to reduce damage by visitors whilst enhancing their experience is the provision of Personal Digital Assistants (PDA) with GPS connectivity in order to provide visitors with route information for trails in natural park areas (see example of Peneda-Geres National Park trails in Table 3.25).

Some examples of tourism control measures in protected areas are provided in Table 3.4. Various voluntary mechanisms may also be used, such as certification or award schemes for tourism enterprises – these are explored in more detail in section 4.2 and section 4.3.

Table 3.24: Measures that can be used to control tourism impacts in protected areas

Category	Control measure
Spatial	Designation of areas where an activity may or may not occur
Temporal	Seasonal cycle – exclusions at sensitive times Diurnal cycle – separation of activities Time within which activity must occur Duration of permit or decision before review or renewal
Impact	Require works or actions to include assessments and measures to limit adverse environmental impacts
Equipment	Required equipment health and safety waste, water cycle/sewerage monitoring Prohibited/restricted equipment vehicles weapons
Intensity / volume quotas	Visitor numbers overall/cumulative- per year, month week site, maximum number at one time activity, maximum number at one time
Knowledge / qualifications	Operator competence (certification) Visitor information on conditions of entry Visitor information on activities and attractions
Management actions	Monitoring Management of compliance with conditions
Source: SCBD (2007).	

Applicability

Biodiversity conservation is relevant to both urban and rural destinations, though different specif measures apply (see above).

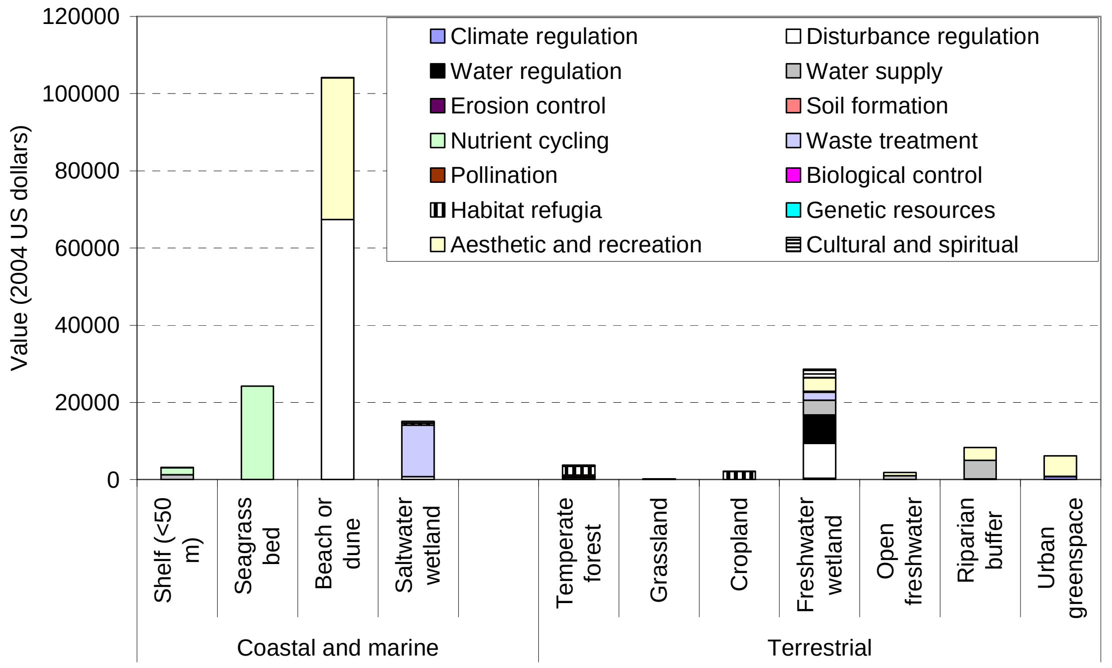
The organisations and sub-departments involved in biodiversity conservation are similar to those responsible for implementation of Destination Plans (see section 3.1)

Economics

Economic value of natural ecosystems

Assessing the contribution of biodiversity towards well-being and the economy is challenging given the multitude of ways in which biodiversity contributes towards these factors, and unquantifiable potential future and intrinsic values. However, some studies have attempted to monetise ecosystem values.

Brenner et al. (2010) estimated that Catalan coastal systems delivered an economic value of over EUR 2 573 million to citizens in 2004 (Figure 3.9), through ecosystem services such as protection against disturbances including storms and hurricanes (EUR 62 324 per hectare per year). Beach and dune areas were found to provide the highest benefit per hectare (EUR 83 820 per hectare per year), whilst temperate forest had the greatest total worth.



Source: Derived from data in Brenner (2010).

Figure 3.9: The value of ecosystem services provided by different habitats along the Catalan coast

SCBD (2009) quotes the economic value of coral reefs, largely generated through nature tourism, at US$ 30 billion per year globally, or US$ 100 000 to US$ 600 000 per km2 per year. This compares with an estimated protection cost of US$ 775 per km2 per year.

Consequently, costs associated with conservation measures should be balanced against the value of ecosystems being protected. From a public (authority) perspective, the costs of inaction are likely to be higher than the costs of action. Braat and Brink (2008) estimated that the continued degradation of ecological services up to 2050 could result in a loss of economic value of up to 7 % of global GDP. Further information on the economics of biodiversity loss is available at: http://ec.europa.eu/environment/nature/biodiversity/economics/teeb_en.htm. Meanwhile, the WBCSD (2011) provides a guide for corporate ecosystem valuation.

Tourism revenue for conservation

Well managed tourism can support biodiversity conservation through the provision of funds, although SCBD (2007) note that tourism revenue rarely provides a major portion of site management costs, and often does not even cover the costs of tourism-related impacts. Evaluation of the potential for tourism to contribute to the conservation of a protected area should consider:

- the existence of a realistic actual or potential demand from tourists visiting the site
- the potential for tourism to be operated at the site as a viable business (whether it is run directly by the site, or by tourism enterprises).

When assessing the potential conservation value of a natural amenity and visitors´ willingness to pay for that access to that amenity, STCRC (2009) recommend the use of a methodology such as the travel cost method that reflects the aggregate recreational value of amenities to both tourists and locals.

The following economic instruments can be used to raise revenues and control the access of tourists to biodiversity, especially in protected areas:

- entrance fees

- user fees
- concessions and leases
- direct operation of commercial activities
- taxes
- volunteers and donations.

In addition, financial incentives, such as tax incentives or grants, may be used to shape more sustainable development and tourist behaviour.
Entrance fees may be calculated using a range of methods, including peak-load pricing, comparable pricing, marginal cost pricing and multi-tiered pricing (Europarc Federation, 2012). However, it is often difficult to charge visitor fees for entering protected areas. Instead, fees can be charged for specific services and facilities within the area, such as:

- parking fees
- fees for camping and mountain huts
- entrance fees for attractions such as visitor centres, canopy walkways, board walks
- permits for fishing and hunting
- permits for activities such as diving, snorkelling, mountain biking, hiking, kayaking, etc

rent of equipment for camping, boating, mountaineering, kayaking, etc.

<u>Europarc Federation</u>
Improving biodiversity management in protected areas through membership of the Europarc Federation incurs an annual membership fee of EUR 5 000 plus any costs associated with implementation of the Charter (see below). For example, during 2010, the Junta de Andalucia invested over 96 000 in maintenance and improvement of the the Sierra de la Nieves Nature Park in southern Spain (Europarc, 2012).

Driving forces for implementation

See section 3.1. Natural resources, including biodiversity, are a major draw of tourists to many destinations, so that conservation is necessary to ensure that tourism remains a viable industry in the long term.

Case studies

Cornwall AONB partnership and Unit described in section 3.1 and this section represents a detailed illustrative case study of best practice. Additional case studies on best practice in protected areas are presented in Table 3.25.

Table 3.25: Case studies of possible best practice management of protected areas

Location	Description
Cairngorms, Scotland (UK)	An Action Plan for how sustainable tourism will continue to be supported in the Cairngorms National Park has been endorsed by the Board of the Cairngorms National Park Authority (CNPA). This new Strategy for 2011 – 2015 will form the basis of an application for the *European Charter for Sustainable Tourism in Protected Areas* to the EUROPARC Federation. In 2005, the Cairngorms National Park became the first UK National Park to be awarded this Charter for the period 2005 – 2010. The CNPA’s Sustainable Economy Manager, Chris Bremner, said: 'We have a distinctive mix of economic activity in the Park but it is tourism that dominates. It is important that tourism development is managed and supported in a way that recognises and takes account of the needs of local communities and the environment as well as local businesses. ' A number of objectives have been identified in the Strategy including: Growth in the value of tourism generated and retained in the Park; the needs of customers to be understood and addressed; enabling people to experience the special qualities of the National Park; recognition and promotion of geographical diversity; minimising negative environmental impact and supporting enhancement.

Location	Description
	The Strategy has been developed through the Cairngorms Sustainable Tourism Forum (CSTF) which was set up in May 2010 to bring together those with an interest in and responsibility for implementing the principles of the European Charter. *Source:* European Charter (2012).
Île de France (F)	– The Île de France region homes 10 million residents and spans a long biodiversity axis that includes the forests of Yvelines, Rambouillet and Fontainebleau and the wetlands of the Bassée. Biodiversity is threatened by factors including urbanisation, landscape fragmentation, diffuse pollution and invasion by alien species. The Conseil Régional of the Île de France (CRIDF) adopted the Biodiversity Charter in 2003, and implements a Regional Strategy for Biodiversity, coordinated through a regional office for nature and biodiversity (NatureParif). NatureParif coordinates actions across local authorities, the private sector and citizens. A Master plan has been drawn up for the region that identifies desirable social, economic and environmental ooutcomes over the next 25 years. Related objectives are incorporated into public procurement, legislation, taxation and subsidies. Ten goals are contained within the Master Plan: – maintain and restore ecological communities; – develop a network of protected areas; – reduce pressure on natural habitats; – improve knowledge of biodiversity and monitor its evolution; – involve all members of civil society actively in the chosen goals; – support them in integrating biodiversity into all policies, across administrative lines; – raise awareness of biodiversity by taking an inventory of biodiversity; – build co-operative initiatives for biodiversity on levels from the interregional to the international; – assess and predict the impact of climate change on the diversity of living systems; – lead by example. Specific practical measures include the construction of 'fish ladders' at hydro-power sites and the introduction of wildlife crossings on roadways. In addition, relevant aspects of the Master Plan are incorporated into urban planning documents and assistance is provided to farmers to implement agro-environmental measures and to become organic certified. *Source:* Houdet (2008).
Jurassic Coast (UK)	The Dorset and East Devon Coast World Heritage Site is England's first natural World Heritage Site – it is known popularly as The Jurassic Coast. The Site is located on the south coast of England and covers 95 miles (155 km) of truly stunning coastline from East Devon to Dorset, with rocks recording 185 million years of the Earth's history.The Site was declared a World Heritage Site by UNESCO in 2001, as 'an outstanding example representing major stages of the Earth's history, including the record of life, significant ongoing geological processes in the development of landforms, and significant geomorphic or physiographic features.'World Heritage status was achieved because of the site's unique insight into the Earth Sciences as it clearly depicts a geological 'walk through time' spanning the Triassic, Jurassic and Cretaceous periods which make up the Mesozoic Era of geological time, between 250 and 65 million years ago. The Jurassic Coast has high visitor numbers so Visitor Management is of paramount importance, and sustainable tourism is encouraged and promoted throughout the Site. Sustainable transport options are offered to the visitor through literature, websites and an ongoing commitment to improvement of services. The X53 Jurassic Coast Bus Service which covers access to the full length of the site (via feeder services in some cases) continues to be a great success, with new buses introduced for 2008. The potential to develop viable waterborne transport services is an exciting prospect, and as of 2010 is in its early stages of development. *Source:* WTTC (2012).
Müritz National Park (DE)	Müritz National Park in the north east of Germany is a popular site for tourists and receives about 600 000 visitors each year to enjoy the lakes, forests and bogs of the post-glacial landscape and view a variety of species including white-tailed eagles, ospreys, cranes and red deer. The park covers 32 200 hectares and was established in 1990. Starting with almost

Location	Description
	zero tourism, national park tourism now generates over v 13 million a year for the region, supporting an estimated 628 full time jobs. Müritz National Park covers mainly state-owned land, but communal, church and privately-owned land is also included. Most public areas can be freely accessed. The visitor infrastructure includes an extensive system of marked trails, cycle and canoe routes, platforms, hides and towers. Managing the park effectively requires the cooperation of local communities and businesses located in or surrounding the park. The National Park Authority has therefore undertaken a highly participatory process for preparation of the Müritz National Park Plan, which was produced in 2004. This process has involved the National Parks Association of Local Communities and District Councils, as well as a series of issue-based working groups with local and other relevant stakeholders, and consideration of over 900 written submissions. The participatory process used to prepare the plan is being continued for its implementation. This provides an important mechanism for integrating conservation with rural development of the region. The park can be accessed from many sites, and a visitor monitoring scheme was established in 1999 (see below). One example of visitor management is the introduction of controlled viewing of migrant cranes around Lake Rederang. The park hosts up to 8 000 migrating cranes (*Grus grus*) at any one time during September and October, and also has a small population breeding of about 80 cranes. The cranes rest overnight on the shallow, undisturbed lakeshores within Müritz National Park, where they are safe from predators, and during the day feed on nearby agricultural fields. Cranes are sensitive to disturbance from visitors – including impacts from noise, flash photography, and bright coloured clothing – and change their pre-resting habits and flight patterns under these conditions. To control visitation and minimize impacts, a ticket and guiding system to view the cranes as they come to their overnight resting sites was introduced in 2003. The 'Crane Ticket' system has been developed as a public-private partnership that involves Müritz National Park Authority and the National Park Service OHG, which is a local tourism company that has contracted guiding and bus services from two more companies. Tickets cost v 7 per visitor, and there is a limit of 130 visitors each evening. The ticket price includes the bus transfer from the nearby town of Waren (Müritz). Viewing is conducted in groups of up to 20 visitors, and is confined to two locations. Free access to the resting locations is prevented by partial closure of trails during the evenings. The National Park Rangers control the restrictions and provide one guided tour to each location, and the tourism company provides further guides, who are usually experienced conservationists. The income from the Crane Ticket is just sufficient to cover the costs of the private services that are involved. Although the income does not directly support conservation in the park, the scheme provides significant non-monetary benefits for conservation by regulating viewing and minimizing any disturbance to the cranes, by providing a general incentive for tour companies linked to crane conservation, and by enabling the park to promote greater awareness of crane ecology and conservation and the interpretation that it provides. The Crane Ticket also helps to promote tourism to the region in the lower season. In 2005, a total of 3 100 visitors took advantage of the Crane Ticket in September and October. Some hotels also include Crane Tickets as a special offer for their guests. The visitor monitoring scheme was established in 1999 to identify the magnitude of visitation per day and over the season, where visitors go and what they do (i.e. how they move around the park: walking, biking, canoeing, horse-back riding).39 This is being done by counting visitors at 15 determined sites on 15 determined days throughout the year. Besides calculating the approximate total number of visitors per year, the results indicate a spatial distribution of tourists and their main activities. The visitor monitoring is repeated at full scale every three years; usually visitor surveys are being done at the same time. Sample checks are made annually. Special monitoring of biodiversity indicators (species and habitats) are being enacted on sites identified critical to visitor impact, for example around the crane resting areas and the habitats along the waterways for canoeing. Following the monitoring results, visitation to the crane resting areas has been adapted and the crane monitoring now reflects the effectiveness of the management measures. Similar adaptive changes are currently being discussed in a multi-stakeholder forum concerning canoeing. *Source:* UNEP and CMS (2006); SCBD (2007).
Peneda Geres National	In 2008, ADERE-PG (Association for the Development of the Regions of Peneda-Gerês National Park) developed a project for the implementation of 10 new hiking trails, guided by PDAs with inbuilt GPS, in the Peneda-Gerês National Park. These trails are located in the

Location	Description
Park trails, Portugal	'Natural Environment Zone' of the Park (protection zone, which is regulated by the Management Plan of the Park). For this reason, ADERE-PG (in association with the Park and the Municipalities) decided to develop this technology in order to guide visitors in these sensitive areas and to control their activities. This technology leads visitors along the trail and provides all the information about the route, provides directions, displays points of interest, and provides a guide to fauna and flora species from the perspective of environmental education. The main objective is providing visitors the opportunity to observe and experience wildlife and other natural and cultural values of the protected area (especially in the protection zones), according to the conservation and management objectives. The visiting and touristic activities in these particulars zones of the National Park (protection zones) are subject to specific regulations, and licences depend on carrying capacity assessments. The PDA with GPS can be requested at the 'Gates' of the National Park (Visitor Information Centers), where there are also a thematic exhibition and multimedia kiosks with more information about the values of the Park, the importance of their preservation and the best practice to visit the park. With this technology visitors can hike on some trails located in protected zones with greater assurance for park managers that they will not stray from the trail and cause impacts such as trampling damage. At the same time, visitors have access to much information about the natural values and this leads them to respect more nature. Monitoring of the environmental impact of use of the tracks is planned, based on environmental indicators such as: – diversity of flora in the tracks and its close surroundings (number of present species) – density (coverage rate) of indicator species (choose one or two species that are indicative of the state of progress or representative of the conservation area) – density (coverage rate) of species considered rare or associated with very specific locations – trampled areas near the rail – number of secondary trails open (meaning that visitors coming out of the track recommended). Whilst software and navigation systems for personal PDAs with GPS are freely available, In our project, ADERE-PG developed their own software because of the wish to provide descriptive information on the routes and points of interest as well as flora and fauna guides (text and images). *Source:* Europarc Federation (2012).
Syöte National Park (FI)	Syöte National Park is a chain of old-growth forests, part of which is high altitude forest. One fourth of the area of the Park is mires of different types. Most of these are North Ostrobothnian aapa bogs, but some are hanging bogs on the hill slopes at altitude of even 300 metres. Many of the mires represent the old meadow culture. Remains and marks of the slash-and-burn agriculture, reindeer-herding, and forestry of the old times can be seen in many places. Syöte National Park is managed respecting the nature and the history of land use in the area. The buildings are being renovated or rebuilt, the traditional agricultural landscapes are being restored, and the recovery of plant populations there is being studied. The Syöte Visitor Centre works closely with the area’s schools. New study material for schoolchildren and other groups is drafted every year. There are special teachers’ pages on the internet site of the Syöte Visitor Centre, which help teachers to find ideas for their teaching programmes on ecological, cultural and environmental aspects of the area. Guided tours are arranged both in the visitor centre and the national park. The main exhibition at the visitor centre presents the nature and cultural heritage of the park. Part of the exhibition is renewed four times a year. Several times a year there are nature events and other public happenings in the visitor centre or in the park, some arranged with local people. The Syöte National Park was awarded the European Charter for Sustainable Tourism in

Location	Description
	Protected Areas (www.european-charter.org) by the EUROPARC Federation in 2004. *Source:* European Charter (2012).

Reference organisations

Bulgarian Government; Cairngorms National Park Authority; Calvià Local Authority; Conseil Régional of the Île de France; Cornwall AONB Partnership and Unit; Egyptian Tourism Development Authority; Europarc Federation.

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3.3 Infrastructure and service provision

Description

Many recreational activities in tourism destinations take place in or on water bodies and depend on good water quality (swimming, boating, fishing, diving), or are supported by appropriation of large quantities of water (golf, skiing). All types of tourism directly rely on the availability of potable water, and indirectly on water necessary to support ecosystems and produce a multitude of products and services (from food to energy). Degradation of water resources through over abstraction and pollution can undermine these activities, and incur huge costs through loss of ecosystem services and restoration requirements (Gössling et al., 2011). Fluctuating water demand and wastewater generation in destinations can pose challenges for water provision and wastewater treatment. These two services are therefore particularly important for destination managers to control, and are the focus of this technique.

Other potentially acute environmental pressures within destinations arise from waste disposal via landfilling and car-based transport. As with wastewater treatment, good waste and traffic management in tourism destinations require systems that are not only environmentally sound (i.e. recycling of waste, provision of efficient public transport or personal mobility options such as cycling), but of sufficient capacity to cope with peak demand during tourism high season.

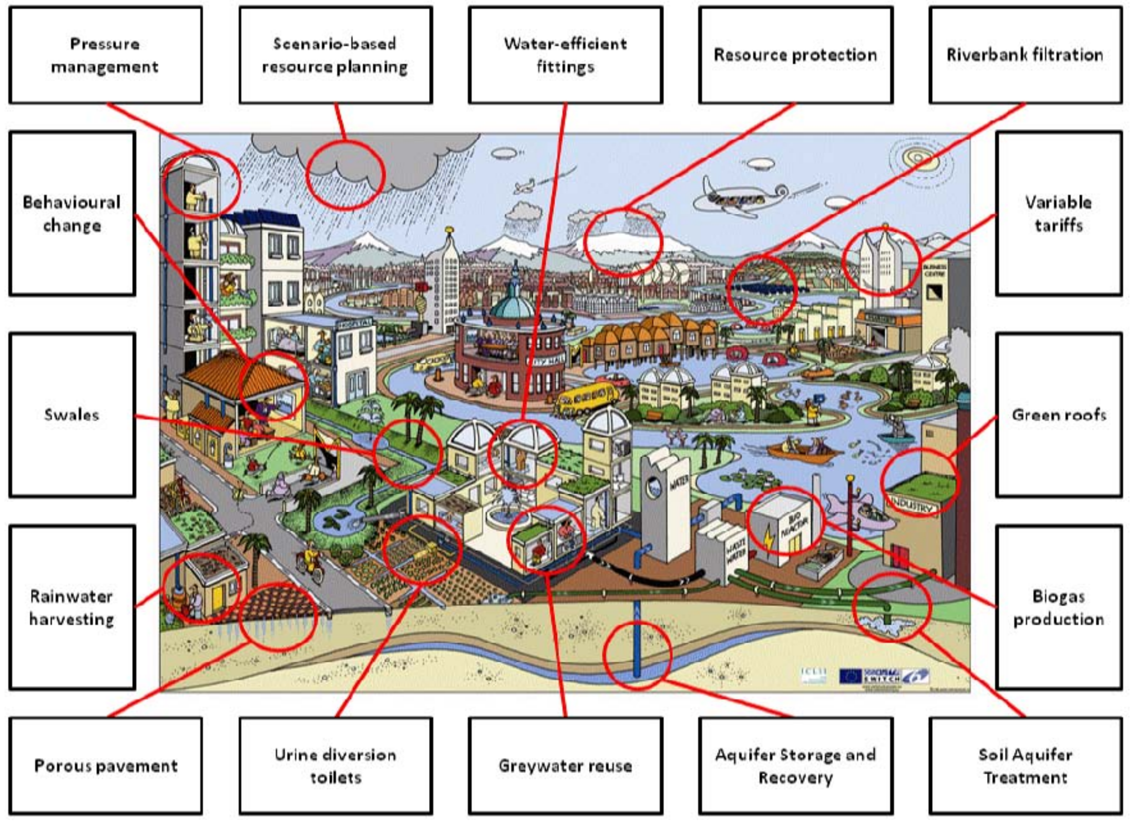
Best practice in the provision of infrastructure and services in destinations largely overlaps with best practice for public administration (especially local authorities), and is covered in the EMAS SRD public administration that is in preparation at the time of writing (EC, 2012). This section provides a brief technical overview of best practice techniques such as wastewater treatment and anaerobic digestion of organic waste, and identifies best management practices specifically important for tourism destinations. The focus is on infrastructure and services that can alleviate the environmental hotspot pressures commonly experienced by major tourism destinations:

- provision of adequate wastewater treatment facilities that are able to cope with seasonal peak loadings and achieving a performace as indicated below
- provision of waste collection and recycling services
- provision of renewable water via a distribution network that minimises leakages and includes incentives for tourism enterprises to reduce water pollution
- provision of public transport to ports, airports, train stations and tourist areas (attractions, high concentrations of hotels).

Table 3.26: Key environmental aspects and best practice measures for destination managers

Aspect	Best practice measures
Wastewater treatment	– Ensure WWTP of sufficient capacity to cope with peak loads in tourist season (e.g. modular design) – Install sufficient treatment technology (secondary or tertiary level) to avoid water pollution incidents achieving the values indicated in the table below
Water provision	– Resource protection and sustainable abstraction plans – Demand reduction measures (variable tarrifs, incentives for water-efficient fittings, taxes, etc.) – Measures to increase infiltration and percolation to groundwater (reducing impermeable surfaces, green roofs, etc.)
Waste management	– Avoid landfill – Implement an extensive and user-friendly collection and recycling service – Implement anaerobic digestion for organic waste
Transport	– Ensure public transport system has the capacity to cope with peak tourist numbers (e.g. increase buses etc, during tourist season) – Ensure public transport routing provides a convenient service to all major tourism locations – Promote daily and weekly integrated (tourist) tickets to encourage use of public transport – Provide green infrastructure and encourage mobility by foot and bike (car-free zones, bicycle lanes, public bike schemes)

Water management in destinations is an overarching issue that requires full integration of tourism demand into sustainable management plans implemented by public authorities and public or private water providers. Figure 3.10 summarises some of the main best practice measures applicable to public administrations in relation to water management, from the public administration SRD (EC, 2012). Readers are referred to that document for more detailed information on these best practice measures. Encouraging water use efficiency across tourism enterprises via mechanisms described in (section 3.1), and avoiding loss of ecosystem functions (section 3.2) from over-abstraction, are important integrated best practice measures. The minimisation of leakage from water distribution systems is described under operational data as this is a stand-alone aspect of destination improvement specifically referred to by tour operators (ABTA, 2011).



Source: ICLEI European Secretariat (2011), as presented in EC (2012).

Figure 3.10: Water supply, stormwater and wastewater BEMPs illustrated in the SWITCH Water-Sensitive City of the Future

Provision of renewable energy is an important best practice measure for public authorities (EC, 2012), but not specifc to tourism destination managers as tourism-related energy consumption typically does not give rise to acute environmental pressures within destinations. Therefore, provision of renewable energy is outside the scope of this section: readers are referred to EC (2012). As referred to in section 3.1, best practice for tourism destination managers is to encourage energy efficiency and decentralised onsite renewable energy generation across tourism enterprises (see also section 7.6).

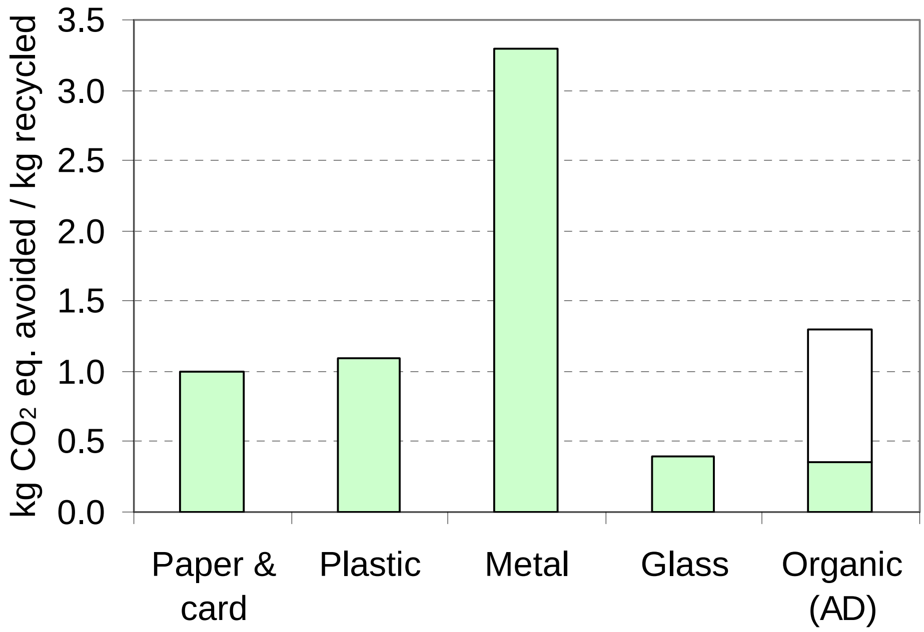
Achieved environmental benefit

<u>Wastewater treatment</u>

Adequate wastewater treatment can ensure the maintenance of high water quality in surface water bodies, delivering the full suite of potential ecosystem services (including habitat provision for biodiversity and amenity value). The environmental condition of receiving bodies can be maintained at levels that ensure compliance with the Water Framework Directive (2000/60/EC) for freshwater bodies and Blue Flag certification criteria for seawater.

<u>Waste management</u>

As described in sections 6.2 and 8.2, waste recycling leads to significant reductions in GHG emissions, resource depletion and other impacts compared with disposal and production based on virgin resources. Figure 3.11 displays the GHG emissions avoided per kg waste recycled for different waste streams.



NB: Organic waste GHG avoidance based on two reference scenarios: (i) landfill with methane gas capture (standard); (ii) landfill without methane gas capture (bad practice; high GHG avoidance).
Source: Envirowise (2008); Fruergaard and Astrup (2011); WRAP (2011).

Figure 3.11: GHG avoided through recycling one kg of each waste type, including anaerobic digestion with energy recovery for organic waste

Water supply
Good water management can reduce water consumption by over 50 %. Leakage prevention alone can reduce abstraction rates by over 30 % (although leakage water may ultimately be recycled via groundwater, and made available for future abstraction). Best practice in water management can optimise the provision of ecosystem services from water bodies by maintaining adequate provision for non-commercial uses (e.g. supporting biodiversity).

Traffic
Reducing traffic and shifting transport away from cars to public transport and foot or bicycle can result in significant reductions in emissions of CO_2, SOx, NOx, NMVOCs and PM (e.g. Figure 4.4 in section 4.1). In areas of high traffic density, redcuing traffic can be an important way to comply with ambient air quality targets specified in the Air Quality Directive (2008/50/EC).

Appropriate environmental indicators

Standardised indicators
Indicators from the EC TSG group and GSTC may be used in order to improve standardisation of reporting across destinations. These criteria relate to various aspects of infrastructure and service provision in destinations, and are included in the tables below.

ABTA have also produced a set of Destination Sustainability Indicators that may be applied by destination managers (seee section 4.3). These include checks such as whether governments offer incentives to install renewable energy or water conservation technologies, whether waste generation and water consumption from tourism is calculated, and whether water quality is tested, in addition to percentage rates for renewable energy consumption, etc

Wastewater management
Table 3.27 summarises some relevant international indicators relevant to wastewater management at the destination level.

Table 3.27: Relevant indicators for wastewater management within destinations

Indicator source	Indicator
EC TSG	Percentage sewage discharge treated in destination – Level of contamination (faecal coli forms,campylobacter) – Number of days beach/shore closed due to contamination Percentage of bathing places (beaches, lakes, ..) rated good, acceptable and poor etc
GSTC	The destination has a system in place to monitor water quality in aquatic areas and sources of drinking water The destination implements practices to minimize pollution from wastewater, run-off, erosion, noise, light, harmful substances, ozone-depleting compounds, and air, water and soil contaminants and requires tourism enterprises to adhere to these practices
Other	Percentage of (tourism) population connected to a mains sewer network Percentage of wastewater receiving secondary and tertiary treatment Implementation of modular wastewater treatment plants with additional streams to cope with peak tourism-related loads
Technical data	Pollutant (COD, ammonia, total nitrogen, total phosphorus) removal efficiency (%) Pollutant concentrations (see Table 3.31)
NB: TSG and GSTC are draft criteria. Check the relevant websites for updated criteria. Source: EC TSG (2011); GSTC (2012).	

Waste management

Table 3.28 summarises some relevant international indicators relevant to waste management at the destination level.

Table 3.28: Relevant indicators for waste management performance within destinations

Indicator source	Indicator
EC TSG	– Percentage of tourism enterprises involved in waste reduction activities – Waste volume produced by destination (per person per year) Volume of waste recycled percentage or per person per year – preferably per month
GSTC	The destination has systems in place to ensure wastes from tourism sites and enterprises are properly treated and reused or released safely, with no adverse effects to the local population and the environment. The destination has systems in place to ensure waste from tourism sources is minimized, reused or recycled. Any residual solid waste disposal for tourism and supporting community is sustainable, with quantitative goals to minimize waste that is not reused or recycled
Other	No waste sent to landfill Percantage organic waste sent for anaerobic digestion, combustion with energy recovery or composting
NB: TSG and GSTC are draft criteria. Check the relevant websites for updated criteria. *Source:* EC TSG (2011); GSTC (2012).	

Water supply

Table 3.29 summarises some relevant international indicators relevant to water supply management at the destination level.

Table 3.29: Relevant indicators for water supply management within destinations

Indicator source	Indicator
EC TSG	– Freshwater consumption (in litres) per tourist night – Percentage of tourism enterprises participating in water saving actions – Percentage leakage rates in destination – Percentage of tourism enterprises using recycled water Percentage of recycled water used in the destination
GSTC	The destination has a program to monitor and conserve water use at the destination level and to encourage tourism enterprises monitor and conserve water The water supply for tourism used at the destination is sustainable ecologically and does not adversely affect community uses, taking into account the overall cumulative impacts or all local surface and groundwater use
Other	Percentage split of water sources (ground/surface/desalination…) Percentage leakage rate in destination Percentage water recycled or from rainwater harvesting Energy and carbon footprint of desalinated or imported water Percentage impermeable area Percentage precipitation captured and stored as surface water or infiltrating into ground
NB: TSG and GSTC are draft criteria. Check the relevant websites for updated criteria. *Source:* EC TSG (2011); GSTC (2012).	

<u>Traffic management</u>

Table 3.30 summarises some relevant international indicators relevant to traffic management at the destination level.

Table 3.30: Relevant indicators for traffic management within destinations

Indicator source	Indicator
EC TSG	Average length of stay of tourists (nights) Average length of stay same day visitors (hours) Average km travel by tourists to and from home to destination Average km travel by same day visitors from and to destination Percentage usage of different modes of transport (public/private and type) for arriving tourists and same day visitors Percentage of visitors using local/soft (e.g. walking, bicycle) mobility services
GSTC	– The destination has a policy and plan in place to increase the use of low-impact transport, including public transport, in the destination
Other	Provision of high capacity public transport to/from major tourism hubs (airports, ports, main attractions)
NB: TSG and GSTC are draft criteria. Check the relevant websites for updated criteria. *Source:* EC TSG (2011); GSTC (2012).	

<u>Benchmarks of excellence</u>

As with sections 3.1 and 3.2, monitoring and reporting of all applicable EC TSG or GSTC criteria at regular intervals (e.g. every two years) is one benchmark of excellence. The following overarching benchmark of excellence is proposed:

BM: environment-related services, including public transport, water provision, wastewater treatment and waste recycling, are designed to cope with peak demand and to ensure the sustainability of tourism within the destination.

Benchmarks for specific services are listed below:

BM: ≥95 % wastewater generated in the destination receives at least secondary treatment, or tertiary treatment for discharge to sensitive receiving waters, including during peak tourist season.

BM: ≥95 % of waste is diverted from landfill and recycled, or at least sent for anaerobic digestion or incineration with energy recovery.

In relation to reducing water demand, direct water consumption per tourist-night is a key indicator. Figure 1.12 in section 1.2.2 displays the average tourist water consumption of 440 L per day in Mallorca (excluding indirect consumption via consumed food and drink, etc.). This compares with already high residential consumption of between 140 and 250 L per capita per day in rural and urban areas of Mallorca, respectively (UNEP, 2004). This compares with domestic consumption of 112 L per capita per day in Berlin (ICLEI Secretariat, 2011). Meanwhile, average tourist consumption in benidorm is less than 200 L per day (SITC, 2012), compatible with the benchmark of 140 L per guest-night for fully serviced accommodation (plus additional consumption for meals and activities). Based on this information and in the context of limited available data, the following benchmark of excellence is tentatively proposed for reducing water demand:

BM: average tourist water consumption of ≤200 L per day.

Based on a review of applications for the European Green Capital award, the highest shares of public transport and soft mobility (walking, cycling) are achieved in Barcelona, Stockholm and Freiburg, where they account for between 68 % and 80 % of journeys within the destinaiton. The proposed benchmark for city destinations is therefore:

BM: public transport, walking and cycling accounts for ≥80 % of journeys within city destinations.

Cross-media effects

Wastewater treatment

Wastewater treatment can consume a significant amount of energy. In the 'Breisgauer Bucht' wastewater treatment plant near Freiburg in Southern Germany, described below, electricity consumption totals 13.8 million kWh per year (0.66 kWh per m^3 wastewater treated). Over 50 % of this is provided by onsite combined heat and power generators that run off biogas from the anaerobic digestors (heat is used for anaerobic digestion and sludge drying). In addition, energy is exported in dried sludge pellets for combustion in a cement plant, so that the total energy balance of the plant is approximately neutral.

Waste management

As described in section 6.2 (e.g. Figure 6.13), the environmental impact associated with collecting, transporting and recycling waste materials is almost always lower than the environmental impact associated with disposal and production from virgin materials.

Transport infrastructure

Where provision of public transport requires the construction of dedicated infrastructure (e.g. railway tracks), significant cross-media effects may arise through biodiversy displacement and fragmentation. These can be minimised through careful planning, mitigation measures (e.g. animal crossings) and biodiversity compensation measures. Such effects may be considerably smaller than for alternative road expansion.

Operational data

Wastewater management

Best practice for wastewater treatment is:

- to treat at least up to double of the dry weather wastewater flow (in case of rain or thawing)
- to treat the wastewater at nitrifying conditions (food-to microorganisms ratio of <0.15 kg BOD_5/kg MLSS x d), and to perform denitrification and phosphorous removal
- to remove suspended solids by means of sandfiltration in case of sensitive receiving water bodies or other tertiary treatment such as activated carbon filtration or oxidation with chlorine-free oxidising agents in order to reduce micro-pollutants such as man-made hormone-disrupting chemicals
- to on-line monitor organic compounds (total organic carbon), ammonia, nitrate and phosphorous in case of plant capacities of more than 100 000 inhabitants equivalents or of a daily influent BOD_5-load of more than 6000 kg respectively
- preferably to stabilise primary and excess sludge in anaerobic digesters and to use the produced biogas for on-site electricity production and sludge drying, at least for plants with a capacity of more than 100 000 inhabitants equivalents or of a daily influent BOD_5-load of more than 6000 kg respectively
- to dry the anaerobically stabilised sludge and to send it to incineration or co-incineration plants (e.g. in coal-fired power plants or cement plants) meeting the standards according to IED; in case of small plants, the mechanically de-watered sludge can be sent to central sludge drying plants.

As an example, a plant achieving the above mentioned performance is shown in Figure 3.12. This plant treats wastewater from an entire region, incorporating the city of Freiburg i.Br./Germany and 28 municipalities with a total 360 000 inhabitants. Plant capacity is for 600 000 inhabitant equivalents, allowing for the treatment of wastewater from industrial and other commercial activities, such as tourism, in addition to domestic wastewater.

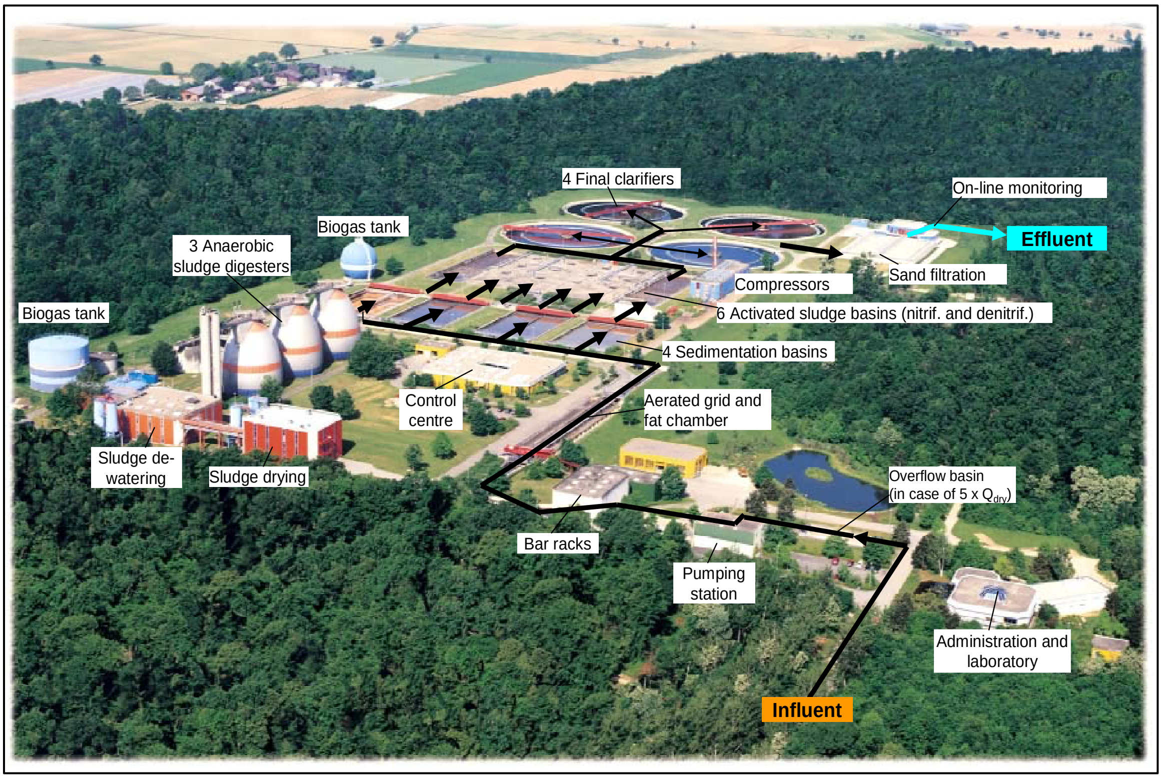


Figure 3.12: Aerial view of a best practice municipal wastewater treatment plant ('Breisgauer Bucht' near Freiburg in southern Germany)

This plant demonstrates good wastewater the performance as indicated in Table 3.31 with low variations (stable performance) as presented in for the parameter COD (Figure 3.13).

Table 3.31: Performance of a best practice municipal effluent treatment plant (example: treatment plant 'Breisgauer Bucht' set-up and operated by a grouping of 29 municipalities)

Parameter	Removal efficiency in % (load in/load out)	Annual average concentration in mg/l	Min-max-values for 24-h composite samples
BOD_5	>98	<5	no data available
COD	>90	20	9.5 – 30
Ammonia	>90	0.1	0.02 – 2.0
Sum of inorganic nitrogen compounds	>80	7	2.3 – 13
Total phosphorous	>90	0.6	0.1 – 0.7

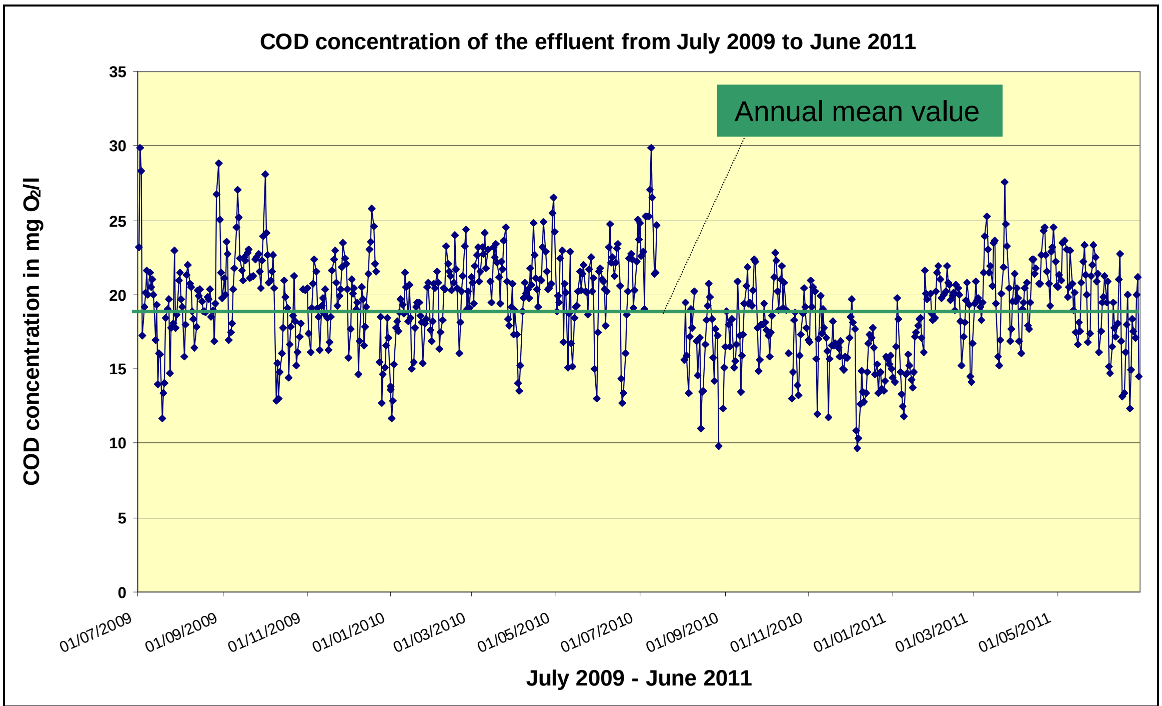


Figure 3.13: COD emission curve (values of 24 h composite samples) of the treatment plant 'Breisgauer Bucht' set-up and operated by a grouping of 29 municipalities

Another plant is shown in Figure 3.14. This plant is located in a rural area where there is no significant industry, but where tourism leads to high seasonal loading.

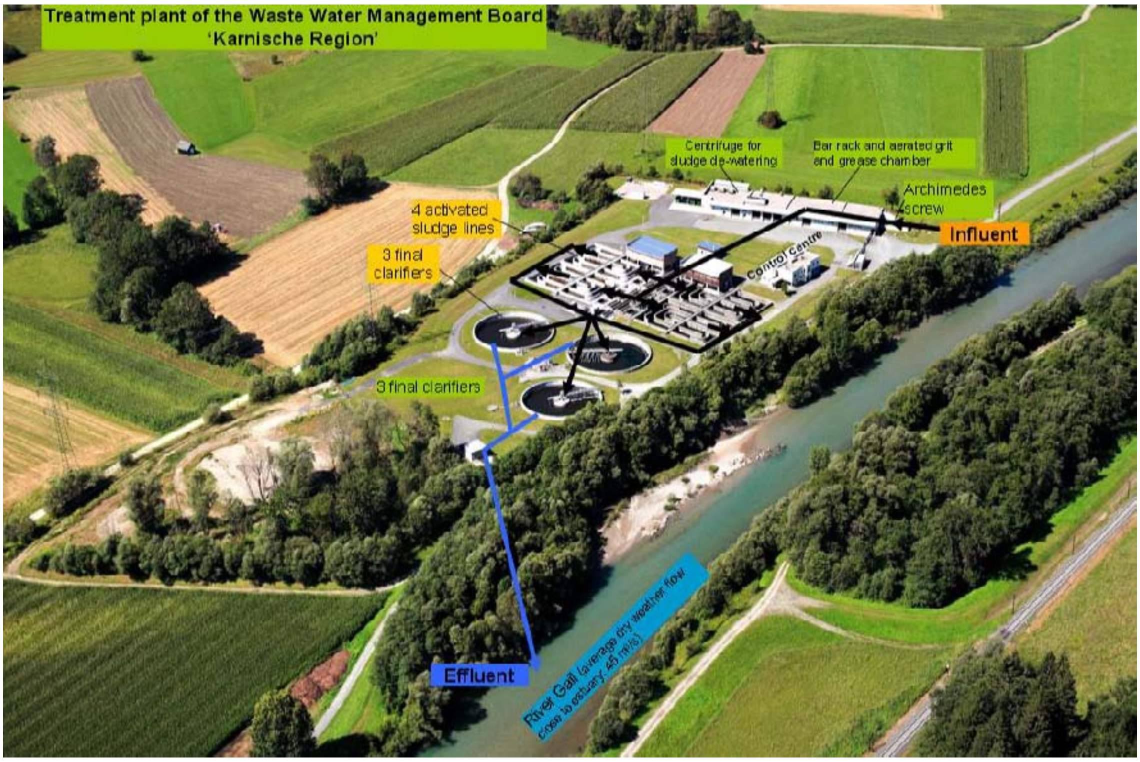


Figure 3.14: Aerial view of a best practice municipal wastewater treatment plant (operated by the management board 'Karnische Region' in South Kaernten/Austria)

The wastewater treatment plant shown in Figure 3.14 is designed for 44 000 inhabitant equivalents, but serves a resident population of only 155 00 (one third of the capacity). The residual capacity is primarily to cope with tourism loads related to ski tourism in winter (high peaks) and leisure tourism in summer (lower peaks). Because of the peaks in tourism, the day mean values of the influent COD-load varies by factor of 3 to 9.

The activated sludge system consists of four lines which can be operated individually. During high season conditions, all four lines are in operation, and during low season conditions, only two lines may be in operation. It takes about 3–4 weeks to reactivate a line; so, it has to be done well in advance of the expected peak. The plant has no anaerobic digester but performs so-called aerobic sludge stabilisation (extended aeration at a food-to-microorganism ratio <0.05 kg BOD_5/kg MLSS x d), de-waters the sludge by centrifuge and sends it to an industry for incineration in a process producing roofing felt. Because of the smaller size of the plant, the ranges of the values for the different wastewater parameters are smaller compared with the bigger plant described above (Breisgauer Bucht). Integrated denitrification and simultaneous phosphorous removal is performed.

The design and the capacity of the plant effectively reduce and equalises the influent load of organic compounds. The effluent COD-load (after treatment) shows some peaks which are not due to insufficient treatment but to intense rainfall events (excessive hydraulic load). The average flow in 2010 – 2011 was 3 450 m^3/d but the maximum, arising from one intense rainfall event, was four times higher (13 600 m^3/d).

The plant performance is indicated in Table 3.32, with high removal efficiencies shown for the parameter COD in Figure 3.15. Here, the COD load, rather than the COD concentration, is presented to visualise the high variation during the year associated with tourism activities. Especially in winter, winter sport activities cause high peak loads which are well managed by the plant (constant low effluent load). However, in case of intense rainfall events, small peaks of COD load occur due to very high hydraulic load (and not to influent load peaks); a well-known phenomenon of municipal wastewater treatment plants.

Table 3.32: Performance of a medium-sized best practice municipal effluent treatment plant with special operation mode for peak loads resulting from tourism

Parameter	Removal efficiency in % (load in/load out) – annual average	Annual average concentration in mg/l	Min-max-values for 24-h composite samples
BOD_5	>97	5	1 – 23
COD	>95	25	2 – 84
Ammonia (NH_4-N)	>99	0.3	0.1 – 9((*))
Sum of inorganic nitrogen compounds	>88	6	0.3 – 18
Total phosphorous	>80	1.3	0.3 – 8.1

(*) out of 486 measured values in 2010 – 2011, only 18 value are above 1 mg NH_4-N (in winter due to low wastewater temperatures slowing down nitrification), 80% of the values are below 0.2 or 0.1 mg NH_4-N/l
Source: Data from plant operated by the wastewater management board 'Karnische Region' in South Kaernten/Austria).

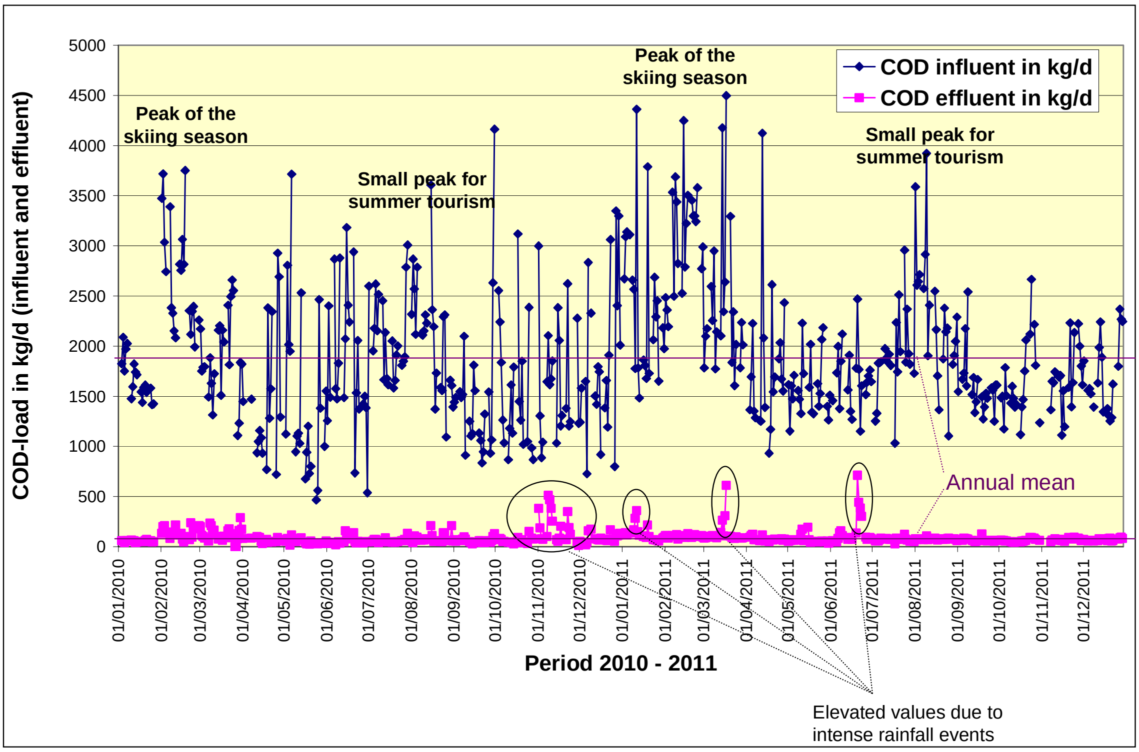


Figure 3.15: COD emission curve (load values for the influent and effluent of 24 h composite samples) of the treatment plant of the wastewater management board 'Karnische Region' in South Kaernten/Austria

Waste minimisation and collection for recycling

San Francisco authorities have a target for zero waste to be sent to landfill or incineration by 2020, and currently achieve a 75% diversion rate. San Francisco authirities introduced a mandatory recycling and composting ordinance in 2009 (100-09), that: (i) requires all residents to separate recyclables, compostables and landfill trash; (ii) provides for enforcement mechanisms and penalties for violations; (iii) ensures that all properties subcribe to a refuse collection service.

Free services and assistance are provided by the city council and waste management companies, including the provision of kitchen compost pails, container labels, signs, commercial building toolkits, educational materials, multi-lingual trainings and business consultations (San Francisco City, 2012). In addition, San Francisco published a list of over 1 000 approved green products that public staff must choose during procurement and that inform green procurement by citizens and busiensses. These products are associated with reduced waste and hardous waste generation.

Property owners and managers of service businesses are required to provide colour coded and labeled containers in convenient locations (blue for recycling, green for composting, and black for residual waste), and to educate tenants, employees and contractors on what goes into each container. The city council places an emphasis on education and assistance with compliance, but reserve the right to pursue persistent non-compliance with legal mechanisms and fines.

Waste collection services within a destination may be operated by local authorities or private companies. Figure 3.16 shows an example of recycling point (or 'Ihla ecológica') in the Portuguese resort of Alvor, highlighting some important features of good practice. Plastic and metal (easily separable), glass and paper and card fractions are collected separately. As is common for southern European countries, there is no organic waste collection bin owing to concerns over odours and vermin that restrict application of best practice for organic waste management.

Figure 3.16: An example of a recycling point in the Portuguese Algarve resort of Alvor

<u>Waste management</u>
Collection of used cooking oil to produce biodiesel is a profitable activity undertaken by private companies in many areas (section 8.2), but that may also be undertaken by local authorities to e.g. produce fuel for buses (as in Seville, Spain). Tourism related food and accommodation services are large sources of used cooking oil.

Centralised anaerobic digestion is best practice with respect to management of organic waste. Anaerobic digestion plants may be operated by local authorities or private companies. The process is described here using the Swiss biogas plant example (Otelfingen) that is also presented in the EMAS SRD for the retail trade sector (EC, 2011). Figure 3.17 summarises the process. Green and food wastes are delivered by trucks and discharged to a bunker from where they are fed with a crane to a conveyor. Before shredding the waste to pieces of less than 500 mm, any metal pieces are removed. Usually, the waste contains less than 3 % undesired components. The shredded waste is then mixed with the aqueous phase from the anaerobic fermentation process, stored in the feed tank, and subsequently pumped to the fermenter. The solid content in the fermenter is about 25 %. The fermentation process lasts 14 – 20 days, the temperature is 55–60 °C (thermophilic conditions). The methane content of the formed biogas is about 58 % (rest CO_2, H_20, H_2S and other trace gases). The produced biogas is stored in a tank and is further processed (mainly the removal of water, carbon dioxide and H_2S). The biogas is incinerated in a gas motor (combined heat and power plant). The produced electricity is fed to the public grid and the heat is used for heating the fermenter. The fermentation liquor is slowly moved by a horizontal paddle system. Part of the fermented mass is dewatered in a screw press and part of it is stored as 'liquid fertiliser'. For the dewatered compost, there is a post-composting process that lasts for about three weeks, prior to delivery to customers. For application on agricultural land, post-composting is not necessary. The compost complies with standards required for its application as a fertiliser for agricultural fields.

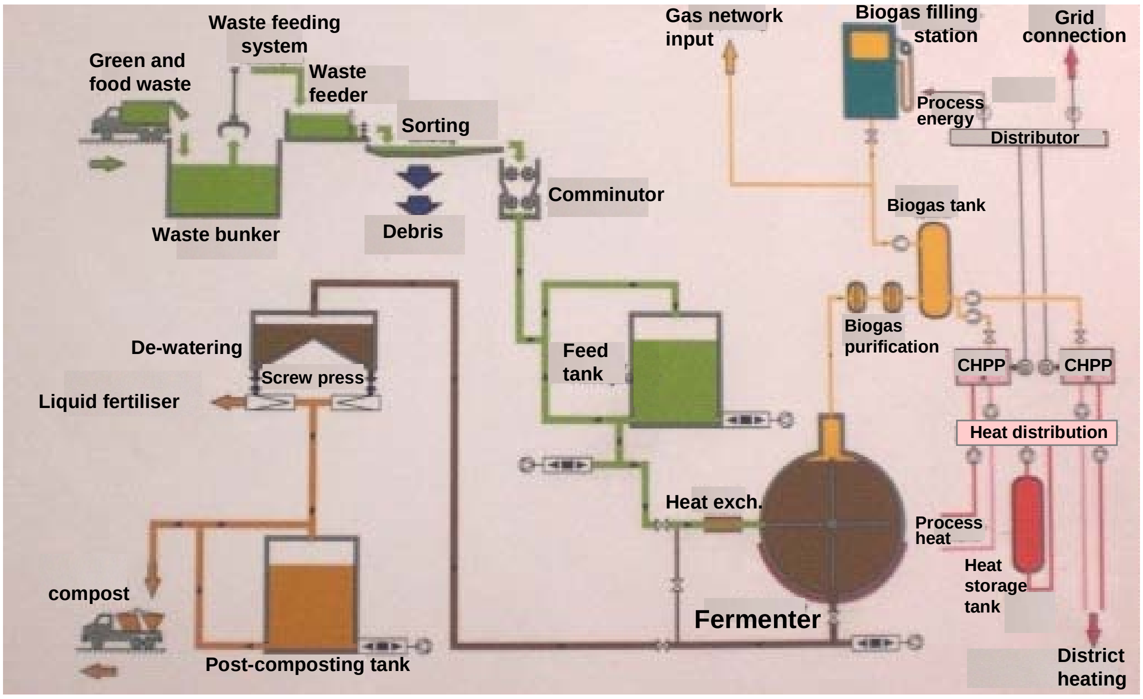


Figure 3.17: Flow chart of the biogas plant in Otelfingen, processing food and green waste

The biogas plant in Otelfingen, Switzerland, went into operation in 1996. Table 3.33 presents inputs and outputs from the plant in 2008. The fermenter in Otelfingen has a volume of 900 m^3. Other fermenters in Switzerland have volumes between 280 and 1600 m^3. Today, the standard is 1600 m^3. The Otelfingen plant processes food waste such as vegetables, meat, fish, sausage, bread, milk, yogurts, etc, from bars, restaurants, hotels, catering companies, canteens, hospital kitchens, food trade companies, retailers, butcher shops and food manufacturing industries. It can also process packed food waste and has a pasteurisation step in order to inactivate pathogen microorganisms.

Table 3.33: Input/output of the biogas plant in CH-Otelfingen for one year

Input		Output	
Green wastes, especially from municipalities	10 500 tonnes	Raw biogas	Approx. 9 GWh
Organic wastes, especially from food manufacturing industries	3 300 tonnes	Fermentation liquor from the screw press	8 200 tonnes
		Solid compost	3 300 tonnes

Source: Axpo (2010).

In relation to best practice within tourism destinations, as for wastewater treatment, anaerobc digestion plants should be of sufficient capacity to cope with peak loading during tourism high seasons. There is more flexibility for biogas plants compared with wastewater treatment plants, as organic waste may be stored for short periods (away from residential areas).

Where anaerobic digestion is not provided, centralised compositing may be provided for organic waste to prevent it being disposed of in landfill (the worst option). Small-scale composting that can be undertaken onsite at tourism service providers' premises is described in section 8.2 in relation to management of kitchen organic waste. Organic waste sorting described in section 8.2 also applies to waste that is collected for centralised composting.

At centralised composting sites, machines mechanically aerate waste which is piled into windrows of sufficient depth to retain heat produced by organic decomposition. High temperature stimulates the proliferation of thermophilic microorganisms that decompose the waste, often at temperatures in excess of 70 ºC. Compost produced from centralised processes may be distributed to gardeners via local waste recycling centres, used in agriculture, or used for green amenity areas.

Source: DKNYT (2008).

Figure 3.18: A central composting site in Struer, Denmark, producing 5 000 tonnes compost per year

Water supply management

In the first instance, it is important to reduce demand. This may be achieved in a number of ways, including regulation, voluntary improvement schemes (e.g. certification), and economic instruments. San Francisco City Council provides grants for low-flow fittings and greywater recycling, for example, (San Francisco City, 2012) and the UK Government provides tax incentives for businesses to save water through the Enhanced Capital Allowance scheme (see section 5.2).

A key measure is to ensure that water charges reflect not just the scarcity of water (market forces), but also the external cost of water abstraction (ecosystem impacts), requiring some form of intervention – e.g. taxes or tradable water permits (e.g. Cashman and Moore, 2011). Variable water tarrifs may also be implemented to encourage lower water consumption per person (EC, 2012).

Leak avoidance should be based on:

- water network mapping, identifying the ages and materials of distribution pipes throughout the network so that maintenance and replacement can be efficiently prioritised
- targeted leak detection using e.g. acoustic detection techniques.

Application of these techniques is described in the following case study for Berlin, taken from EC (2012). Immediately following reunification, water leakage in west Berlin was less than 5 % compared with 25 % in east Berlin, due in large part to differences in materials used, the method of pipe laying, and maintenance. The city succeeded in bringing leakage rates in the east on a par with those in the west, and the Berlin Water Works also implemented a vast water saving campaign modelled on the work it had done in the west, to bridge the gap in water consumption between the two parts of the city.

Leaks in a pipe make a distinct noise, which varies depending on the soil, the material and diameter of the pipe, the pressure the water is under and a number of other factors. Monitoring these leakage noises is an effective means to detect and subsequently repair leaks. In Berlin, a system of microphones and sound locators (positioned in hydrants, valves or household connections) captures these leakage sounds and converts them to electric signals which are transmitted to a central correlation unit that assists ground-based teams in locating the leaks. In addition to these acoustic position-finding techniques, Berlin also uses a number of other techniques such as colour testing, differential pressure measurement, moisture measurement, infrared thermography and small cameras. An extensive database of the pipe network has been established, comprising information about the age, material and condition of pipes as well as information relating to their diameter, depth and flow capacity. The database also records information about leakages to determine both their nature and causes – natural events, traffic or construction or rather linked to shortcomings in their manufacture, installation or maintenance. Using the information gathered in the database, the city is better able to target leakage control activities by starting with the most affected areas (Heinzmann, 2003). This systematic and technical approach to leak detection is considerably more efficient than previous random inspections (Berliner Wasserbetriebe, 2010).

<u>Transport</u>
Details on the provision of public transport and facilitating walking and cycling are provided in EC (2012), particularly in relation to cycling networks (e.g. Copenhagen, Amsterdam) and integrated public transport systems (e.g. Freiburg). Charging schemes may also be used to discourage private car use, in the form of congestion charges (e.g. London) or high parking charges. Examples of cycling and walking paths provided specifically for tourism include:

- the Paseo de Calvia in Mallorca, a 40 km cycling and walking path built between urban centres and widely used by tourists and residents
- the 1 450 km Wales coastal path follows the Welsh coast as closely as is practical and legal, and links up with the 270 km Offa's Dyke Path National Trail to provide the longest continuous walking route around a country (Coountryside Council for Wales, 2012)

- the Algarve coastal cycle route 'Ecovia do Litoral' combines trails in nature protection areas with stretches of restriced traffic routes across 12 Algarve municipalities to provide a 214 km route from Vila real de San Antonio at the Spanish border to Cabo de Sao Vicente on the Atlantic (Ecovias Algarve, 2012).

Further case studies of destinations that have limited traffic are summarised in Table 3.34.

Table 3.34: Case study examples of best practice in traffic minimisation

Example	Description
Association for Car Free Tourism Destinations in Switzerland (GAST)	Since 1988, nine Swiss villages have formed the Association for Car Free Tourism Destinations in Switzerland. This association's goal is to position car free tourism as a high quality product. A ban on vehicles with internal combustion engines, as well as a general speed limit of 15 – 20 km/hour for electro-buses, electrocars and electro-taxis, helps to ensure a relaxed atmosphere and preserve the natural surroundings.
Morizine	Morizine offers for example a complete linked free shuttle bus services running every day during winter and summer seasons from 8 am to 8 pm. Two of the shuttles are electric buses. Morzine operates also the 'charte architecturale' to make new building as environmentally friendly as possible. The resort offers financial incentives to encourage the installation of solar power facilities on roofs.
Werfenweng and Badhofgastein	In Austria, two NETS destinations – Werfenweng and Badhofgastein – are the basis of the Austrian model project on 'Soft Mobility – Car Free Tourism'. The first pedestrian zone in Austria, created in 1972 in Badhofgastein, imposed a 30 km/hour zone in most of the village, with traffic prohibited at night except for inhabitants, deliveries only by vehicles up to 7.5 tonnes and only on certain days, and (since 1990) support for public transport systems. The Gastein Super-Ski Ticket (in existence for some time) guarantees the use of all lifts as well as many types of public transport. Werfenweng, about 45 km south of the city of Salzburg, developed the 'Werfenweng – Soft & Mobile' project with a section 'Arrival Logistics'. The findings of this project helped to create a soft-mobile holiday package and led to the foundation of a group of tourism establishments focusing on 'Holiday from the Car'. This special interest group rewards soft and mobile behaviour by their guests with exclusive advantages. In cooperation with train companies, a door-to-door luggage service and free transportation from the railway station to the hotel are offered. Visitors arriving in Werfenweng by train or leaving their car keys at the local tourist board receive a card allowing free use of electromobiles, electro-bicycles, electro-scooters and fun riders. In addition, the night bus and taxi service can be used at no charge. To request a taxi, each family is provided with a mobile phone. Another offer was designed for train users. Those using public transport pay – at the end of their visit – only as much as they consider it was worth. Having created a 'soft and mobile' offer, Werfenweng is now emphasizing staff training. Employees of hotels or the local tourist board are being taught how to promote the soft and mobile offer and influence tourist behaviour towards use of public transport.

Cornwall's AONB Destination Plan (section 3.1) includes specific actions and progress related to enhancing the sustainability of transport within Cornwall, especially through the integration of tourism demand and specificities into wider transport and accessibility planning (Table 3.35). Of particular note is the variety of public authority departments and organisations involved.

Table 3.35: Transport related target actions, progress, responsible partners and role of Area of Outstanding natural Beauty (AONB) Unit identified in Cornwall's AONB Delivery Plan

Aspect	Actions	Progress	Main partners	AONB Unit role
Transport and Access	Include landscape, local distinctiveness and the AONB designation within the Local Transport Plan 3, Cornwall Access Strategy and Green Infrastructure Strategy.	AONB objectives within appropriate strategies/ plans	– Cornwall Council Transportation and Highways – Cornwall Council Environment Service	– Advice and guidance – Consultation response
	Identify sustainable linkages between AONB sections and the major urban areas of Falmouth, Truro, Camborne/ Pool/ Redruth, Penzance, Helston, St Ives and Wadebridge within the Green Infrastructure Strategy and initiate a pilot project to improve links in an identified project area.	Linkages identified and included in the GI strategy Pilot project initiated	– Cornwall Council Environment Service – Cornwall Council Planning and Regeneration	– Support and encourage
	Identify a number of circular routes from population centres into the AONB, using ROW, permissive routes and other trails and promote as part of the Unlocking our Coastal Heritage Project, TRAC Project, Walking for Health, Mobilise Cornwall or other similar initiative.	Circular routes identified and promoted	– Natural England – The South West Coast Path Team	– Co-ordinate – Publicise

Source: Cornwall AONB (2011).

Applicability

Best practice in the provision of infrastructure and services to reduce environmental impacts in destinations is applicable across all types of destination, though the relative importance of different services will vary across destinations. Priority areas and specific applicable measures to address them can be identified by Destination Plans (section 3.1).

Benchmarks referred to in this section are widely applicable, but the benchmark for public transport and soft mobility in city destinations may not be applicable to rural and less densely populated destinations, especially where attractions are further apart and where critical mass is not achieved for frequent high capacity services.

Economics

Wastewater treatment

In the Breisgauer Bucht wastewater treatment plant near Freiburg in Southern Germany, described above, total operating costs were EUR 13.9 million in 2010, equating to EUR 0.68 per m^3. Fees charged to users of the sewage network are EUR 1.16 per m^3, one of the lowest in Germany (typical range EUR 1 to 3 per m^3).

Capital investment costs for an entire sewage collection and treatment system can be high. The Breisgauer Bucht plant serves 360 000 people over an area of 650 km^2. The construction of over 150 km of sewer canals between 1968 and 1980 cost EUR 75 million. Plant construction costs comprised EUR 51 million for the bio-mechanical systems (~1980) and a further EUR 51 million for the extended treatment and sludge treatment systems (1992 – 2002). However, these capital costs must be annualised over operating lifetimes of many decades for comparison with annual operating costs and fees.

Waste management

As referred to in section 6.2, pay-as-you-throw waste collection charges for residual waste, with low or zero charge for recycling collection, can act as a strong incentive for enterprises and individuals to reduce waste generation and to separate waste for recycling.

Providing waste is clean and well sorted, recycling is commercially viable for most materials, especially metals, paper and some plastics, but also for glass.

Operators of biogas plants may charge for organic waste acceptance. In Switzerland, this cost is approximately 70 EUR per tonne plus transportation costs of between 15 and 45 EUR per tonne, and compares with incineration costs of between 110 and 150 EUR per tonne. Biogas operators realise income by selling electricity and heat generated from biogas, or by selling biogas as a transport fuel. Energy produced from biogas may also be eligible for Government renewable energy subsidues. In Switzerland, the operators of biogas plants receive 11 cents/kWh of electricity fed into the public grid.

Water supply management

As referred to above, it is important that the external costs of water stress are considered when pricing water supplies. Destination managers should integrate land planning into the management of water resources, and take care not to sacrifice sustainable water management for options that appear attractive from a short term perspective. For example, EEA (2009) note that economic driving forces favour golf courses over agriculture owing to higher revenue per unit of water consumed. However, on a regional and global level, displacing the production of food to other areas, including areas outside the destination, is not necessarily a sustainable solution to water management from a lifecycle perspective. Best environmental management practice is for destination managers to take a lifecycle perspective of destination sustainability.

Reducing water demand in the context of water scarcity can realise significant cost savings. Gössling et al. (2011) report on a study showing that Southern Spain's anticipated water requirements will amount to an additional 1 063 million m^3 per year and cost EUR 3.8 billion per year.

However, new seawater desalination systems may produce water for as little as EUR 0.50 per m^3, redcuing the financial incentives for water users and destination managers to reduce use (Gössling et al., 2011). Nonetheless, there is a considerale upside risk to this cost, which is highly dependent on energy prices, and high levels of desalination will increase the vulnerability of destinations to energy supply disruptions or price volatility, in addition to undermining sustainability.

Traffic management

The external costs of transport options should be fully accounted for in Destinaiton Plans – in particular in relation to climate change, air pollution, health impacts, noise and traffic congestion. Long term cost-benefit assessments that include wider socio-economic impacts and external environmental costs may favour investment in public transport infrastructure and services over road expansion. Public transport investment may be paid for by taxes on motorists, for example via fuel duty, road tolls, congestion and parking charges, etc.

Driving forces for implementation

As with implementation of a strategic destination plan, the provision of environmental services within destinations adequate to cope with peak demand is driven by the following objectives:
to maintain the natural and cultural resources upon which tourism is based and continue to offer an attractive destination to tourists;
to optimise the economic, social and environmental outcomes of development within the destination in accordance with the principles of sustainability.

Various EU and Member State regulations require locl authorities to ensure the provision of minimum levels of services to citizens.

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3.4 Environmental management of events

Description

A siginificant portion of tourism in many destinations is attracted by large (annual) events that can be particular hotspots for environmental pressures. For example, county Cornwall in the UK hosts 150 hallmark events annually. Such events events are seen as making an important contribution to the rural economy, and also to the cultural and heritage appeal, of the county. Many cities host festivals and events that draw increased tourist numbers. Events may be managed directly by destination managers, or by third parties operating within the destination. This brief BEMP section uses a case study of event management in Cornwall to highlight aspects of best practice that may be employed by the destination managers and/or event organisers.

The case was provided by Visit Cornwall (the local tourist board) and the Cornwall Development Company, in relation to the Relentless Boardmasters Music Festival 2011 held in Newquay (Figure 3.19). The Boardmasters is Europe's largest surf, skate and music festival, and has taken place in Newquay every year since 1981. VisitCornwall aims to support local events to become greener, in part through measurement and reduction of GHG emissions.

Source: VistCornwall (2012).

Figure 3.19: TheRelentless Boardmasters Music Festival 2011

VisitCornwall, the official tourist board for Cornwall, together with the Low Carbon Team at Cornwall Development Company, and the Cornish based rainforest charity Cool Earth, worked in partnership on a pilot project to:

- measure the carbon footprint of the 150 000 visitors to the festival
- to reduce environmental impacts arising from the event
- compensate for environmental impacts by protecting an area of threatened rainforest in Peru.

The main aim of the project was to improve environmental sustainability practices at events in Cornwall. The specific objectives were:

- to evaluate and understand the current environmental impact of an event that takes place annually in Cornwall
- to work in partnership with and contribute to Cool Earth's objective of rainforest protection
- to inform and encourage better practice in sustainable management of events in Cornwall by:
  - contributing to the measurement and reduction of event carbon emissions
  - application of the REAP model, including training and identification of gaps that require other forms of measurement
  - developing a training package for event organisers
  - rolling out the pilot project by developing best practice advice to event organisers and identifying key issues.

The above mentioned objectives were delivered through the application of three main techniques (Table 3.36).

Table 3.36: The three main techniques employed for the events management project

Technique	Description
Visitor Survey	A face to face on-site survey with around 500 visitors to the Boardmasters Music Festival over two days of the event (Friday and Saturday). The survey explored their demographic profile, accommodation and travel choices, spending patterns and thoughts on environmental improvements. Full details of the results of the visitor survey can be accessed through Cool Earth.
Operational Data Capture	Through Sportsvision the event organisers, and the event utility providers, data was obtained regarding the operational impact and staff profile and behaviours.
REAP Tourism Modelling	Using data derived from components 1 and 2, the overall carbon footprint of the 2011 Boardmasters Music Festival was estimated using REAP.

Based on the outputs of this project, the following best practice measures are recommended for event organisers (Table 3.37), and referred to under 'Operational data', below.

Table 3.37: Major best practice measures for environmental management of events

Aspect	Measure	Comments
All	Implement an environmental management plan	– Undertake an assessment of the main environmental aspects, using surveys, supplier information, available LCA tools, etc. – Identify relevant indicators and benchmarks – Implement an improvement programme that includes all relevant stakeholders
	Offset impacts	– Offset GHG emissions and biodiversity impacts through certified offset schemes
Transport	Promote the use of public transport to the event	– Coordinate additional transport services to events – Implement a car parking charge scheme
Material efficiency	Implement a green procurement plan	– Purchase environment-certified products and services – Avoid disposble items where possible – Avoid excess packaging
	Encourage waste recycling	– Provide convenient waste recycling facilities – Employ staff to supervise and tidy these facilities
	Implement energy- and water- efficiency plans	– Work with providers to identify main demand sources and identify improvement options

Achieved environmental benefit

The main environmental benefits attributable to this project were:

- protection of 16 hectares of rainforest in the Ashaninka region of the Peruvian Amazon (equivalent to the area used for the venue), including 1 760 mature trees, 7 600 saplings, 322 types of plant, 11 000 species of insect and worm and the habitats of six endangered animals
- 'locked in' carbon to the protected rainforest equivalent to 10 400 tonnes CO_2 emissions (six times the festival's emissions)
- contribution to the formation of a 'protective shield' for a further one million hectares of adjacent rainforest.

In addition, good management of events can significantly reduce direct GHG emissions and waste disposal, and impacts associated with traffic to events (reduced GHG emissions, air pollution, congestion) and with energy and consumable supply chains.

Appropriate environmental indicator

Indicators of overall pressures

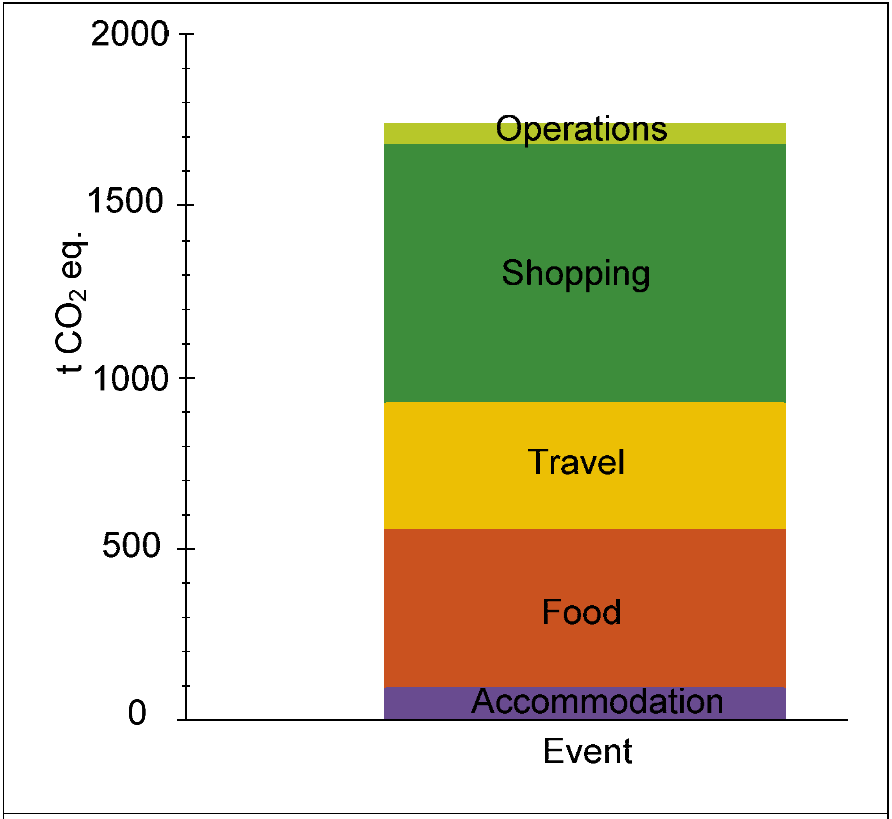
For the Relentless Boardmasters pilot project, the REAP Tourism model (REAP, 2012) was used to determine environmental impacts. REAP is a software tool designed to calculate the energy and carbon footprint of visitors to any area in the UK. The basic foundation of the tool is a calculator which uses day visitor and staying visitor data combined with data on visitor expenditure, accommodation choices and recreational behaviour for any user-defined area.

The carbon footprint for the event was determined by collating results regarding recycling and litter, packaging, transport and energy use, and is summarised in Figure 3.20. The total GHG footprint for the event was calculated at 1 742 t CO_2 eq. The largest contributor to emissions was shopping (43 %), followed by food (27 %) and then travel (21 %). Events operations only contributed 4 % towards total emissions.

In addition to the carbon footprint, other environmental pressures are important. The two additional indicators used in this project were:

- total water footprint (115 000 litres)
- total waste footprint (41 380 tonnes).

Other important indicators are the recycling rate, and the quantity of residual waste sent for disposal, and the percentage of visitors arriving with public transport or soft mobility (on foot or bicycle).



Source: VisitCornwall (2012).

Figure 3.20: Breakdown of GHG emission sources for the Boardmasters festival

Indicators for benchmarking

The most relevant way to normalise environmental pressures for events to enable comparison across events and over time is to express them per person per day. In the pilot project case study referred to here, the event carbon footprint translated into 31 kg CO_2 eq. per visitor per day.

A list of relevant indicators is summarised below:

- kg CO_2 eq. / visitor-day (includes transport and upstream suipply chain impacts)
- L water / visitor-day
- kg waste / visitor-day
- kg residual (unsorted) waste / visitor-day.

Good practice in sustainable event management may be represented by certification with EMAS or ISO 14001. In the UK, BS890 is a new Britsh Standard that defines the requirements for a sustainabilty event management system, and offers guidance on how to improve event sustainability. The responsible section within a DMO or public authority, or outsourced event managers, may be certified according to these standards.

Cross-media effects

There are no significant negative environmental effects from environmental management of events.

Operational data

Event impact monitoring

The project captured data for both visitor consumption and the operational impact of the music festival. Using the data a carbon footprint assessment was made and, working with Cool Earth, an area of rainforest was protected. Views were also gained from the visitors for environmental improvements for future events.

In relation to collation of energy data, the energy supplier for the event advised that:

- it was hard to give accurate figures as the loads on individual machines varied greatly depending on times of day
- different machines also went online at different times
- these data are easy collect if collection is planned prior to the event.

Communicating environmental initiatives

It became clear through the capture of data that existing sustainable practices required better communication to visitors. Many visitors were unaware of the recycling options in place and the alternative travel options that could ease congestion issues on the site.

The event partnered with key environmental organisations. Cool Earth was able to use the event to advertise their work and collect donations. They created a photo board and produced wrist bands, and received endorsements from acts through quotes and interviews. A View Area was set up for Cool Earth, and resulted in over 19 000 Facebook 'views' of photos taken in this area, leading to Cool Earth 'fans' increasing by 3 000 % after the event.

Organising public transport

In partnership with National Express, a nationwide bus company, public transport to the event was promoted through provision of various options:

- a bus service from Newquay town centre to the festival site
- a direct footpath was created between the site and Newquay town centre to encourage people to walk to the event
- local contractors were used wherever possible to minimise transport emissions
- event bicycles used wherever possible.

In partnership with 'GoCarShare', car sharing was promoted via:

- a Green Car Tax of EUR 6 per day or EUR 10 for the weekend was introduced for those driving to the event (proceeds went towards the Cornish campaign group 'Surfers Against Sewage').

Waste management

The following actions were taken to reduce resource consumption and waste generation:

- where possible waste was sorted onsite and recycled
- event branding was reusable
- PVC branding used by third parties was reduced
- promotional material was printed from sustainable sources
- green procurement of catering ensured use of recycled packaging and recyclable utensils
- beer and cider was served in bottles which were recycled
- organic and local based caterers were used wherever possible
- a daily beach clean was organised at Fistral Beach.

The following recommendations were made by the waste contractor:

- uncontaminated segregation only happens with constant monitoring
- increase the number of staff to police waste segregation during the event
- waste should ideally be properly segregated onsite, using a combination of technology and a picking line.

These recommendations will be implemented for the 2012 event.

Applicability

Environmental assessment tools, such as the REAP model, can easily be applied to inform better practice in management of all types of event.

Carbon offsetting and other (associated) compensation measures, including the protection of rainforests, can be performed by all event organisers.

Similarly, organising additional public transport and waste recycling facilities can be undertaken when planning large events.

Economics

Investment in event management by destination managers can realise a high return for the destination's economy. For example, the 2009 Boardmasters event was estimated to attract EUR 7 million of visitor spend, and to generate total business turnover of almost EUR 10 million, supporting 129 full time equivalent jobs.

In this context, additional expenditure on environmental management is small, and can be more than compensated for by savings realised (e.g. reduced energy and waste disposal costs). Such expenditure can also be regarded as a sound investment in green marketing.

Driving force for implementation

This project was undertaken because VisitCornwall wanted to support local events to become greener and to help them to measure and manage their carbon footprint. This is regarded as making an important contribution to sustainable tourism development in the destination, that combines strong economic benefits (above) with sound environmental management.

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4 TOUR OPERATORS AND TRAVEL AGENT BEST PRACTICE

Tour operator sphere of influence

Tour operators are key actors within the tourism sector, with significant direct influence over:

- tourism service providers – transport (section 4.1), accommodations (section 4.2), food and drink providers, excursions and activities (section 4.4);
- destination managers – local authorities, regional authorities, national government, etc. (section 4.3);
- consumers and tourists – including choice of destination and transport mode (section 4.4), behaviour in the destination (section 4.5).

Through these relationships, tour operators also have significant indirect influence over environmentally important upstream supply chains that supply products and services to accommodation and food and drink providers, and over environmentally important functions under the remit of destination managers, such as land-planning and service provision within destinations (Figure 4.1).

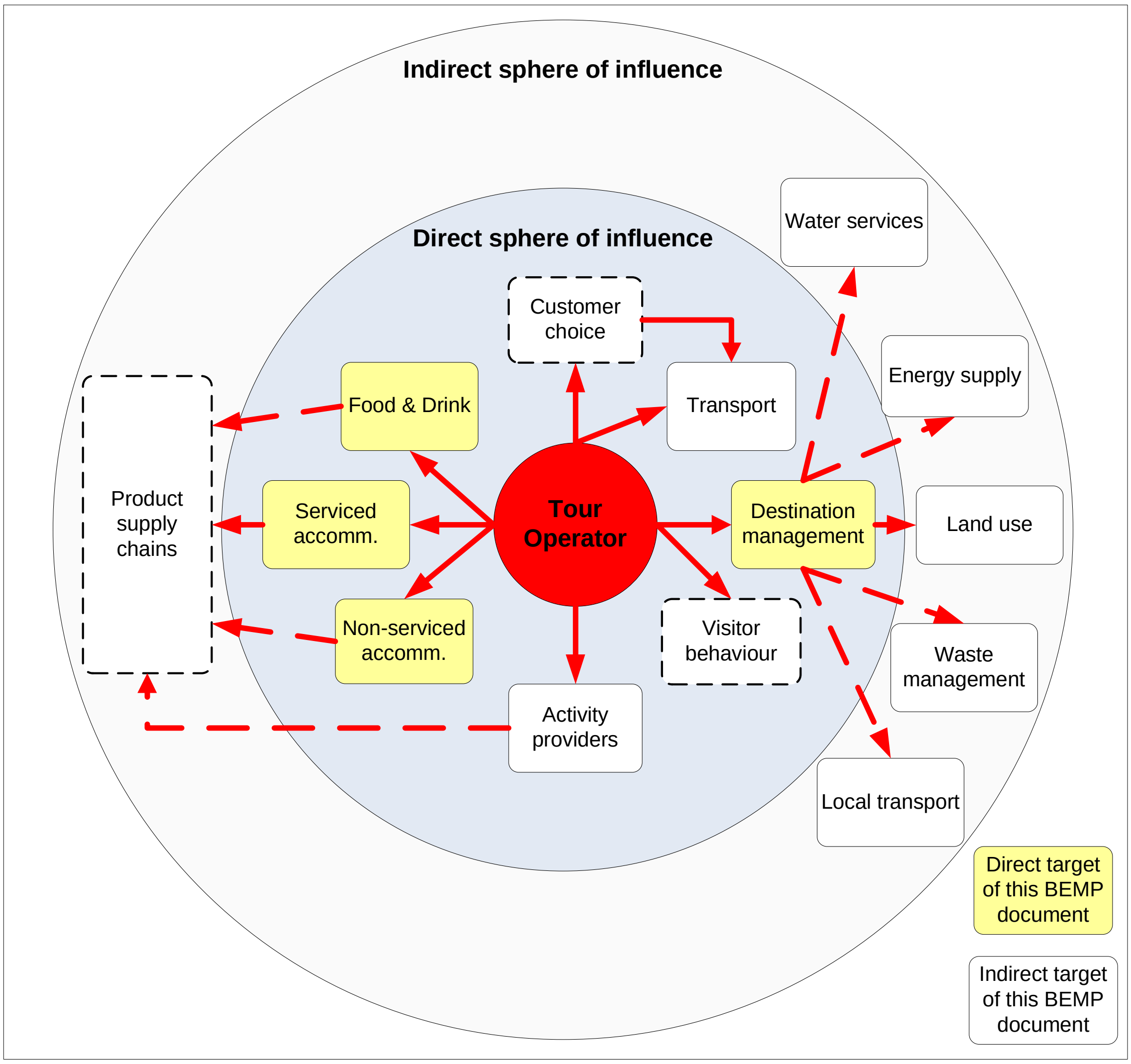
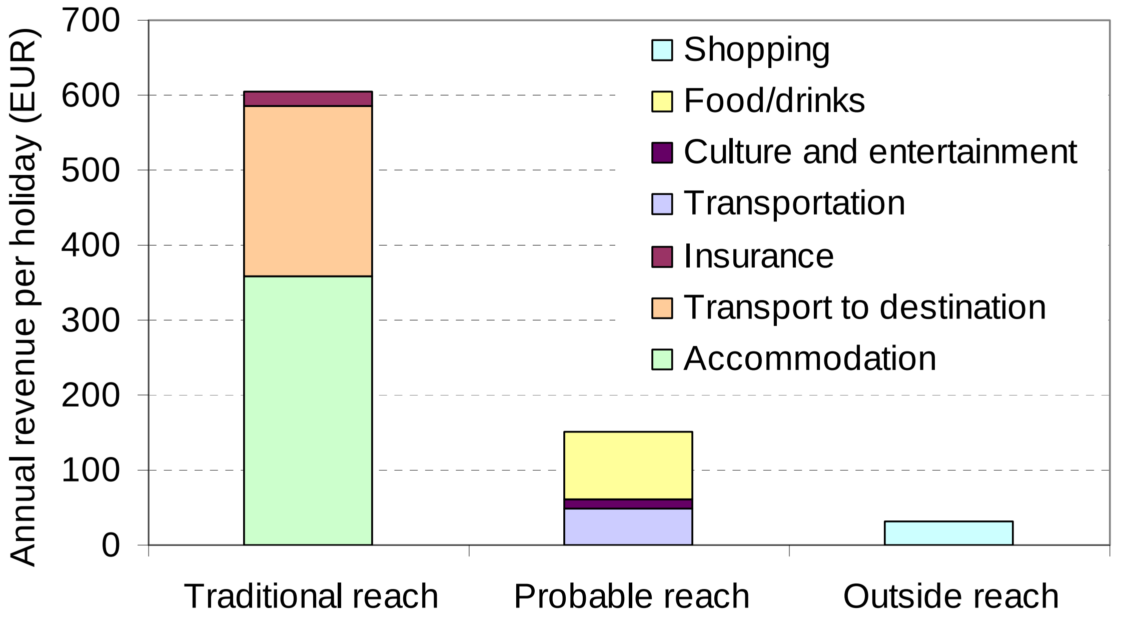


Figure 4.1: Major actors and aspects relevant to the environmental performance of tourism falling within direct and indirect spheres of influence of tour operators

Thus, tour operators are strategically positioned to coordinate and leverage sustainability improvements across the tourism sector – i.e. to improve the economic, social and environmental performance of the sector. Assured social and environmental standards form an increasingly important aspect of quality for many tourists. More than 90 % of customers expect their holiday company to work to tackle climate change and support destination communities, and 44 % have a better image of holiday companies that actively invest in environmental or social initiatives (TUI Travel plc, 2010). However, holiday-makers ranked environmental impact as the least important of nine criteria considered when choosing a holiday (TUI Travel plc, 2010), implying that customers expect tour operators and other key actors to take a leadership role in driving environmental improvement across the tourism sector. This is reflected in the following two statements made by customers replying to a TUI survey (TUI Travel plc, 2011):

- *'Of course I would like to think that my holiday was environmentally friendly and that I was helping the locals where I travel to, but I don't want to pay more for my holiday';*
- *'I go on holiday once a year and expect my holiday company to think about the environment I am travelling to, working with care and consideration, not just for the environment but also about the welfare of the people in the countries I choose to travel to'.*

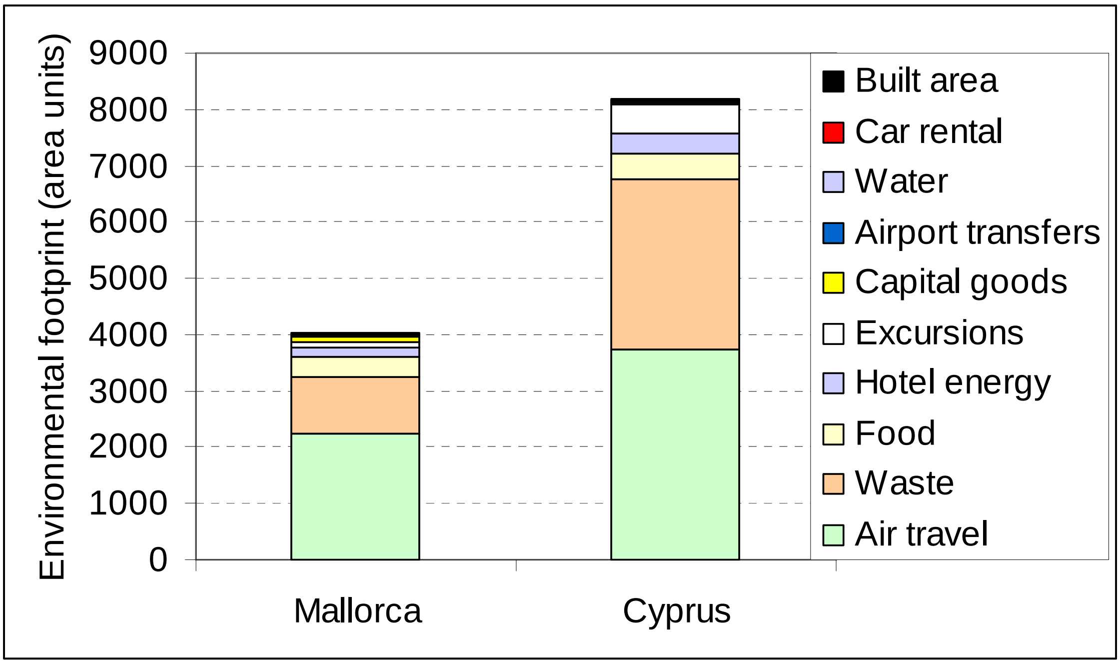
Figure 4.2 presents activities traditionally and potentially within reach of tour operator influence, highlighting how these represent the vast majority of typical holiday expenditure.



Source: Data from Döring and Neuhaus (2004).

Figure 4.2: The traditional and possible reach of tour operators, expressed in relation to holiday activities quantified by turnover for an average German holiday booking

WWF-UK (2002) performed a more complete environmental footprint assessment of two two-week package holidays from Thomson, to four star resorts in Mallorca and Cyprus, including accommodation, food, transfers, and air transport from London Gatwick airport (Figure 4.3). Air transport dominates not just the carbon footprint, but the overall environmental impact of typical package holidays offered by tour operators – accounting for 46 % and 56 %, respectively, of the total environmental footprint of the Mallorca and Cyprus package holiday examples (Figure 4.3). Waste management was the next largest source of environmental impact, followed by food supply chains and hotel energy consumption. Thus, tour operators have strong influence over important transport and accommodation impacts, and significant but weaker influence over important impacts related to waste management and food and drink supplies. In the latter cases, influence is exerted via accommodation suppliers, food and drink suppliers and destination managers.



Source: Data from WWF-UK (2002).

Figure 4.3: The environmental footprint (WWF methology) for two two-week package holidays

Driving forces for tour operators to drive supplier sustainability

Tour operators increasingly report on cultural and social aspects of sustainability in their tourism destinations. There has been particular emphasis on reducing human rights infringements, improving labour and working conditions, and avoiding sexual exploitation of children. These important issues fall outside the environmental scope of this document, although mechanisms used by tour operators to address these issues can also be applied to environmental issues (UNEP & TOI, 2005). Measures that improve environmental performance are often concordant with good economic and social performance, but on occasion there may be trade-offs that require evaluation by tour operators.

A small number of large tour operators dominate the industry in Europe, and margins are tight owing to high competition and a trend towards internet bookings (Döring and Neuhaus, 2004). Forty seven percent of the 1 500 respondents to a European survey had used the internet to make travel bookings (IDC Retail Insights, 2010), while a survey in the US identified a potential 98 million online travel customers, of whom 70 % had used online travel agency sites such as Expedia, Travelocity or Priceline and 60 % had booked directly with service provider companies (TIAA, 2005). In this context, sustainability objectives represent an important opportunity for tour operators and travel agents to differentiate and add value to their service compared with online competition. Thus, there are a variety of reasons for tour operators to implement sustainability measures, including the following listed by Travelife (2011):

- increased business, related to responsible image;
- reduced costs, associated with enhanced management and more efficient operations;
- improved access to capital, related to conformity with social and environmental criteria;

- human resource efficiency, related to motivation and retention associated with good performance;
- improved corporate image, increasingly perceived as an indicator of service quality;
- conservation of destinations, contributing to business continuity;
- risk management, reducing exposure to liability;
- government legislation, insofar as sustainability measures can facilitate compliance with, or avoid further, legislation.

Tour operator best practice guidance

The Travelife Initiative (Travelife, 2011) offers guidance to tour operators on implementation of sustainability management systems, with a focus on training and dissemination and implementation of best practices across tour operators and their suppliers (Table 4.1). The initiative has been introduced to over 450 European tour operators via associations including ANVR (NL), FTO and ABTA (UK), FAR (DE), ABTO, BTOV, VVR, BFNO and FBAA (BE), and intends to assist with the process of EMAS registration. A training manual has recently been published (Travelife, 2011) in which tour operators are provided guidance across eight modules based upon TOI methodology (listed below). Readers will be referred to these modules where relevant through this chapter on BEMPs for tour operators. Travelife modules comprise: (1) Sustainability management; (2) Internal management; (3) Sustainable supply-chain management; (4) Transport; (5) Accommodations; (6) Sustainable excursions; (7) Destinations; (8) Customer communication.

Table 4.1: A summary of the objectives and methods of the Travelife initiative, and instruments and tools provided to help tour operators achieve them

Objectives	Methods	Instruments and tools provided
– Improve the sustainability of travel products. – Improve customer satisfaction. – Improve the quality of life in destinations.	– Stimulate cooperation between tour operators and their suppliers. – Stimulate cooperation between tour operators and the people in the destinations. – Collate and disseminate collective knowledge of tour operators and their associations. – Generate a critical mass to achieve a standardised approach and 'level playing field'. – Contribute to the use of common standards in order to avoid 'standard proliferation'.	– Management system: an international management standard for the implementation of sustainable tourism by tour operators. – Training: a state of the art course including industry best practices. – Action Planning: setting and monitoring company commitments through an 'action planning system'. – Suppliers Assessment: best practice standards, advice and support, and assessment for tourism suppliers and destinations by means of the Travelife Sustainability System. – Market place: informing tour operators about best practice suppliers and initiatives world wide.

The Tour Operators Initiative for sustainable tourism development (TOI, 2010) was launched in 2000 by a group of tour operators with the support of the UNWTO, which hosts the TOI Secretariat, the UNEP and the UNESCO, to assist and encourage social and environmental responsibility across tour operators. In 2010, 16 tour operators were members of the initiative, including some of the largest tour operators in Europe. TOI (2010) provides detailed guidance and case studies on best practice classified according to five key areas of action:

- research and information exchange to explore and share ideas and practices on key environmental, socio-economic and cultural topics;
- capacity building to assist members of the Initiative and other tour operators in putting into practice sustainable development and management principles through publications, workshops, conferences and training;
- technical support for members of the Initiative to further their commitment to the sustainable development of tourism;
- communication to increase awareness on sustainability issues of key players in the tourism industry such as tourists, local communities and people, tourism trade associations, and local and national authorities with the main aim of improving the quality of the tourism experience at the local level;
- outreach to open direct dialogues with other tour operators and stakeholders.

In addition, the Global Sustainable Tourism Council (GSTC) is an organisation composed of a diverse global membership including UN agencies, leading travel companies, hotels, country tourism boards and tour operators. The GSTC promotes knowledge sharing and the adoption of sustainable tourism practices by both tourism service providers and tourists. Underpinning this work is a list of Global Sustainable Tourism Criteria, representing the minimum requirements that any tourism business should achieve to protect the world’s natural and cultural resources while ensuring tourism meets its potential as a tool for conservation and poverty alleviation.

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4.1 Reduce and mitigate the environmental impact of transport operations

Description

Global transport pressures

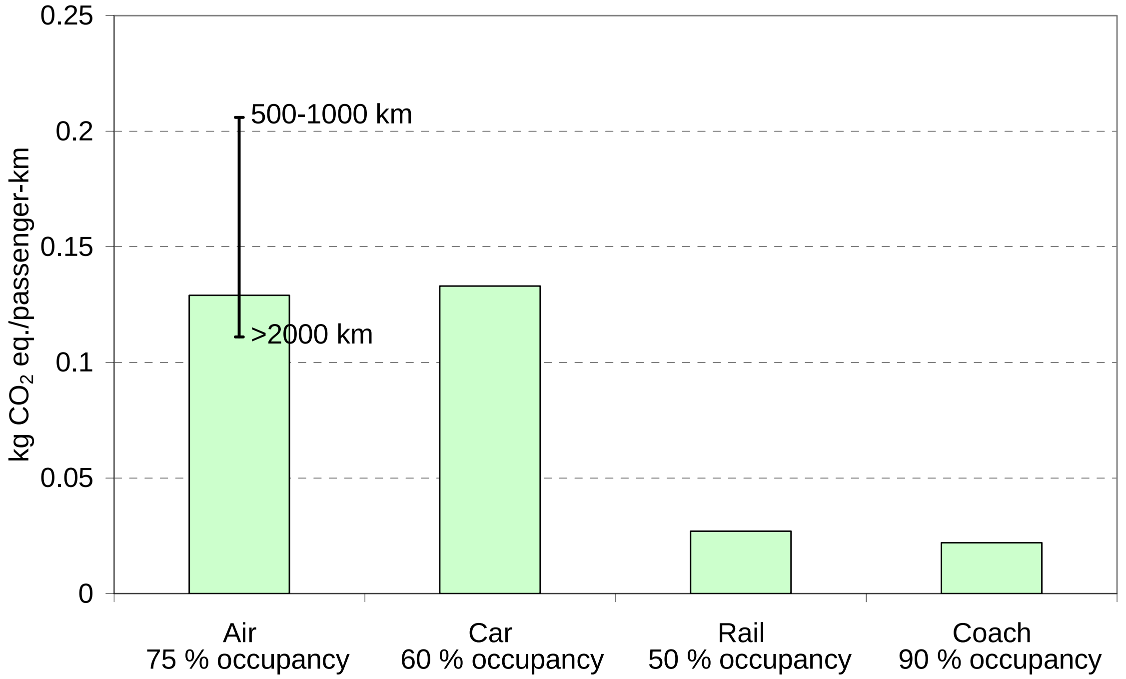
Data from Eurostat (2009) indicate that the dominant mode of passenger transport within the EU-27 is car, accounting for 4 602 billion pkm in 2006, followed by bus/coach, train, air and sea transport (Table 4.2).The growth trends are highest for air transport (4.6 %) and car transport (1.6 %).

Table 4.2: Passenger transport in the EU-27 between 1995 and 2006

Mode	**Billion passenger km**		**Annualised growth rate**
	1995	**2006**	**%**
Car	3 855	4 602	1.6
Bus/coach	501	523	0.4
Train	348	374	0.9
Air	335	547	4.6
Sea	44	40	-1.0

NB: Air and sea data include only domestic and intra-EU-27 transport.
Source: Eurostat (2009).

However, the modal distribution of transport for tourism is considerably different, being dominated by air transport that accounts for the emission of over 500 million tonnes CO_2 eq. annually (see Figure 1.9 in section 1.2.2). Specific emissions, expressed per pkm travelled, are high for air transport compared with other modes, though vary considerably depending on the distance (Figure 4.4) and load factors of different transport modes. Although total emissions are higher from long-haul flights, emissions per km are considerably lower.



NB: Excludes radiative forcing factor for air emissions.
Source: UNWTO et al. (2008).

Figure 4.4: Specific GHG emissions, expressed per passenger km, for different transport modes according to occupancy factors and, for air transport, distance

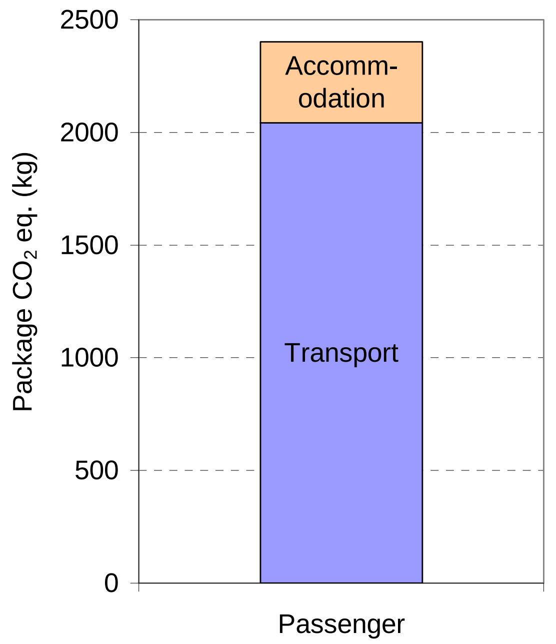
An extensive assessment of global data from ten years of commercial airline operations found that the efficiency of air transport, expressed as CO_2 per pkm, has improved by 20 % since 2000, but varies by a factor of 10 across the industry (Brighter planet, 2011). Efficiency was found to be dominated by five factors, listed in Table 4.3.

Table 4.3: Factors found to determine the efficiency of commercial air transport

Factor	Passenger-weighted correlation coefficient
Aircraft fuel efficiency (model, retrofits)	0.76
Load factor (operational)	0.52
Flight distance (operational)	0.35
Freight share (operational)	0.25
Seating density (cabin configuration)	0.11
Source: Brighter Planet (2011).	

Transport contribution to the environmental burden of tourism

A study undertaken by Breda University found that the average carbon footprint per passenger on tours sold by Sawadee in 2010 was 2 403 kg of CO_2 eq., with transport accounting for 85% and accommodation 15 % (Figure 4.5). Although the total carbon footprint and transport portion may be elevated in this example owing to a high proportion of long-haul flights associated with this specialist adventure tourism tour operator, it emphasises the importance of air transport with respect to tour operator package energy and GHG burdens. Figure 4.3 in the introduction to this chapter indicates that air transport accounts for approximately half of the overall environmental impact of all-inclusive package holidays (including food and drink supply chains, waste management, etc.).



Source: TUI Travel plc (2011).

Figure 4.5: The average carbon footprint of a Sawadee passenger

Tour operators have considerable influence over the environmental burden of transport operations. Firstly, they can promote closer destinations and more efficient modes, especially for distances up to approximately 1 500 km where trains may conveniently substitute flying (Travelife, 2012). Reducing the share of energy intensive transport modes such as flying and driving is an important aspect of best practice that overlaps with measures to promote more sustainable tourism packages (section 4.4) and encouraging more sustainable tourist behaviour (section 4.5). In addition, tour operators have strong direct influence over transport suppliers, and large tour operators such as Thomson Travel operate their own aircraft fleets. This control and influence can be used to increase the efficiency of transport operations.

<u>Best practice measures</u>

TUI Travel plc (2011) reports that cruise ships contribute 5 % towards the direct carbon footprint of the business, but cruises are excluded from this document owing to the high specificity of their operations. This BEMP section focuses on measures that tour operators can take to reduce and mitigate the environmental impact of transport operations (summarised in Table 4.4, below).

Initial priority measures are listed at the top of Table 4.4, and include first the monitoring of performance and the avoidance of unnecessary air travel. Trains and coaches offer convenient modes of transport up to 1 500 km (and further as high-speed rail networks expand). The latter measure overlaps with sections 4.4 and 4.5 describing how tour operators can influence customer choices and behaviour.

Subsequent measures are listed in approximate order of priority, with reference to Table 4.3 (above) for aircraft. Green procurement, retro-fitting and operational optimisation options are universally applicable and can improve economic efficiency as well as environmental performance for aircraft and buses/coaches. Such measures should be prioritised over carbon offsetting which only represents best practice in as far as it partially compensates for unavoidable emissions in the short term. In fact, the Responsible Travel campaign in the UK discourages carbon offsetting because of the danger that it distracts attention, and diverts efforts away from efficiency improvements (Responsible Travel, 2011). Nonetheless, where implemented properly, carbon offsetting can lead to environmental benefits at the global level and therefore is included as an element of best practice.

Table 4.4: Best practice measures to mitigate the environmental impact of transport operations based on different approaches listed in order of priority (highest on top)

Approach	Measure	Examples
Benchmark transport efficiency and improvement options	Monitor and report transport GHG emissions	TUI Travel plc (2011) report average emissions of 0.076 kg CO_2 pkm, and aim to reduce total direct carbon emissions by 6 % by 2013/14 (relative to 2007/08). Thomson Travel and TUI Nordic airlines implement ISO 14001 certified EMSs.
Choice editing	Do not offer flight packages where convenient alternatives exist	In order to be member of the Forum Anders Reisen association in Germany, tour operators must comply with a set of mandatory criteria: no flights offered up to 700 km, between 700 km to 2 000 km only if the client stays in the destination more than 8 days (Travelife, 2011).
Green procurement	Select the most efficient aircraft/vehicles	TUIfly Nordic removed inefficient Boeing 747s from its fleet, and is buying more efficient Boeing 787 Dreamliner aircraft. Rabbie's Travel operate minicoaches with Euro 5 engines
	Select efficient and environmentally responsible providers	TUI Nordic external carrier contracts require disclosure of average fuel consumption. Carriers with low fuel consumption and certified EMS are prioritised. All coach and bus companies contracted by TUI NL and OAD must be certified by the Dutch label 'Keurmerk Touringcarbedrijf' that includes safety, quality and environmental criteria (Travelife, 2011).
Retrofit aircraft/vehicles	Fit winglets (aircraft)	76 % of TUI Travel's aircraft are fitted with winglets. TUIfly is retro-fitting Boeing 767 aircraft
	Minimise weight	Thomas Cook have stripped aircrafts to the essential parts to remove unnecessary weight
	Adapt fuel systems to run on **sustainable** biofuels	Thomson Airways is trialling th use of a 50/50 blend of used cooking oil and kerosene on commercial flights between Birmingham and Palma. KLM is trialling the use of 50/50 blend of camelina-derived fuel and kerosene.
	Optimise engine management systems (coaches)	Rabbie's Travel operate mini-coaches with remapped engines tuned to use fuel more efficiently when combined with eco driving techniques
	Fit speed limiters (coaches)	No specific example provided
	Fit low rolling resistance tyres (coaches)	No specific example provided
Optimise operational efficiency (liaise with airport operators)	Maximise occupancy rates	Tuifly Nordic (2011) report a load factor of 94.1 % for 2009/10. Also important for buses/coaches (e.g. sending correct size mini-bus/coach for airport pickups, etc.)
	Driver training	Studiosus has begun to require coach and bus transport

Approach	Measure	Examples
	(coaches)	providers to install notices reminding drivers to stop the engine when waiting for passengers to board and leave the coach/bus (Travelife, 2011).
	Operate continuous decent approaches (aircraft)	98 % Thomson Airways flights achieved continuous descent approaches in 2009/10(*)
	Periodic cleaning of jets engines	Thomson Travel ensures jet engines are cleaned using closed-loop high pressure water twice per year
	Minimise engine use for ground operations	Assisted taxiing and connections to airport electricity
	Minimise impact of inflight services	Thomson Travel avoids plastic packaging for blankets, has reduced the weight of magazines, and recycles all drinks cans on inbound flights
Other measures	Promote public transport to departure points	Rabbie's Travel offices and departure points are all in city centers. TUI Deutschland provide all air package holiday customers with a second class rail ticket for travel to and from airports in Germany that includes the use of all public transport in twelve major German public transport associations. Bensbus offers low cost transfers from Grenoble airport to many major resorts in the French Alps by grouping everyone together and putting them all on one big bus (Travelife, 2011).
	Carbon offsetting (for emissions that cannot be avoided)	TUI Travel, in partnership with ClimateCare, has invested in five renewable energy projects in destinations, scheduled to offset in excess of 483 000 t CO_2 by 2013.
(*)excluding Air Traffic Control instructed or safety related deviations.		

Achieved environmental benefit

Air transport

Table 4.5 summarises some of the environmental benefits achievable through measures to improve environmental performance of air transport. Green procurement of efficient aircraft tailored to operational requirements, retrofitting with winglets, and regular cleaning of jet engines can result in significant improvements in fuel efficiency and reductions in associated emissions (see Table 4.6 and Table 4.7, below).

Table 4.5: Environmental benefits reported for specific measures to mitigate the impacts of air transport

Measure	Environmental benefit
Benchmarking and operational efficiency improvement across fleet(s)	A 6 % (>300 000 t CO_2 eq.) reduction in GHG emissions between 2007/8 and 20013/14 for TUI Travel airlines
Green procurement	New Boeing Dreamliner 20 % more efficient than Boeing 767
Continuous descent approaches	300 kg CO_2 per flight, 8.9 t CO_2 over fleet (Thomson, 2011)
Cleaning jet engines	Up to 750 t CO_2 eq. per aircraft per year (Thomson, 2011)

Measure	Environmental benefit
Retrofitted winglets	5 – 6 % reduction in fuel consumption (TUI Nordic, 2008; Thomson Travel, 2011)
Carbon offsetting	483 000 t CO_2 emissions directly offset by 2013 (TUI Travel plc, 2011)
Minimise impact of inflight services	Recycling of one million drinks cans per year, avoidance of 900 000 plastic bags per year, saving of 29 t CO_2 eq. per year from smaller magazines

Coach transport

The environmental benefits achievable from green procurement of buses and coaches with cleaner engines are indicated by the differences in emission limits between lower and higher EURO tier standards displayed in Table 4.8, below.

Purchasing CNG or biogas powered buses and coaches can lead to significant reductions in CO_2 and air pollutant emissions, especially particulates.

Low rolling resistance tyres on large vehicles can reduce fuel consumption by up to 5 %, whilst automatic tyre inflation can result in further savings of a similar magnitude (Ricardo, 2010).

Training drivers in efficient driving techniques can reduce fuel consumption and associated emission by up to 10 %.

Fitting particulate filters can reduce particulate matter emissions by between 85 % and 99 % (TfL, 2011).

Carbon offsetting

All GHG emissions arising from transport may be offset through appropriate carbon offset schemes. Although such an approach is not sustainable in the long term and should not substitute efficiency measures, it can lead to environmental benefits by:

- avoiding GHG emissions elsewhere
- stimulating low-carbon development (e.g. renewable energy)
- protecting HNV areas (e.g. rainforest)
- enhancing local biodiversity and ecosystem functions (where trees are planted).

Appropriate environmental indicator

Transport impacts

Various indicators may be used to determine transport impacts, normalised per passenger km or per 100 passenger km travelled. Two basic indicators are recommended for universal reporting:

- fuel consumption, expressed as litres per 100 pkm travelled;
- direct CO_2 emissions, expressed as kg CO_2 per pkm travelled.

Tour operators often refer to 'revenue passenger km', excluding people who have not paid for their seasts, most notably staff and babies. Direct direct CO_2 and other GHG emissions (CO_2 eq.) can be calculated by applying simple multiplication factors to fuel consumption (Table 4.6). Other environmentally important direct emissions arising from transport include particulate matter (PM), SO_x, NO_x and non-methane volatile organic compounds (NMVOCs). Some of these can be calculated from fuel consumption according to fixed emission factors. For example, for air transport IFEU (2010) report an emission factor of 1.0 g SO_x per kg fuel consumed. Other direct emissions depend on the combustion and abatement technology integrated into the mode, and the use pattern. For air transport, take-off and landing account for a large portion of NMVOC, and to a lesser extent NO_x, emissions, so that emission factors per pkm or litre of fuel typically decline significantly as the distance travelled increases (Table 4.7).

Indirect emissions arising from fuel extraction, processing and supply are also important, and significantly increase the lifecycle environmental burden of transport (Table 4.6). Furthermore, aircraft emissions at high altitudes give rise to additional radiative forcing effects, increasing their global warming potential relative to emissions at ground level. Best practice is for tour operators to refer to aircraft-specific emission factors when selecting aircraft or transport providers, and to multiple aircraft emissions by a relevant radiative forcing index (RFI) when comparing mode options and when calculating quantities of carbon to be offset. Appropriate RFIs are proposed in the 'Operational data' section.

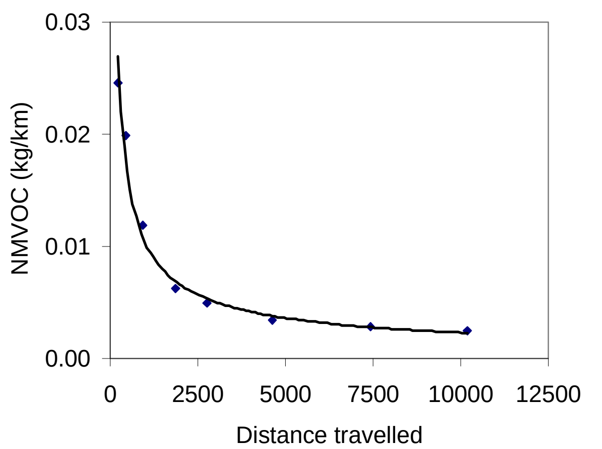
Table 4.6: Direct and indirect emissions attributable to fuel consumption for the main fuel types

Fuel	Direct effects			Indirect effects					
	Energy	**CO_2**	**CO_2 eq.**	CO_2	Energy	NO_x	SO_2	NMVOC	PM
	MJ / L	**Kg / L**	**Kg / L**	kg / L	MJ / L	g / L	g / L	g / L	g / L
Gasoline	**32.1**	**2.24**	**2.25**	0.48	8.03	1.52	4.18	1.52	0.21
Diesel	**36.0**	**2.55**	**2.57**	0.39	7.92	1.49	3.64	1.26	0.19
Biodiesel	**38.1**	**0**	**0.015**	0.73	15.24	5.25	1.36	0.95	0.60
Kerosene	**35.3**	**2.52**	**2.55**	0.36	7.41	1.41	3.44	1.21	0.18

Source: IFEU (2010) and DEFRA (2011).

Table 4.7: Variation in direct emissions per km for a 747-400 type aircraft with journey distance

Distance	CO_2	NO_x	NMVOC	PM
	kg/km			
232	86.2	0.513	0.0246	0.0039
926	45.4	0.245	0.0119	0.0025
2 778	34.9	0.161	0.0049	0.0021
10 186	35.7	0.166	0.0025	0.0022



Source: IFEU (2010).

For coaches, EURO emission standards (tiers EURO I to EURO VI) define limits for the major polluting emissions, and are a useful reference for coach performance and for green procurement of new or used coaches and transport providers (Table 4.8).

Table 4.8: Emission limit values for heavy duty diesel engines associated with various EURO standards, expressed per kWh engine output, and year of introduction

Tier	Date	Test	CO	HC	NOx	PM	Smoke
			g/kWh				m^{-1}
EURO I	1992	ECE R-49	4.5	1.1	8.0	0.36	
EURO II	1998		4.0	1.1	7.0	0.15	
EURO III	2000	ESC + ELR	2.1	0.66	5.0	0.1	0.8
EURO IV	2005		1.5	0.46	3.5	0.02	0.5
EURO V	2013		1.5	0.46	2.0	0.02	0.5
EURO VI	2013		1.5	0.13	0.4	0.01	

NB: Values are for steady-state testing (ECE R-49), European Stationary Cycle (ESC) and European Load Response (ELR).

Source: DieselNet (2009).

TUI Nordic provide an example of best practice with respect to transport performance benchmarking, also collating data from external transport providers (Table 4.9).

Table 4.9: Basic data related to environmental performance reported by TUI Nordic (2011)

	Customers	GHG emissions	Fuel efficiency	Specific emissions(*)
	Number	Tonnes CO_2	L/100 pkm	kg CO_2/pkm
TUIfly Nordic	680 264	361 201	2.66	0.067
Contracted airlines	591 462	427 219	2.70	0.068

(*)Calculated based on 2.522 kg CO_2 eq./L kerosene.

<u>Carbon offsetting</u>

Details on how to calculate quantities of carbon to be offset (i.e. to include RFI for aviation emissions) are provided under 'Operational data', below). The most important aspect of best practice for carbon offsetting is to ensure that it is based on genuine and **verified additional** carbon avoidance (e.g. additional renewable energy installation) or sequestration (e.g. additional aforestation). This can be achieved in two ways:

- direct investment in carbon avoidance/sequestration projects
- purchase of third-party verified carbon offset certificates.

In relation to the latter option, the most rigorous verification of carbon offsetting is applied to Carbon Reduction Units (CRUs) officially recognised under the UN Framework Convention on Climate Change (UNFCCC) Kyoto protocol. Such verification is obtained through certification with Clean Development Mechanism (CDM) and Joint Implementation (JI) standards. For the voluntary carbon offsetting market, a number of certification standards exist. Three important standards are summarised in Table 4.10, based on information provided by the Carbon Fund (2011).

Table 4.10: Three major certification standards used to verify the integrity of carbon offsetting schemes

VCS VOLUNTARY CARBON STANDARD	The Verified Carbon Standard is the result of more than two years of consultation headed by groups including The Climate Group, the International Emissions Trading Association and the World Economic Forum. The most recent set of standards, known as VCS Program Guidelines 2007.1, were released in 2008. VCS is building international consensus by reviewing other existing standards and endorsing them as approved VCS programmes. To date, approved VCS programmes include the UNFCCC's CDM and Joint Implementation (JI). VCS-certified offsets must be real, additional, measurable, permanent, and independently verified. The certification is designed to standardize and bring transparency to the voluntary carbon offset market, as well as create a trusted and tradable offset credit, called a Verified Carbon Unit.
CCB Standards The Climate, Community & Biodiversity Alliance	The Climate, Community & Biodiversity Standards are a comprehensive set of standards that take into account a land-based carbon reduction project's impact on the climate, local community, and regional biodiversity. Released in 2005 and updated in 2008, the standards were developed through a broad partnership between the nonprofit and private environmental communities. The partnership includes world-class organisations such as Conservation International, Rainforest Alliance, The Nature Conservancy and CARE. Certification requires developers to go beyond what is required of the Kyoto Protocol's Clean Development Mechanism (CDM) or other carbon accounting standards like the VCS by generating positive community and biodiversity benefits. Projects from all over the world are eligible and all land-use activities are covered, including reforestation and agricultural carbon sequestration. More than 150 projects around the world are under development using the CCB Standards.
The Gold Standard Premium quality carbon credits	The Gold Standard is widely used for projects aimed at satisfying the United Nations' CDM and JI programmes, although it may also be used in the voluntary carbon offset market. Launched in 2003 by the World Wildlife Foundation, SouthSouthNorth, and Helio International, the standard also carries the endorsement of more than 49 non-governmental organizations worldwide. The standard focuses exclusively on renewable energy and energy efficiency projects, on the basis that a large-scale shift in demand to clean energy technologies will be essential to mitigate global climate change. The Gold Standard, a nonprofit organisation based in Switzerland, awards the certification based on an independent verification of project design, greenhouse gas reduction, and additionality. Organisations performing the verifications are accredited by the United Nations.

Source: Carbon Fund (2011).

<u>Benchmark of excellence</u>

In the first instance, best practice for tour operators to reduce energy intensive travel modes can be represented by the Forum Anders Reisen criteria for flying:

BM: tour operators do not offer flights for: (i) destinations less than 700 km; (ii) destinations up to 2 000 km away for a duration of stay less than eight days, or; for destinations more than 2 000 km away with a duration of stay less than 14 days.

The first aspect of the benchmark (flights less than 700 km) is not applicable to islands, including the UK and Ireland, where it is often not possible to travel 700 km without taking a boat or plane.

TUIfly Nordic achieves the lowest specific fuel consumption of all TUI fleets, averaging 2.66 L/100 pkm, translating into a direct CO_2 emission factor of 0.067 kg CO_2 per pkm in 2009/10. TUIfly Nordic have a target to reduce these figures to 2.34 L/100 pkm and 0.059 kg CO_2 per pkm by 2014. This target is therefore proposed as a benchmark of excellence.

BM: tour operator airline fleets achieve average specific fuel consumption of ≤2.7 litres per 100 passenger km, falling to ≤2.4 litres per 100 passenger km by 2014.

The Austrian Ecolabel awards points for the use of EURO 5-compliant vehicles, or vehicles propelled by alternative means (e.g. hybrid, natural gas). There are few data available on coach fuel consumption, but average fuel consumption for a 55-seat coach is 30 litres per 100 km, and can be reduced to 26 litres per 100 km through basic efficiency measures (Scania, 2010). Based on this information, the following benchmark of excellence is proposed.

BM: average coach or bus fleet fuel consumption of ≤0.75 litres per 100 passenger km and at least 90 % of fleet are EURO 5- compliant or run on alternative fuel systems.

The fuel consumption benchmark assumes average vehicle occupancy of approximately 70 % for a large, efficient coach. Fuel consumption may be significantly higher for smaller coaches and minibuses, and/or where occupancy rates are unavoidably lower.

A number of tour operators automatically include contributions to carbon offset schemes to compensate transport GHG emissions in the price of the packages they sell. Such operators include Club Robinson (part of TUI), Crystal Holidays, Discovery Initiatives, Greentours, High and Wild, South American Experience Ltd, The Expedition Company, The Last Resort, Wildlife World. A final benchmark for tour operators with respect to transport best practice is thus:

BM: transport GHG emissions from all packages sold are automatically compensated by investing directly in GHG avoidance projects or by purchasing certified carbon credits.

Cross-media effects

Measures to shift from flying to more efficient transport modes, and to reduce fuel consumption, are not associated with any significant cross-media effects. Measures to reduce non-CO_2 emissions such as NO_x and particulates can sometimes result in small fuel consumption increases, although the overall environmental effect is positive.

Operational data

Environmental management

Best management practice with respect to monitoring and benchmarking environmental performance is to monitor total fuel consumption and associated CO_2 emissions, and report on a per passenger km basis, as described under 'Appropriate environmental indicator' (above). To enable the identification of efficiencies, performance should be benchmarked at least across routes and vehicle or aircraft types, and ideally for individual vehicles and drivers or pilots. It is important to include the performance of external transport providers. TUI Nordic specifiy data requirements in contracts with external transport providers, and are thus able to benchmark their performance (see Table 4.9, above).

Green procurement and retrofitting

Selecting the most efficient aircraft for operations and retrofitting existing aircraft with winglets are major decisions regarding operational efficiency, and therefore should be driven by economic considerations. Meanwhile, the use of biofuel-kerosene blends containing up to 50 % biofuel does not require retrofitting of aircraft fuel or engine systems, and meets all of the critical specifications for flights (e.g. a freeze point of -47 ºC or below and a flash point of 38 °C or above). More sustainable biofuels are produced from non-food crops and waste products, such as used cooking oil, camelina oil, jatropha oil, and algae. The latter three feedstock require conversion via an hydrogenation process.

New coaches and minibuses should be compliant with high EURO emission standards, but when purchasing used vehicles it is important to select the most efficient vehicles that comply with the highest possible EURO standard (preferably EURO 5 or EURO 6). The fleet's oldest trucks should be replaced first to achieve maximum benefit.

Older vehicles may also be retrofitted to improve their environmental performance. In addition to modifications to the engine management system to optimise fuel consumption in relation to typical use patterns, selective catalytic reduction and urea dosing systems may be added to reduce NOx emissions. Diesel particulate filters (DPF) may also be fitted to reduce PM emissions. This option may be necessary for older public transport vehicles to be allowed free access into Low Emission Zones (LEZs) in Europe, such as city centres. Transport for London (TfL) has produced guidelines on how to comply with the London LEZ, including case studies. One such case study, for a EURO 2 compliant Mercedes Sprinter minibus registered in 1999, is referred to here (TfL, 2011). As with other popular vehicle models, a 'direct fit' solution is available at a cost of approximately EUR 1 700. TfL specifies an approved list of DPF models and fitters that allow entry into the LEZ (www.tfl.gov.uk/lez). Following fitting, the vehicle owner must obtain a Low Emission Certificate to prove that the DPF is working properly, from an official vehicle testing centre, specified at: http://www.businesslink.gov.uk/lez. This certificate enables the minibus to enter into the LEZ without charge after January 2012. DPFs can reduce PM emissions by between 85 % and 99 %, and represent best practice. Partial filters are also available that reduce PM emissions by between 30 % and 50 % (TfL, 2011).

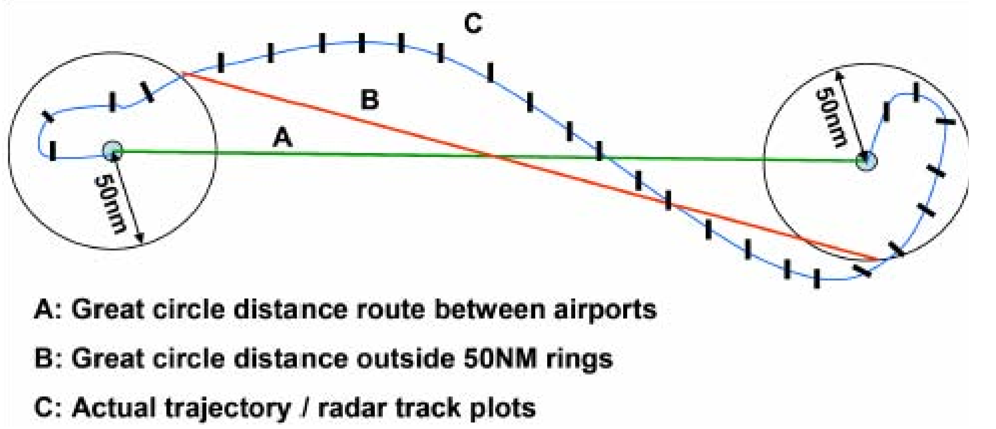
Coaches and minbuses may also be fuelled with 'biodiesel'. The most sustainable biodiesel is made from waste cooking oils (see section 8.2), as this does not require dedicated cultivation of rape seed or other high-input crops. The European Commission provides guidelines on how to identify more sustainable biofuels (EC, 2010) – these should be referred to in order to ensure that biofuels are sourced from the most sustainable sources. Third-party certification with recognised labels is the most rigorous form of identification (Table 4.11). New options, such as the production of 'second generation' biofuels from low-input woods and grasses, and algae, are being developed (EBTP, 2011). In addition, buses and coaches may be purchased that can run on biogas, produced from anaerobic digestion of organic waste (sections 3.3 and 8.2).

Table 4.11: Schemes recognised by the European Commission for identifying sustainable biofuels, as of July 2011

List of schemes
ISCC (German government financed scheme covering all types of biofuels) Bonsucro EU (Roundtable initiative for sugarcane-based biofuels, focus on Brazil) RTRS EU RED (Roundtable initiative for soy-based biofuels, focus on Argentina and Brazil) RSB EU RED (Roundtable initiative covering all types of biofuels) 2BSvs (French industry scheme covering all types of biofuels) RSBA (Industry scheme for Abengoa covering their supply chain) Greenergy (Industry scheme for Greenergy covering sugar cane ethanol from Brazil)
Source: EBTP (2011).

Operational optimisation
Two important aspects of operational optimisation for air transport are the minimisation of transport distances and the implementation of continuous descent approaches.

Flight distances are significantly greater than direct airport-to-airport distances owing to air traffic control logistical constraints and associated practices such as stacking (Figure 4.6). In addition to circling airports on take-off and landing, deviations from direct routes between airports increase flight distances by an average of 4 % in Europe (IFEU, 2010). Work is ongoing to more closely coordinate air traffic control systems across Member States in order to optimise air transport distances (i.e. to achieve routes closer to line 'B' in Figure 4.6). Tour operators may play a role in this through lobbying and the provision of data demonstrating the potential benefits (i.e. distances and emissions reductions) that could be achieved through route optimisation.



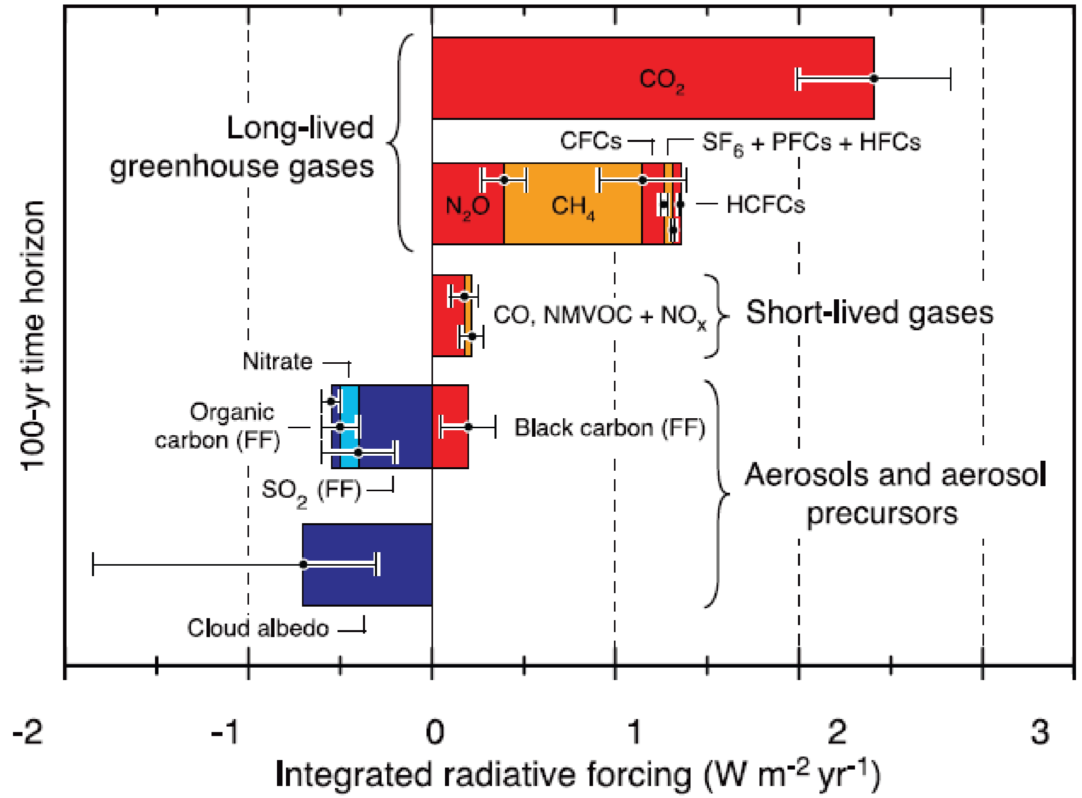
NB: NM = nautical miles.
Source: IFEU (2010).

Figure 4.6: Representation of actual flight distance between two airports

Driver training in efficient driving techniques may be supported by performance monitoring based on vehicle fuel consumption data for each driver and periodic re-training (e.g. every two years). There are also vehicle retrofit systems that provide drivers with real-time feedback on their driving style. For example, Stagecoach in the UK employs the GreenRoad 360 system that uses a dashboard traffic light style system that informs drivers of their efficiency based on speed, braking, acceleration, lane-handling and turning. Stagecoach aims to achieve reductions in fuel consumption of 4 % through the implementation of this system (Stagecoach, 2011).

Performance bonuses may be offered to the most fuel-efficient drivers to further encourage implementation of eco-driving skills. For example, Stagecoach operate an EcoDriver incentive scheme that gives employees the chance to earn 'green points' that are converted into financial benefits from a potential one million EUR annual bonus pot.

Calculating carbon offset
Carbon offsetting may be based on direct carbon emissions, calculated from emission factors presented in Table 4.6 (above). For air transport emissions, best practice is to multiply emissions by a relevant RFI that reflects the integrated radiative forcing (i.e. global warming) potential of emissions at high altitude, including indirect ozone- and cloud- formation effects (Figure 4.7).



Source: Figure 2.22 on p. 206 of IPCC (2007).

Figure 4.7: Integrated radiative forcing of all anthropogenic GHGs emitted in the year 2000 over a 100-year time horizon

Forster et al. (2006) emphasise the uncertainties involved in RFI calculation, refleting factors such as time-scale sensitivity and dependence on location and altitude. Nonetheless, IFEU (2010) propose specific RFIs for air transport according to flight length and altitude to fully reflect climate impacts (Table 4.12). Tour operators are recommended to multiply direct CO_2 emissions by the appropriate RFI(s) in order to calculate the full quantity of carbon to be offset.

Table 4.12: Radiative Forcing Index factor applied to aircraft GHG emissions, depending on altitude (flight length)

Flight distance (km)	Flight % above 9 000 m altitude	Average RFI factor
500	0 %	1.00
750	50 %	1.81
1 000	72 %	2.18
2 000	85 %	2.53
4 000	93 %	2.73
10 000	97 %	2.87
Source: IFEU (2010).		

Forum Anders Reisen (2011) have produced criteria for carbon offsetting of flight travel by tour operators that may be regarded as best practice, based on the Atmosfair standard (Atmosfair, 2012). This standard requires aircraft GHG emissions to be multiplied by an RFI of at least 2.7, and that projects to offset GHG emissions meet the standards of the CDM and the Gold Standard.

Carbon offsetting

Travelife (2011) recognises the following levels of involvement of tour operators with respect to carbon offsetting:

1. indicating the GHG emissions (related to international transport) to the client and referring to a credible compensation scheme
2. offering a voluntary carbon offset service as part of the booking process
3. including GHG compensation as an integral part of the package price.

The third level of involvement represents best practice. Any competitive (price) disadvantage may be compensated through improved company image (Travelife, 2012).

Tour operators may fund or purchase credits for projects certified by carbon offset standards. The Gold Standard (Table 4.10, above) is one of the most rigorous carbon offset standards, only awarded to projects that shift economies away from fossil-fuel dependence and that have a range of sustainability benefits (WWF, 2011). The Gold Standard was initially conceived to certify UN CDM and JI credits, but now includes a simplified methodology for voluntary carbon offset projects based in low-income countries. Two categories of project activities are eligible for Gold Standard registration.

- Renewable energy supply: the generation and delivery of energy services from non-fossil and non-depletable energy sources.
- End-use energy efficiency improvement: activities that reduce the amount of energy required for delivering or producing non-energy physical goods or services.

Alternatively, tour operators may directly instigate carbon offset projects. One option is to combine carbon offsetting with destination improvement through aforestation schemes, following the example of TUI's aforestation scheme in Mallorca. Some relevant considerations for carbon sequestration calculations are referred to below.

One hectare of mature forest in Europe can store up to 300 tonnes of carbon in soil, litter, roots and wood, depending on the climate, soil type and tree species (Figure 4.8). However, it takes decades for forests to mature following establishment (Figure 4.9), and net carbon sequestration depends on previous land use. Annual carbon sequestration rates following tree planting are therefore in the range of 3 to 15 tonnes per hectare per year of carbon (44 to 55 t/ha/yr CO_2), and should be calculated following Land Use, Land Use Change and Forestry (LULUCF) accounting guidelines specified in IPCC (2003).

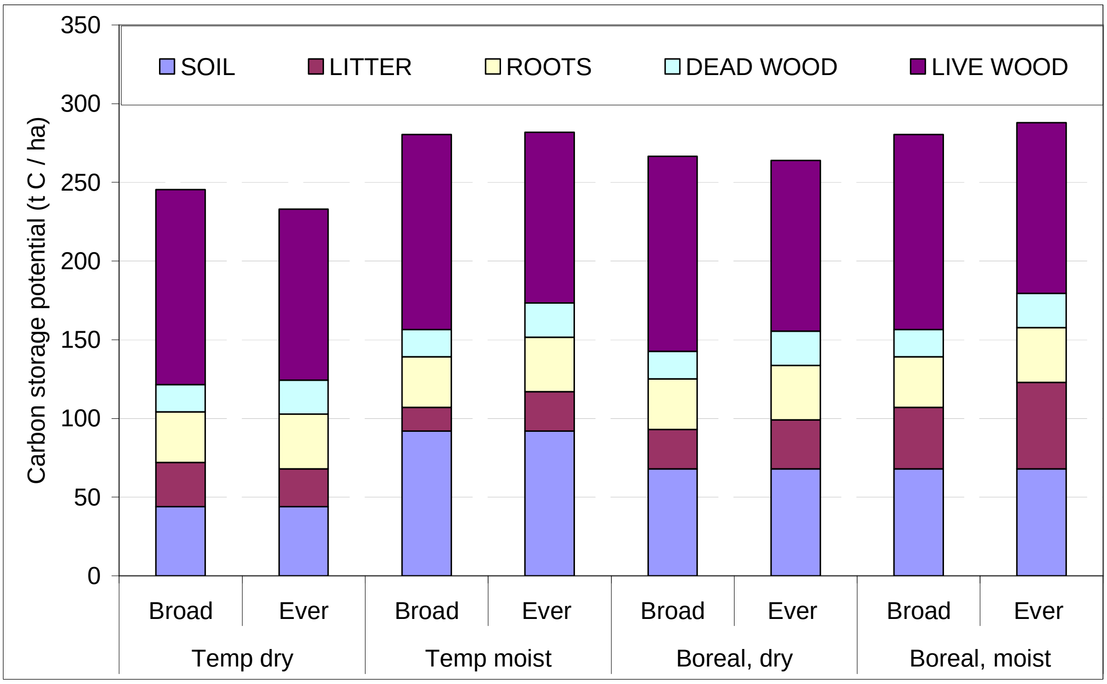


Figure 4.8: Carbon storage in soil, litter, dead wood and live wood fractions of broadleaf and evergreen forests under different climatic conditions (based on values in IPPC, 2003)

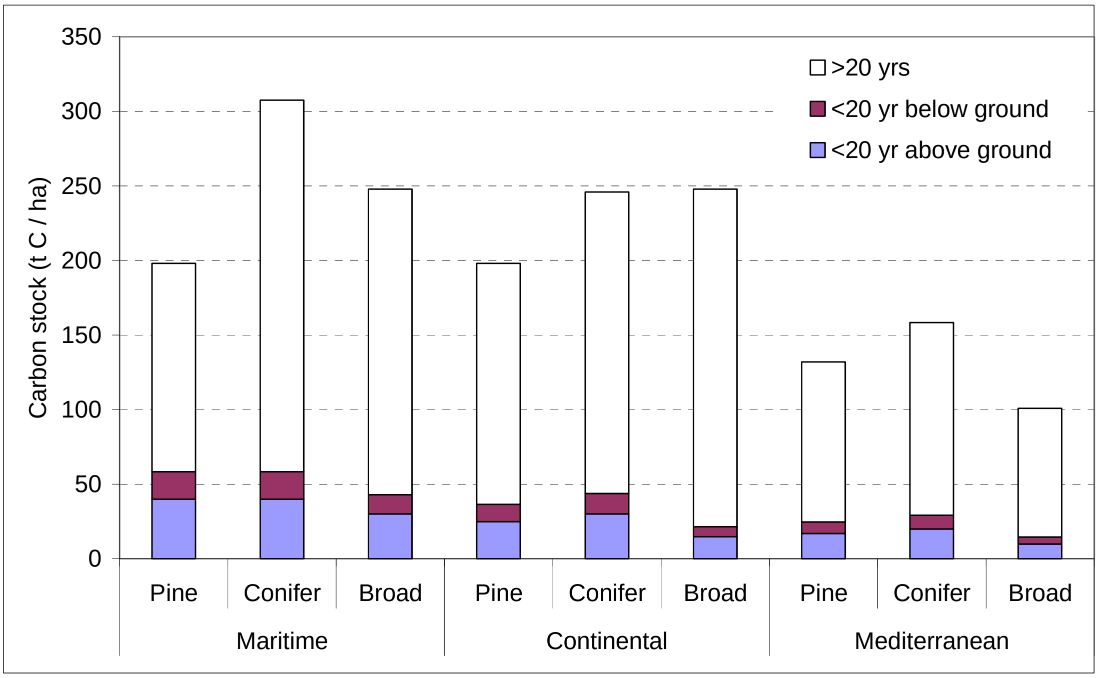


Figure 4.9: Carbon storage in above ground and below biomass fractions of young (less than 20 year old) pine, conifer and broadleaf forests in different climatic zones, and total carbon storage in mature (more than 20 year old) forests (based on values in IPPC, 2003)

Applicability

All tour operators can implement an environmental management system based on monitoring of environmental key performance indicators, and can undertake carbon offsetting. All tour operators can also undertake a number of the additional measures contained in this BEMP section for air transport and coach operations.

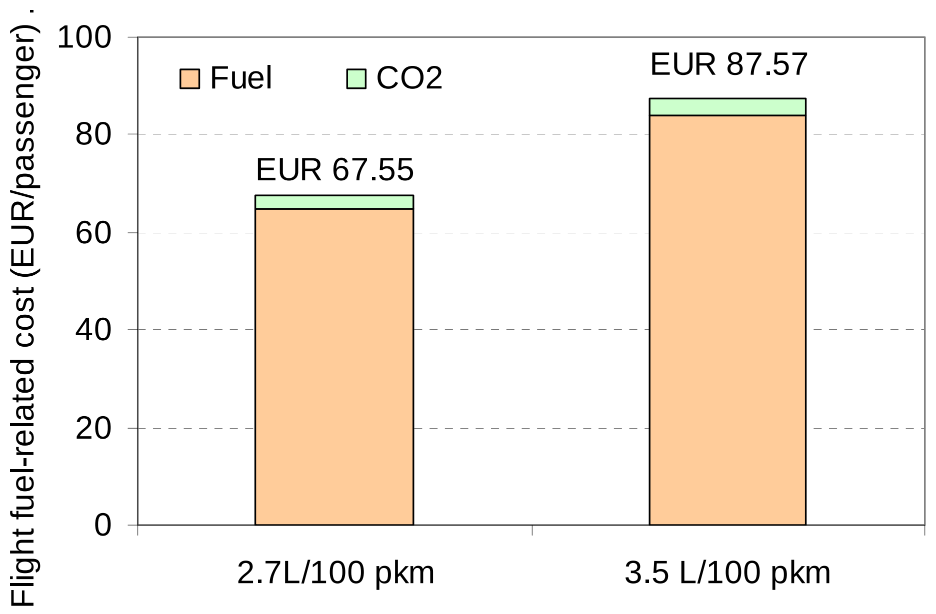
Green procurement of efficient aircraft/vehicles is only applicable at economically-determined replacement periods.

The benchmark of excellence for air transport may be more challenging for tour operators with a higher share of shorter flights. Nonetheless, best practice in relation to influencing more sustainable tourist behaviour is to encourage alternative transport modes for short-haul tours (section 4.5).

Economics

Air transport

Assuming a jet kerosene price of EUR 0.60 per litre (IATA, 2011) and emission allowance price of EUR 10 per tonne CO_2 under the European Emission Trading Scheme (which will include emissions from all flights in, to and from the EU from 2012 onwards), fuel related costs for a return flight of 2000 km each way could be reduced by EUR 20 per passenger by increasing fuel efficiency by 23 % (from 3.5 to 2.7 L per 100 passenger km) (Figure 4.10). Although modest, this represents a significant potential increase in average profit margin for tourism package offers.



NB: Based on jet kerosene price of EUR 0.60 per litre and a carbon price of EUR 10 per tonne CO_2 (Point Carbon, 2011).

Figure 4.10: Fuel related costs per passenger for a return flight of 2 000 km each way, based on average fuel consumption of 2.7 and 3.5 L/100 pkm

The additional cost of purchasing carbon allowances is small, amounting to EUR 0.0255 per litre of kerosene costing approximately EUR 0.60, and compared with taxes in excess of 50 % for land transport fuels.

Tour operators or tourists may purchase carbon offset certificates for a similar price, representing a small premium on ticket prices.

Coach/bus

Buying more efficient new coaches, or coaches able to run on alternative fuels such as compressed natural gas or biogas, can pay back within a few years based on reduced operating costs. The cost and payback of retrofit options vary widely, depending on the complexity of application and commercial implications relating to factors such as accessibility to city centre areas. For instance, particulate filters may be fitted relatively simply to mini-buses by replacing the front silencer on the exhaust system, at a modest total fitted cost of approximately EUR 1 700 (TfL, 2011).

Driving force for implementation

The main driving force for BEMP measures described in this section is to reduce operational costs through efficiency improvements and reduced fuel consumption. Inclusion of aviation in the European Emission Trading Scheme adds a small additional incentive for tour operators to improve the efficiency of air transport.

Corporate responsibility and stakeholder (shareholder, customer) expectations are two important factors driving the accounting and reporting of transport carbon emissions, and subsequent reduction and offsetting measures. Improving company image and reducing reputational risk are two important criteria in the decision making process of large companies in particular.

For coaches and buses, European emission legislation is driving improvements across new vehicles. Meanwhile, the retrofitting of older vehicles is being driven in part by maximum emission limits for vehicles allowed into Low Emissions Zones in Europe, including city centre areas of high tourism importance.

Reference companies

TUIfly Nordic, Shearings Holidays.

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4.2 Drive environmental improvement of accommodation providers

Description

Tour operators can improve the environmental management and performance of their accommodation suppliers through a range of voluntary measures and mandatory requirements (Figure 4.11). The key element of best practice is for tour operators to drive systematic improvement across all suppliers. The environmental rigour of the main improvement mechanisms available to tour operators increases from the top left to the bottom right of Figure 4.11.

From an environmental perspective, the most rigorous and verifiable mechanism to ensure high levels of environmental performance across suppliers is to require universal certification of suppliers according to one or more environmental standards such as the EU Flower or Nordic Swan (some relevant environmental standards are summarised and classified under 'appropriate environmental indicators', below). As the number of environmentally certified accommodation suppliers remains limited, and a wide range of certification standards are used, tour operators prefer to work with existing suppliers in order to instil environmental responsibility and stimulate environmental management, possibly culminating in third-party environmental certification, through incentives and practical assistance (ABTA, 2011).

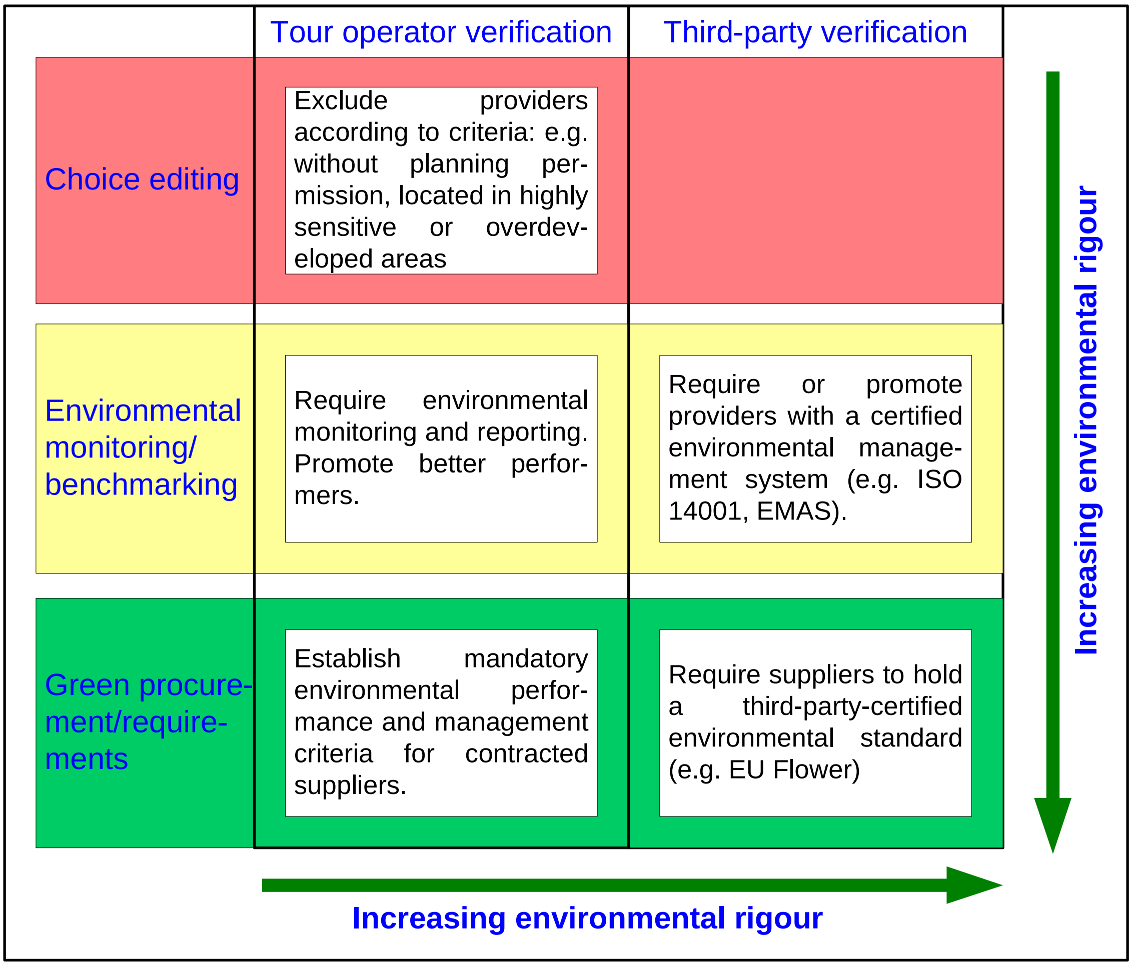

Figure 4.11: Summary of major mechanisms used by tour operators to influence suppliers

Tour operators and their associations may produce practical guidance manuals for their accommodation providers, with an emphasis on opportunities to improve operational efficiency (e.g. TUI Travel plc, 2011), and may offer promotional incentives related to improved environmental performance demonstrated by inspections, questionnaire returns, or third-party certification of environmental management. For example, TUI Travel plc preferentially advertise accommodation providers with Travelife Sustainability System Bronze, Silver or Gold Awards (Travelife, 2011) (Table 4.13). Such performance 'ladders' may be preferred initially because they offer the opportunity for suppliers to demsontrate progress, and to be rewarded from an early stage of implementation compared with front-runner standards such as the EU Flower or Nordic Swan ecolabel.

Table 4.13: Examples of voluntary measures implemented by tour operators to improve the environmental management and performance of suppliers

Measure	Examples
Provide practical guidelines for accommodation providers to improve environmental performance	TUI Travel plc have published an 83 page manual for accommodation suppliers entitled 'Guidelines for Sustainability in Hotels' (TUI Travel plc, 2011). This manual contains practical recommendations on good environmental management practice across accommodation operations and lifecycle stages, divided into nine chapters: (i) building and pre-design; design and architecture; (iii) construction and renovation; (iv) engineering and energy management; (v) operations; (vi) maintenance/technical services; (vii) employees and the community; (viii) travelife sustainability system; (ix) reporting and monitoring. Information is presented concisely as lists of good practice measures, illustrated with clear pictures, and accompanied by economic information. REWE Touristik have published a 32 page manual 'Das Ferienhotel: Mit ökologischer und sozilaer Verantwortung zum Erfolg' (REWE Toursitik, 2011) in six European languages, providing guidance on how to implement good environmental practices across topics from water and energy management to communication. The manual is distributed to hotel managers who are supported by environmentally trained REWE Touristik representatives. Benefits include improved environmental performance across hotels and better long-term dialogue with contracted hotels. Organisations funded by or representing multiple tour operators also provide good practice guidance for accommodation providers. The Federation of Tour Operators produced the 'Travelife Supplier Sustainability handbook' (FTO, 2006) that lists good practice across tour operator suppliers, including accommodation. More recently, the UK Travel Foundation has produced an interactive online tool for accommodation providers (Travel Foundation, 2011) divided into modules on: (i) monitoring; (ii) water; (iii) energy; (iv) waste; (v) buying local; (vi) fair employment; (vii) communications. A module for self-catering accommodation will soon be added.
Encourage certification or monitoring of environmental performance through promotion incentives	Since 1996, TUI Travel plc have recognised their 100 most environmentally-friendly supplier hotels with annual 'Environmental Champion' awards, based on customer feedback and quantitative environmental performance information. More recently, TUI have begun using the Travelife Sustainability System (Travelife, 2011) to recognise better environmental performance. In 2010, 69 % of suppliers used the Travelife system, and 400 hotels have received awards. Accommodation providers holding Travelife awards are advertised preferentially in brochures and online publicity material (TUI, 2011). Premier Tours, a safari tour specialist in Southern and East Africa, preferentially contracts safari camps that: employ full-time ecologists for environmental management; generate electricity from solar panels or generators that run during the day; do not allow hunting but support photographic safaris; support local communities and/or conservation projects; have lined tanks for sewage processing; dispose of waste safely (TOI, 2003). First Choice trained 80 in-house specialists in the Travelife sustainability handbook and accompanying checklist, and as of 2007 had conducted audits of their 250 most used hotels, representing 60 % of their customer accommodation. The best performing hotels in terms of use of natural resources, employment issues and involvement with local communities, are highlighted in First Choice brochures (Travelife, 2011).
Collate data on environmental management for benchmarking	Tour operators use questionnaires to extract environmental information from their suppliers for a range of purposes including benchmarking and marketing. Best practice involves simple yes/no checklist questions based on implementation of good practice. An example of a basic checklist is provided by Orizzonti (Table 4.19) while an example of a more comprehensive checklist is provided by the Travelife Sustainability System (Table 4.20).

Checklists of environmental performance and management criteria offer a simple mechanism to monitor the environmental performance of accommodation providers, but may be insufficient to drive improvement, especially where responses are not mandatory. Monitoring of key environmental performance indicators is an important prerequisite, but not a guarantee, of good performance. Rigorous auditing of environmental management, and verification of environmental performance data, across accommodation operations by tour operators or third parties is a key element of best practice (see 'Operational data', below). One basic element of best practice is for tour operators to require environmental performance reporting, for example through mandatory checklists (e.g. TUI Travel plc example in Table 4.14).

Table 4.14: Examples of mandatory measures implemented by tour operators to improve the environmental management and performance of suppliers

Measure	Examples of approaches
Exclude poorly performing suppliers based on exclusion criteria	Premier Tours applies a range of criteria in the selection of the tented camps and lodges that it uses in national parks and private game reserves to ensure that suppliers are committed to sustainability. Most notably, brick-and-mortar establishments in environmentally sensitive areas and over-crowded camps are avoided (TOI, 2003).
Require environmental award	The organisations behind the planning of COP15 in Copenhagen in December 2009 wanted to ensure that as many guests as possible stayed at hotels with an environmental management system. Consequently, a green procurement process was undertaken in which hotels certified by the Green Key were given preference, and simultaneously a promotional campaign for Green Key certification was organised. Consequently, the number of hotels with Green Key certification in Copenhagen increased by 78 %, and the number of certified rooms increased by 154 % (CLIMATE, 2009).
Require certified EMS	TUI Nordic is working towards universal ISO 14001 certification across all hotels included in its Blue Village programme (TUI Travel plc, 2011). In 2011, TUI Travel plc incorporated a condition into contracts that all suppliers must subscribe to the Travelife Sustainability System (TUI Travel plc, 2011). A group of Costa Rican inbound tour operators operate a policy requiring all accommodation providers they work with to be certified (CESD, 2008).
Require compliance with minimum environmental criteria (e.g. set out in contract)	In 2009/10, 85 % of TUI Travel plc hotel supplier contracts contained environmental and/or social minimum standards, up from 69 % in 2008/9 (TUI Travel plc, 2011). TUI Nordic has set the following limits for water and energy consumption in 'Blue Village' hotels, per guest-night: 250 litres water, 15 kWh electricity, 5 kWh heating. Kuoni, a Swiss outbound tour operator, introduced a mandatory code of conduct for suppliers in 2009, enforced through a centralised procurement and production unit specifically trained in the enforcement of sustainability criteria (see 'Operational data', below). Similarly, the Finnish tour operator Aurinkomatkat monitors supplier compliance with minimum environmental requirements specified in contracts (TOI, 2011). Algemene Nederlandse Vereniging van Reisondernemingen (ANVR), the Dutch association of 170 tour operators, requires its tour operator members to have an environmental statement, trained coordinator, and concrete criteria for selecting hotels and other suppliers.

In summary, best practice to drive environmental improvement across accommodation suppliers first requires the integration of environmental management into the tour operators' own operations, as described in section 2.1 and section 2.2 – in particular to include top-level management, procurement and marketing operations, and to consider all environmental aspects including difficult-to-measure biodiversity pressures. Then, best practice may be defined as the systematic implementation of the measures contained in Figure 4.11, summarised as the following hierarchy of actions.

1	Appoint a person or team responsible for the assessment of environmental management and performance across suppliers.
2	Screen key supplier environmental management issues before and during contract agreements, and avoid or terminate contracts where well defined environmental exclusion criteria are contravened, e.g. if planning authorisation cannot be demonstrated for accommodation buildings.
3	Assess and benchmark supplier environmental performance based on reporting and certification, and promote better performing suppliers.
4	Contractually require suppliers to meet specified levels of environmental management/performance, or to attain certification according to specified environmental standards.

Achieved environmental benefits

After transport providers, accommodation providers are responsible for the largest share of environmental pressure attributable to tour operator holiday packages. By placing environmental requirements on their suppliers, tour operators can drive significant reductions across a wide range of environmental pressures. Achievable environmental benefits for BEMP within accommodation enterprises are quantified across subsequent chapters.

A large portion of tour operator accommodation suppliers are resort-type hotels that are typically characterised by high specific energy and water consumption, and waste generation, compared with other types of accommodation (NH Hoteles, 2010). Table 4.15 indicates the possible magnitude of environmental improvement. Low and high achievable environmental benefits are indicated by the difference between benchmarks of excellence presented in chapters 5, 6 and 7 of this document (derived from top ten-percentile performance across a good performing mid-range hotel chain) and: (i) median performance across the same mid-range hotel chain; (ii) performance reported for resort hotels (NH Hoteles, 2010). It is clear that there is scope to achieve large reductions in water consumption (by up to 80 %), energy consumption (by up to 49 %) and unsorted waste generation (by up to 97 %) through the systematic implementation of BEMP. Tour operators can play a key role in leveraging these improvements.

Table 4.15: Benchmarks of excellence for accommodation providers, and achievable percentage reductions in environmental pressures compared with median values for a good-performing mid-range hotel chain and resort hotels

Aspect	Benchmark	Reduction vs mid-range hotels	Reduction vs resort hotels
Water	140 L/guest-night	27 %	80 %
Energy	179 kWh/m^{2}yr	33 %	49 %
Unsorted waste	0.16 kg/guest-night	65 %	97 %
Chemical consumption(*)	10 g/guest-night(*)	38 %	NA

(*)active chemical ingredient
Source: anonymous hotel chain (median and ten percentile values); NH Hoteles (2010).

Appropriate environmental indicator

Key performance indicators for accommodation suppliers

The net result of tour operator best practice in this technique should be the widespread implementation of BEMP techniques for accommodation described throughout this document across accommodation suppliers.

Table 4.16 lists the main environmental performance indicators for accommodation suppliers that can be used to guide tour operators in supplier assessment and the establishment of criteria. Primary indicators provide an overview of performance at the site or organisation level, integrating performance across a range of processes whose efficiency is reflected in many sub-indicators.

Table 4.16: Summary of key environmental performance indicators for accommodation providers, and relevant sections of this document

Aspect	Primary indicators (organisation level)	Sub-indicator (process level)	Section
Energy	kWh/m^2yr (kWh/guest-night)	Heating and cooling energy final consumption (kWh/m^2yr)	7.1, 7.2
		Renewable energy contribution (% energy final consumption)	7.6
		Electricity consumption (kWh/m^2yr)	7.5
		Installed lighting capacity (W/m2) kWh/m^2yr	7.5
		Kitchen consumption (kWh/cover)	8.4
Water	L/guest-night	Fitting flow rates (L/min)	5.1, 5.2
		Laundry quantity (kg/guest-night)	5.3
		Laundry efficiency (L/kg)	5.4, 5.5
		Pool consumption (L/m^2yr)	5.6
		Water recycling (% reduction in potable water consumption)	5.7
		Kitchen consumption (L/cover meal)	8.3
Waste	kg/guest-night (L/guest-night)	Residual waste sent for disposal (kg/guest-night)	6.1
		Hazardous waste sent for disposal (kg/guest-night)	6.1
		Organic waste generation (kg/cover)	8.2
		(% of waste reused or recycled)	6.2, 8.2
Chemical consumption	g/guest-night	Washing machine and dishwasher consumption (appropriate dosing)	5.3, 5.4, 5.5, 8.3
Green procurement	% environmentally responsible products and/or suppliers	% ecolabelled products	5.3, 5.4, 5.5, 8.3
		% complying specified criteria	2.2, 6.3
		% local sourcing	8.1
		% suppliers with EMS	2.1, 8.1
Biodiversity	Implementation of a biodiversity management plan	Avoidance of development in sensitive areas	3.2
		Destination development within Limits of Acceptable Change to maintain or increase biodiversity	3.2

Aspect	Primary indicators (organisation level)	Sub-indicator (process level)	Section
		Provision of information and education on biodiversity conservation to guests	9.1
		Implementation of biodiversity measures (green roofs, native species, sensitive lighting, habitat provision, etc.)	9.2
		Local environmentally responsible products, e.g. organic (% procurement)	8.1

In addition to these indicators, accommodation providers may report the carbon footprint of their operations, expressed as kg CO2 eq./guest-night. Tour operators may then report on the carbon footprint of holiday packages (travel and accommodation) in customer information material to encourage more sustainable tourism (see section 4.5).

Environmental certification

Various certification schemes exist for accommodation providers, some of which are summarised in Table 4.17. The DestiNet portal provides an overview of environmental labels for tourism accommodation, and an 'atlas of excellence' displaying the locations of ecolabelled accommodation (DestiNet, 2012). Many other certification standards may be relevant for particular aspects of accommodation performance, such as building energy standards (BREEAM, PassiveHouse, Minergie), and products standards (FSC, MSC, organic certification) for supply chain management (detailed in subsequent sections).

In the first instance, certification can be differentiated into EMS certification (EMAS and ISO 14001) that essentially requires monitoring and reporting of environmental performance, and environmental standards that include requirements for implementation of specific environmental management practices or compliance with specific environmental performance levels. However, there remains a wide variation in the rigour of criteria, and their verification, across standards. The most rigorous standards are the ISO Type 1 EU Flower, Nordic Swan and Austrian Ecolabel standards that contain extensive mandatory criteria related to good environmental practices and performance levels (Table 4.18). Many other standards are typically less quantitative and/or less transparent, and are applied at a national level.

Best practice for tour operators when selecting certification standards is to ensure standards are:

- internationally recognised and widely applicable
- contain rigorous criteria related to good environmental practice and performance levels
- are awarded according to a transparent verification process.

Table 4.17: Examples of environmental certification schemes for accommodation

	Certification	Requirements
Environmental management system	ISO 14001	Basic compliance with applicable legal environmental requirements and monitoring and reporting of key environmental performance indicators.
	EMAS (EC, 2009)	Basic compliance with applicable legal environmental requirements and monitoring and reporting of key environmental performance indicators. Latest version (EMAS 3) requires organisations to report sector-specific indicators and consider best environmental management practice outlined in sectoral reference documents.
	HI-Q (Hostelling International,	A quality management system awarded by Hostel International that focuses on hostel management and operations, drawing on

	Certification	Requirements
	2012)	other international management system requirements.
Environmental standards	EU Flower (EC, 2009)	An ISO Type 1 ecolabel awarded to organisations in compliance with a comprehensive range of mandatory criteria and a selection of optional criteria (see Table 4.18). Includes quantitative performance benchmarks.
	Green Tourism Business Scheme (Green Tourism Business Scheme, 2011)	A rating scheme for tourism businesses in the UK that qualitatively assesses performance based on implementation across 60 environmental measures (e.g. 'Returnable and reusable packaging', 'Low energy lighting and controls'). Businesses are rated according to four levels: Going Green, Bronze, Silver, or Gold.
	Green Globe (Green Globe, 2011)	Primarily legal compliance and sustainability monitoring criteria, but also qualitative requirements to implement better environmental practices, e.g. 'Local and fair-trade services and goods are purchased by the business, where available'. Does not include quantitative performance requirements.
	Green Key (Green Key, 2010)	An international sustainability standard with a global baseline for certification based on a set of 100 criteria, some of which are optional. These include specific environmental measures and in some cases quantified benchmarks (e.g. labelled foods must represent at least 5 % by value after one year of certification, and increase annually).
	Ibex label (Steinbock, 2009)	A Swiss standard awarded at five levels depending on points attained across 44 social, environmental and management criteria. Includes environmental criteria such as installation of low-flow water fittings, recent building energy retrofitting, etc.
	Latvia Green Certificate (Green Holidays, 2011)	Lativain ecolabel awarded to tourism establishments in rural areas and small towns that comply with a wide range of mandatory environmental and social criteria across 14 themes.
	Legambiente Turismo (Legambiente Turismo, 2009)	An Italian certification standard awarded to tourism organisations in compliance with good management practices described in relation to ten social and environmental themes including waste, water, energy and transport.
	Nordic Swan (Nordic Ecolabelling, 2008)	An ISO Type 1 ecolabel awarded to organisations in compliance with a comprehensive range of mandatory criteria and a selection of optional criteria. Includes quantitative performance benchmarks.
	Travelife Sustainability System for Hotels (Travelife, 2011)	An international tour operator (supply chain) driven sustainability certification that is awarded as Bronze, Silver of Gold depending on performance across a range of environmental and social criteria (see Table 4.20).
	Viabono (Viabono, 2012)	A German ecolabel for accommodation that includes customer service and environmental criteria, relating to the conservation of resources, waste generation, energy efficiency, water efficiency, GHG emissions and biodiversity conservation.

Table 4.18: Examples of mandatory environmental criteria contained in the EU Flower ecolabel for accommodation

Aspect	Mandatory criteria examples
Energy	Requires at least 50 % renewable electricity (where available), low-sulphur oil and efficient heating boilers, efficient (at least Class A) new air conditioning units and lighting, and appropriate window insulation.
Water	Requires tap and shower water flow rates <9 L per minute, avoidance of continuous flushing of urinals, green area watering evening or morning, wastewater treatment, adherence to local wastewater plan.
Management	Requires good maintenance, environmental statement and action programme, staff training for environmental measures, data collection for the consumption of energy, water and chemicals and the generation of waste.
Waste	Requires management to facilitate waste separation by guests, to sort waste, to avoid disposable products and single-dose food packaging (except where required by law).
Guest information	Requires management to inform guests: of environmental policy; to switch off air conditioning, heating and lights when appropriate; to use waste bins as appropriate; of public transport options.

<u>Key performance indicators for tour operators</u>

Tour operator performance may be assessed according to the following qualitative indicator:

- the tour operator demonstrates systematic improvement of the environmental performance of accommodation suppliers through: (i) dissemination of best environmental practice measures; (ii) benchmarking performance and promoting better perfomers; (iii) requirements for high levels of environmental performance, preferably recognised by ISO Type 1 ecolabels.

A number of important quantitative indicators are listed below.

- Percentage of accommodation in the tour operator's offer, or sold (by value or overnight stays), certified according to third-party environmental standards.
- Percentage of accommodation in the tour operator's offer, or sold (by value or overnight stays), with a verified environmental management system.
- Percentage of accommodation in the tour operator's offer, or sold (by value or overnight stays), compliant with environmental performance levels and/or best practices specified by the tour operator (e.g. in contracts).
- Percentage of accommodation in the tour operator's offer, or sold (by value or overnight stays), subject to best practice training by tour operators.
- Percentage of accommodation in the tour operator's offer, or sold (by value or overnight stays), that have subjected to an environmental audit by a third-party or tour operator representative in the past two years.

<u>Benchmark of excellence</u>

Swiss Youth Hostels require all hostels to be certified according to the EU Flower or Ibex label (Youth Hostel CH, 2011). In 2010, 27 % of TUI UK & Ireland customers stayed in Travelife-awarded hotels, and the target is for this to reach 50 % of UK and Ireland customers by 2011, and 90 % by 2014 (TUI Travel plc, 2011). Reflecting the early stage but rapid development of tour operator actions to improve supplier environmental management, the following benchmark is proposed:

BM: ≥90 % accommodation suppliers, based on sales value or overnight stays, are in compliance with at least basic environmental requirements (preferably recognised by third-party certification).

Basic requirements refer to environmental performance monitoring and reporting at least verified by tour operator inspections.

Tour operators should aim for widespread implementation of BEMPs as described in this document, and in Travelife and Travel Foundation publications, across accommodation suppliers. In the future, as supplier accountability and certification for environmental management become more widespread, the benchmark of excellence may be upgraded to reflect universal attainment of high levels of environmental performance and/or certification.

Cross-media effects

Driving environmental improvement of accommodation providers does not require a large input of resources from tour operators: mainly additional staff training and time. Environmental objectives can be integrated with regular processes such as contracting (minimum conditions), quality assurance (add sustainability standards) and promotion (add sustainability logos in brochures). Environmental pressures arising from these inputs will be small compared with the potential environmental improvements that can be achieved across accommodation suppliers. Training staff based in destinations to perform environmental auditing, and/or integration of such audits with health and safety audits (see below), can minimise additional staff time and travel requirements for auditing.

It is important that tour operators use appropriate metrics, criteria and certification schemes (see above) in order to maximise effectiveness and minimise the risk of significant cross-media effects arising.

Operational data

Collecting key information from accommodation suppliers

In the first instance, tour operators must identify the levels of environmental management and performance, and the main environmental problems, across their accommodation suppliers in order to inform appropriate actions. Environmental management and performance checks can be integrated into health and safety checks. Questionnaires and checklists are an effective means of obtaining basic information from new and existing suppliers in order to determine their suitability as business partners and set a baseline for future monitoring.

A rapid indication of the environmental (management) performance of an accommodation supplier can be obtained by a quick assessment of existing environmental reporting (policies or statements) and third-party certification (e.g. ecolabels, EMAS, ISO 14001: see above). Often, however, further specific information is required, and can be obtained through questionnaires. Questionnaires should be kept simple and be performance oriented, for example based on a yes/no checklist of key environmental management actions across themes (see the Orizzonti example in Table 4.19).

Table 4.19: Basic checklist of questions asked of Orizzonti accommodation suppliers

Water and energy saving	Pollution
The facility: – uses low-energy light bulbs – uses solar energy for the production of hot water – can regulate light intensity – has a central vacuum system for cleaning – has an air conditioning system with variable capacity – regularly maintains and cleans air conditioning filters – has air changing control sytem – uses aerators in sink and/or shower taps – collects and reuses rain water – waters green areas at night time – Waters green areas with greywater – checks lighting energy and water consumption periodically	The facility: – has used non-toxic paints in internal decoration – is sound-proof throughout – has given preference to wooden furniture – changes sheets and towels on request – uses low environmental impact products – analyses wastewater quality – has analysed internal air quality – separates solid waste – collects glass separately – collects plastic separately – collects aluminium separately – collects paper and cardboard separately – has built the facility using mostly local resources – raises client awareness with signs
Source: TOI (2003).	

Voluntary questionnaires from individual tour operators may generate low response rates, and on their own are insufficient to drive performance improvement. For example, Orizzonti reported an average annual return rate of 26 %. More detailed questionnaires may be used to document environmental performance for benchmarking purposes. The Travelife Sustainability System uses a list of 100 sustainability criteria that can be assessed online through simple yes/no answers (Table 4.20). The criteria are based on environmental, social and economic best practice and represent a balanced mix of process and performance indicators to ensure that both management structures for sustainability are in place and that progress is being consistently achieved. This list of criteria is shared between all 150 participating tour operators and is used to assess accommodation for Travelife Sustainability System Bronze, Silver and Gold awards through third-party audits. Travelife also provides supporting information through a training programme.

Table 4.20: Environmental checklist questions contained in the Travelife Hotel Sustainability Code (version 1.7)

Aspect	Questions
Existing certification & management systems	– Does the business hold a current (in date) certificate or documentation as proof that they participate in any of the following: EMAS; ISO14001; VISIT accredited Ecolabel; EU Flower; Green Globe; other (please state)?
Organisation, reporting& management	– Does the business have a written policy document that specifies its aims towards the environment (for example, to minimise its environmental impacts)? – Are one or more individuals within the business designated with responsibility for managing environmental issues? – Are regular (at least annual) progress reports made on environmental issues? – Is the business currently a member or participant in an environmental forum (e.g. a green business club or waste minimisation club)? – Have planning procedures as specified in the country in which this business is based been followed for any new developments undertaken either in the last five years or planned to take place in the next two years?
Energy management	– Is the business actively engaged in achieving a reduction in energy consumption and costs?

Aspect	Questions
	– Is energy efficient lighting installed in at least 50% of areas AND is it effective? – Is there evidence of (or a policy of purchasing) low energy equipment such as large electrical machinery (fridges, microwaves, cookers etc.)?
Renewable energy	– Do the regulations in your country specify that you must buy all of your energy from a specific energy supplier (for example, a Government owned energy generation company)? – Are renewable sources of energy captured on site and used? (e.g. the sun, wind, bio gas or other non-fossil source)? – Is renewable energy purchased for use on site?
Water management	– Is the business actively engaged in achieving a reduction in water consumption (also reduces costs)? – Are water saving devices fitted to reduce water consumption? These devices may include any or all of the following: flow restrictors, aerators, percussion (push) taps or limiters on water pipes. – Are employees regularly reminded to save water? – Is grey water recycled and treated appropriately before use? – Are energy saving taps (e.g. mixer or temperature controlled) fitted to ensure water is delivered at the temperature it is required? – Are low flush WCs fitted or water saving devices installed into WCs? – Do irrigation systems for the hotel grounds and gardens have any of the following features: use treated wastewater; have timing devices fitted to minimise operating times or have a procedure to follow for manual watering; have moisture sensors fitted to ensure they water on demand; work on a system that delivers water to plants below soil level?
Wastewater management	– Is all wastewater discharged from your business treated to meet national regulatory standards? – Does the establishment dispose of all wastewater to: on-lot septic tanks/soakaways; package treatment plants; connections to public sewers, effluent conveyed to wastewater treatment plant; sewage treatment lagoon system; any other (please specify)?
Waste minimisation and management	– Is the business compliant with national waste regulations? – Is the business actively engaged in achieving a reduction in the volume of solid waste produced (this also cuts associated waste disposal costs)? – Does the business know where the solid waste it generates is disposed of? – Are there facilities in the destination to recycle solid waste? – Is recyclable or re-useable waste separated from non-recyclable or non-re-useable waste? If the answer is yes, which of the following is true? glass is recycled; paper and/or cardboard is recycled; plastic is recycled; metal is recycled; specific items are reused (give details). – Is food/bio-matter composted or recycled? – Does the business minimise waste by buying in bulk? – Does the business purchase cleaning materials with low environmental impact? – If refrigeration equipment utilises CFC's (chlorofluorocarbons) or HCFC's (hydro-chlorofluorocarbons) as its coolant does the business: identify which equipment utilises CFC's/HCFC's; repair damaged equipment as quickly as possible; have a replacement plan for equipment?
Nature conservation and biodiversity	– Does the business actively contribute to the upkeep of the natural environment by: – Corporate donation (e.g. by donating money per lobster meal sold)? – Donations (e.g. through a weekly guest raffle or staff pay roll giving schemes)? – In kind support through activity (e.g. by organising a beach clean up using staff volunteers)? – Other (please specify)? – Is the business actively engaged in minimising the use of chemicals known to cause damage to health and/or the environment? (see attached list for chemicals considered by international regulation to have the potential to harm human health/the

Aspect	Questions
	environment).
Nurturing understanding	– Does the business provide customers guidance on environmental protection in the destination (e.g. protecting turtle nesting sites, the importance of barbequing only in dedicated areas, etc.)? – Are automatic devices installed into guest rooms to switch off air conditioning or control heating when windows are opened? – Are key card systems or other devices used to switch off electricity when guest rooms are vacated? – Is there a system in place for reducing the number of towel changes in guest rooms? (e.g. Signs for guests to encourage use for more than one day or number of towel changes limited through a schedule) – If there are signs inviting guests to retain towels rather than change them, is this system supported by appropriate training within the housekeeping department to ensure the procedure is followed?
Choosing suppliers	– Does the business actively choose locally produced goods in preference to imported ones wherever possible? – Does the business actively choose local suppliers of goods and services (can be answered yes even if some of their products are imported)? – Does the business promote local products and services to guests, by recommending, guides, restaurants, markets, craft centres?
Source: Travelife (2006).	

Finally, tour operators may request data on key environmental performance indicators from accommodation providers, such as litres of water consumed per guest-night (see Chapters 5, 6, 7 and 8 in this document). These data may be stored and accessed via a central database, and supplier performance may be used for benchmarking purposes. This is a rigorous approach that enables identification of best performance, consistent with the approach of this document, but may require considerable initial effort to implement. TUI Nordic (2011) report water, electricity, heating energy and CO2 emissions per guest-night for their 'Blue Village' hotels, for which they have established minimum performance criteria (see Table 4.14). Data are compiled in a central 'Agenda2100' database. Best practice for this BEMP overlaps with best practice as described in sections 2.1, 5.1, 6.1 and 7.1 with respect to the monitoring of key performance indicators in accommodation. For example, in section 2.1 the long term environmental performance monitoring at Scandic Hotels is cited as an example of best practice.

<u>Verifying environmental information</u>
It is essential that there is some system of auditing and verification to cross-check the accuracy of self-declared (by the accommodation suppliers) environmental performance. This may involve a requirement to submit verifying data (e.g. energy consumption data from annually submitted electricity and fuel bills), and onsite audits. Tour operator staff may perform full audits of suppliers, whilst onsite representatives may perform basic compliance checks. However, the most efficient way to verify the environmental performance of accommodation suppliers is to use a third-party certification system where specialists perform audits.

Non-compliance with required environmental performance levels or data provision should first be addressed through dialogue to seek improvement, and finally by sanctions to maintain credibility.

It is important to build capacity among suppliers and tour operator staff with respect to environmental training, performance monitoring, reporting, and auditing. Tour operators should provide staff training, information packs, and seminars for hotel managers and other staff. In addition, most tour operators automatically invite their consumers to complete a guest feedback form, which may include opinions on how the establishment manages environmental aspects. Some tour operators even interview their guests to assess the overall quality of their experience

in relation to expectations. Such surveys and interviews could provide useful supplementary information on day-to-day environmental management.
Two examples described below illustrate aspects of best practice.

- Aurinkomatkat, a Finnish outbound tour operator, introduced minimum environmental criteria into contracts with partner hotels (many of which are family owned enterprises) in 2003. The programme was rolled out over a three year period before becoming mandatory (TOI, 2003). Aurinkomatkat provided suppliers with information in their own language on how the system works. The initial monitoring takes place through a checklist completed by the supplier, which is then validated by Aurinkomatkat personnel at the destinations and verified annually in conjunction with the regular hotel check performed by Aurinkomatkat staff in the destination. Feedback from customers is also collected. Any areas of poor performance may result in non-renewal of contracts unless improvements are shown. All Aurinkomatkat staff receive sustainable tourism training. The programme is based on a 100 point scale. Establishments that exceed the basic minimum number of points (30), are awarded one, two or three drops of water, and this is advertised in Aurinkomatkat's brochure (TOI, 2011).

- The Swiss tour operator Kuoni has produced a code of conduct for suppliers (Kuoni, 2009). All suppliers must be able to demonstrate compliance with this code. The code requires basic legal compliance, plus actions to improve performance reflected in criteria such as *'The Supplier shall actively reduce the amount of energy and water used and shall minimize the use of chemicals known to cause damage or pose risks to health and/or the environment'*. If the supplier is found to be in breach of the terms and conditions of this code of conduct, Kuoni is entitled to terminate all business with the supplier with immediate effect, and reserves the right to take legal action. To enforce this code of conduct, Kuoni launched a new centralised Procurement and Production (P&P) unit in March 2010 as a central interface between regional business units and suppliers within destinations. All members of the P&P Unit have participated in training on the implementation of sustainability requirements across suppliers, and reporting on non-compliances. P&P Unit staff were also trained on the Travelife Sustainability System which suppliers are encouraged to adopt.

Applicability

This section is applicable to all accommodation services purchased by tour operators that are managed by third parties. Where tour operators have bought into the supply chain and have operational control of accommodation, they should refer to Chapters 5, 6, 7 and 8 of this document describing BEMP across accommodation operations.

Green procurement based on environmental certification can be implemented by any size of tour operator. Inserting environmental criteria into contract requirements is more feasible for larger tour operators with market power.

Economics

<u>Tour operators</u>

Certification and compliance costs are borne directly by accommodation providers (see below). The main costs for tour operators associated with this technique relate to staff time and training requirements, and possibly additional staff travel. Many tour operators have established environmental management units who lead supplier environmental monitoring and improvement. However, much of the auditing work may be combined with existing inspections (e.g. for health and safety) and/or performed by staff based in destinations, thus minimising additional costs. In order to minimize costs, communicate common standards and to increase credibility towards consumers, leading tour operators have, through their associations, established the Travelife common suppliers assessment and award system based on external third-party audits.

An indication of the costs associated with this technique can be gained from data provided by TUI Travel plc (2010). TUI operates in over 180 countries, providing for over 30 million customers, with a staff of 49 000 and a revenue of almost EUR 15 billion in 2009. In this context, the 40 full time employees working on sustainable development-related activities within TUI represent a cost of between 0.01 % and 0.02 % of turnover.

Meanwhile, there may be some significant economic benefits for tour operators following implementation of environmental requirements for service providers, but these are difficult to quantify. Potential economic benefits that should be considered may arise from:

- a higher sales share of more profitable value-added packages
- greater sales arising from enhanced image and reputation among consumers
- improved long-term business viability (i.e. risk management).

Accommodation suppliers
Suppliers may be required to invest in environmental monitoring and reporting, in environmental technologies, and in achieving and maintaining certification. Travelife (2011) cite annual certification costs of EUR 100 – 350, compared with annual costs for international schemes such as ecolabels of over EUR 1 000.

However, accommodation suppliers may realise significant economic savings following implementation of efficiency measures identified by EMS, informed by best practice guidance, or required by certification schemes. For example, following guidance from TUI Travel plc, the Thomson Sensatori Resort implemented energy and water efficiency measures that save over EUR 100 000 per year in bills (TUI Travel plc, 2011).

Driving force for implementation

TUI Travel plc (2011) state: *'Being more sustainable supports the long-term success of our business. It's as simple as that.'* More specific driving forces listed by TUI are:

- the opportunity to be recognised as a leader by investors
- better risk management and being ready for forthcoming legislation
- meeting growing customer demand and the related potential competitive advantages
- reducing costs
- staff recruitment and satisfaction
- protecting destinations
- improving our product.

Environmental awareness is steadily growing among European citizens who expect to experience the same level of environmental consciousness on holiday as at home. Providing assurance on the environmental performance of suppliers makes good business sense, and can be an integral component of the added value offered by tour operators in the face of competition from direct online booking.

Improved environmental management and value-added holiday packages improve business relationships between local communities and tourism providers, between tourism providers and tour operators, and between tour operators and customers, creating a more robust and sustainable business model.

In addition, tour operators have a strong long-term business interest, and unique position of influence, to preserve environmental quality in tourist destinations.

Reference Tour Operators

Aurinkomatkat, TUI Travel plc, Kuoni.

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4.3 Drive destination improvement

Description

Chapter 3 describes best practice for destination managers, such as local authorities, with direct responsibility for operations and conditions within destinations. Whilst tour operators increasingly work directly with business partners, such as accommodation providers, to improve their environmental performance (section 4.2), or to encourage customers to behave in an environmentally responsible manner (section 1.1), further improvement in the operation of private enterprises or tourist behaviour may be impeded by the infrastructure and services available within the destination. For example, waste collection services may not offer all recycling options, leaky water distribution networks can lose up to 40 % of water supply (ABTA, 2011), electricity companies may deter connection of micro-scale renewable generating capacity to the grid, public transport services may be inadequate, land planning may fail to protect ecologically valuable (and touristic) areas, etc.

Tour operators are key intermediaries between potential tourists and destinations, with significant influence over customer choice with respect to destination selection, and therefore strong leverage over destination managers. In some cases, tour operators may have a greater influence over local authorities than national government (ABTA, 2011), and are in a position to influence destination management in developing countries where pressure on natural resources and biodiversity may be particularly high. For example, rapid tourism development in Bukit Lawang, Indonesia, following the establishment of an orangutan rehabilitation centre in 1976, led to habitat loss, impaired local ecosystem functioning, noise, litter and ultimately also problems for orangutan rehabilitation (SCBD, 2009).

Tour operators also have a strong business interest to maintain and improve the environmental quality of their major destinations. TUI Travel plc (2011) state *'Our customers consider the environmental quality of their holiday destinations to be one of the main factors determining the quality of their holiday – it therefore plays a crucial role in holidaymaker satisfaction. Making sure that nature stays intact is the only way of guaranteeing the long-term economic success of the tourism business'.*

This section focuses on best practice for tour operators to improve destinations through:

- exerting leverage and working with destination managers to drive destination improvement programmes
- directly funding and/or managing destination improvement programmes.

There is significant overlap with the promotion of more sustainable tourism destinations when developing and promoting more sustainable tourism packages, described in section 4.4, and when encouraging more sustainable tourist behaviour, as described in section 4.5.

Figure 4.12 and Table 4.21 summarise the pathways of tour operator influence, and the destination improvement measures that they may instigate, directly or indirectly, using that influence. In all instances, an important component of destination improvement is coordination with other tour operators to target priority destinations, and collaboration with destination mangers to implement best practice as described in Chapter 3. Tour operators should refer to the biodiversity check for tourism organisations developed by the European Business and Biodiversity Campiagn (Annex 1).

The targeting and prioritisation of improvement efforts should be based on:

- the magnitude of environmental damage attributable to tourism activities within a destination
- the scope for improvement based on destination management intervention (e.g. through improvement of services, or regulatory interventions).

Tour operators can maximise their leverage, and achieve efficient destination improvement, through formal or informal coordinating groups, such as the Travel Foundation (see below).

Table 4.21: Destination improvement measures that can be directly or indirectly influenced by tour operators

Direct influence	Indirect influence
– Land use: preserve high nature conservation value areas, regenerate natural habitats, plant trees (possibly combined with carbon offset schemes) – Suppliers: tour operators can drive improved environmental management across suppliers (section 4.2)	– Waste management: provision of additional recycling services – Water services: improvement of distribution infrastructure and wastewater treatment – Energy supply: incentives or removal of barriers for installation of renewable generating capacity – Local transport: improvement or financial incentivisation of public transport services – Land use: protection of high nature conservation value areas, confinement of development to serviced areas

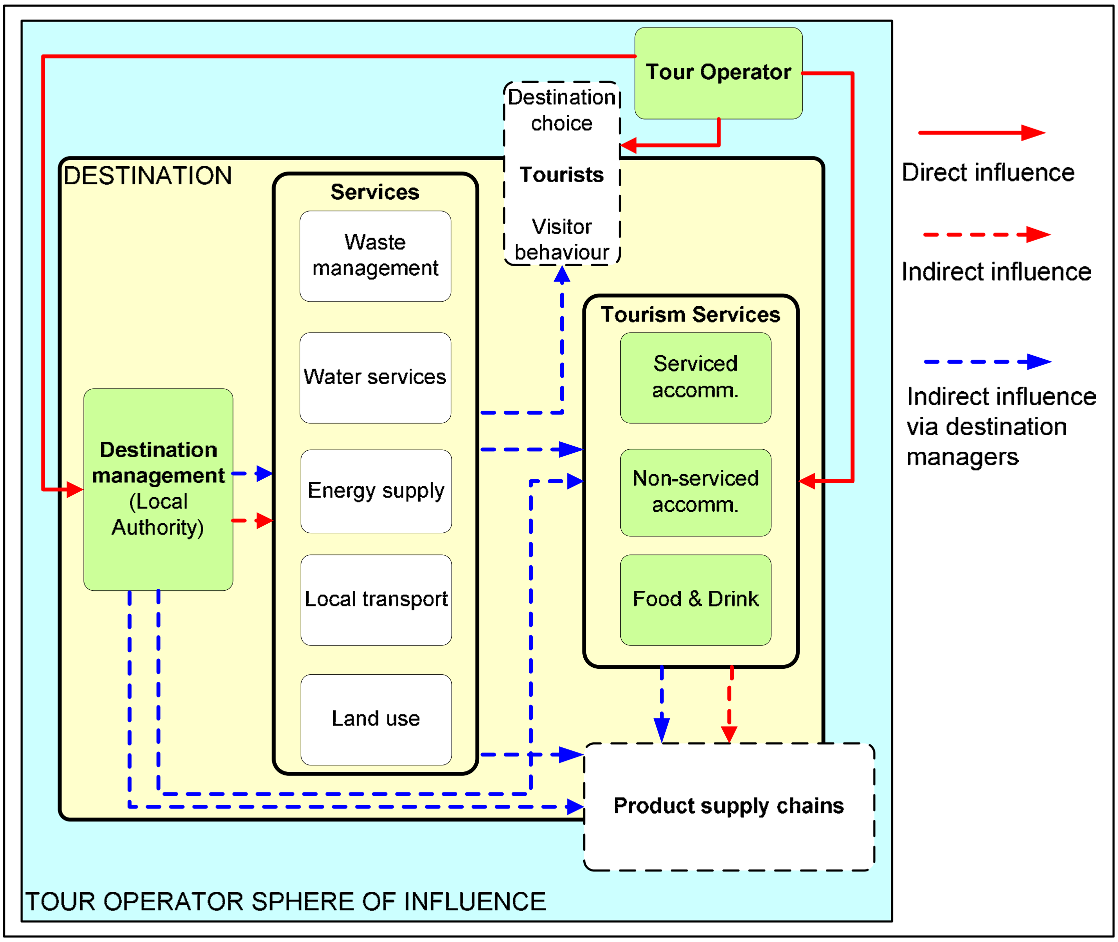

Figure 4.12: Main pathways of direct and indirect influence by tour operators, including via destination managers, over tourists, tourism actors and suppliers

Achieved environmental benefit

Environmental benefits arising from best practice in this technique are diverse and difficult to fully quantify. Environmental benefits arising from good destination management are described in more detail in section 3.2 and section 3.3, whilst environmental benefits arising from accommodation and supply chain improvement are described in section 4.2 and 8.1, respectively.

TUI Travel plc (2011) report that clean energy and energy efficiency projects they have promoted in destination countries saved over 75 000 t CO_2 eq. emissions in 2010/11. Through its work disseminating best practice across enterprises within major destinations, since its establishment in 2003, the Travel Foundation claims to have contributed to savings of:

- 12 000 000 kWh of energy
- over 9 000 000 m^3 of water.

Further examples of environmental benefits arising from destination improvement projects driven by tour operators are referred to below.

Appropriate environmental indicator

<u>Indicators of tour operator management</u>

Best practice is for tour operators to contribute directly, and indirectly via their leverage over destination managers, to the improvement of priority destinations. Table 4.22 summarises best practice criteria for tour operator destination management according to Travelife (2011).

Table 4.22: Travelife recommended best practice actions for destination management

Aspect	Action
Sustainable destinations	In product development it is policy to give preference to sustainable destinations (e.g. traffic-free, sustainable city planning and infrastructure).
Accessible destinations	When composing the tours the company gives preference to destinations which are easily accessible by sustainable means of transport.
Extremely vulnerable destinations	Extremely vulnerable destinations (e.g. Antarctica, Galapagos) will not be visited unless the visit is ecologically responsible.
Local economic network	The organisation supports initiatives that improve the relationships between accommodations and local producers, among which the producers of local food products and souvenirs etc. (e.g. initiatives to improve quality level, logistics, transport).
Protection of heritage	The tour operator collaborates with other tour operators, nature protection organisations, government organisations in order to prevent trade in threatened flora/fauna and archaeological/cultural heritage.
Excursions to support local economy	Excursions that promote local crafts and local (food) production methods are developed and promoted.
Lobby local government	The tour operator influences local government (when possible together with other tour operators and stakeholders) concerning sustainability, destination management and planning, use of natural sources and socio-cultural issues.
Excursions supporting local economy	Local initiatives to support sustainability are included in excursions (e.g. regarding biodiversity, social projects and nature conservation).
Waste (water) management	The tour operator supports the development of adequate waste (water) management, infrastructure and facilities in beach destinations.
Source: Travelife (2011).	

Indicators of destination environmental performance/condition

The environmental performance of enterprises influenced by tour operators may be measured using metrics proposed within section 4.2 and subsequent chapters. Meanwhile, the effectiveness of measures to improve destinations can be measured using metrics proposed in Chapter 3 for destination managers. The carrying capacity of natural resources and man-made infrastructure in relation to peak resident and tourist demand is particularly important. Pressures can be detected by changes in the environmental condition (e.g. water quality).

Tour operators may report on environmental benefits specifically attributable to improvement schemes they have implemented.

Benchmark of excellence

The following benchmark of excellence is proposed for this technique:

BM: the tour operator drives destination environmental improvement by: (i) improving supply chain performance; (ii) influencing destination management; (iii) direct improvement schemes.

Where destination improvement is combined with carbon offsetting schemes, best practice in offsetting should be followed, as demonstrated by indicators specified in section section 4.1.

Cross-media effects

Well planned destination improvement should not give rise to any significant long-term cross-media effects. Appropriate land zoning by planning authorities can achieve multiple environmental benefits (see Table 3.2 in section 3.1).

Infrastructure improvement projects and the establishment of semi-natural areas (e.g. tree planting) may give rise to temporary impacts such as soil erosion, water contamination, air pollution and noise that are minor compared with long-term benefits.

Operational data

Establishing priority areas for action

In order to efficiently target destination improvement schemes, it is necessary to collate information on environmental conditions and the potential for improvement. This can be achieved directly by tour operators through projects managed by them or by representative organisations such as Travel Foundation and Futouris (see below), or by liaison with experts with an overview of sustainability performance across destinations, such as government, academic and NGO scientists. TUI Travel plc work with the Overseas Development Institute, Sustainable Tourism International and Dr Murray Simpson's team at Oxford University, and Tourism Concern to identify destination problems and possible solutions.

Destination surveys are useful tools for tour operators to directly gather information on destination environmental conditions, management and problems. Surveys may be targeted at local accommodation providers (to assess services), at customers (to assess environmental conditions), and at local incoming tour operator representatives. For example, TUI have been collating information on environmental and social development within destinations since 1992, and obtain information on sustainability within destinations from local TUI representatives via a detailed online survey containing over 80 questions across 10 sustainability themes (TUI Travel plc, 2011):

- climate change and air quality;
- energy management (supply, saving measures and renewable energies);
- water and wastewater management;
- waste management (avoidance, recycling and disposal);
- bathing quality and beach quality, coastal protection;
- landscape and building development;
- nature and culture;
- sustainable products;

- environmental policy and sustainable development;
- cooperation with local communities.

Working directly with destination managers

Direct funding and support of destination improvement projects, such as tree planting or dissemination of best practice, is straight forward. Leveraging destination managers to implement large-scale projects requires more collaboration, and ideally coordination amongst tour operators. Formal agreements between tour operators and destination managers are useful to demonstrate the commitment of, and establish specific responsibilities for, collaborating parties. The Travel Foundation has entered into a unique, five year partnership with the Cyprus Tourism Organisation (CTO) (a semi-state organisation promoting tourism and monitoring practices) and Cyprus Sustainable Tourism Initiative (CSTI) to deliver projects that will improve the sustainability of tourism on the island (Travel Foundation, 2011). A memorandum of understanding was signed by the three organisations to demonstrate their commitment to the partnership. The following projects were specified for development or enhancement:

- developing minimum sustainability standards for the hotel and general accommodation industry;
- developing a plan for sustainable development of golf courses;
- developing an indigenous planting scheme for the tourism industry in Cyprus;
- dealing with Solid Waste;
- developing a renewable energy programme using waste from the hotel and accommodation industry;
- developing a composting scheme with a group of accommodation providers in a resort;
- developing a campaign to prevent littering in municipalities;
- developing rural enterprise.

Key aspects of the above agreement are relevant for all agreements between entities working together in destination improvement programmes. These, and possible specific points of agreement, are listed in Table 4.23.

TUI AG is cooperating with the Environment Ministry of the Balearic Islands, and in 2009 signed a framework agreement to preserve and promote the environment of the islands. In 2009, TUI AG started to plant a forest in the Levante nature reserve of eastern Majorca as part of a plan to plant 57 600 wild olive and pine trees over an area of 48 hectares. This is intended to reduce ground erosion on the coastal slopes and to raise awareness of environmental issues among customers. Tourists are informed by TUI that a fixed amount from every booking to Majorca is donated to the project (TUI travel plc, 2010). The intention is to focus on key challenges for the islands, currently climate protection and preservation of biodiversity. Projects will be developed at regular working meetings to promote the environmental awareness of tourists, hotel partners and tour operators (TUI Travel plc, 2011).

More detail is provided on key measures for destination improvement, such as land zoning and wastewater treatment, in Chapter 3.

Table 4.23: Key aspects for agreements between tour operators or representative groups and destination managers, and possible points of agreement (based on the Travel Foundation agreement with Cypriot tourism organisations)

Key aspects of agreement	Possible points of agreement
Agreement to cooperate	– A memorandum of understanding setting out scope and objectives for cooperation.
Objectives	– Support the destination to become a leader in sustainable tourism
Priority aspects of destination management	– Improve energy, water and waste management by hotels – Improve public transport services – Improve energy infrastructure – Improve water infrastructure
Partner commitments (plan of action)	**Tour operators** (the Travel Foundation) agree to: – Provide expertise and technical assistance – Provide access to training, implementation and communication tools – Encourage partners, suppliers and customers to support the programme – Promote the programme and destination The **destination authority** agree to: – Develop a plan of action, including annual targets and budgets – Incorporate the programme into strategic planning – Generate awareness among destination stakeholders and provide incentives for participation – Communicate the programme
Programme management	– A committee of representatives from each signatory party, and volunteers or consultants engaged by the committee, will oversee programme development – Destination authority will appoint a high-level manager to liaise with project partners – Destination authority will appoint a **project manager** who will oversee the improvement program
Funding	– Funding will be provided by tour operators (the Travel Foundation) and the destination authority in agreed ratios. Funding will be sought from other sources, including local and national government, supranational institutions and private stakeholders.
Reporting and evaluation	– The committee will collate information on programme progress and provide regular reporting
Communication	– Each party will recognise the other parties' contribution in consumer and media communications, local signage and notices (according to Travel Foundation partner Communication Guidelines)
Termination	– A programme or agreement timeframe, review period, and termination notice period should be specified (five years, annual review, two month's notice).

Source: Travel Foundation (2011).

Offering assistance to destination managers

Tour operators may provide equipment and expertise to tackle environmental threats within destinations, especially where destination managers have limited resources, as demonstrated by the following case study. The NSWA is an official forum for 18 marine tourism operators to communicate concerns to government agencies and officials and to conduct large-scale public relations and education campaigns to support marine tourism and the diverse marine ecosystems of North Sulawesi. The NSWA meets once a month to discuss issues of common concern to all members (primarily resource management issues), and invites relevant government officials (including the Bunaken National Park management authority and the water police force), environmental NGOs and donor agencies to participate in these meetings. A primary initial concern of the NSWA was the amount of illegal dynamite and cyanide fishing occurring in the area. To help reduce the use of these destructive fishing methods, the dive operators donated their boats and fuel to the water police and rangers so that they could undertake patrols of the area. Initially, dive customers were asked to donate USD 5 to support these efforts, but following liaison between the NSWA and marine park managers, this voluntary fee has been replaced by an entrance fee levied on all visitors to the marine park (Travelife, 2011).

Lobbying destination managers

Tour operators may use their economic influence to encourage destination managers to implement environmental improvement programmess. For example, MyTravel and other tour operators with package offers in the Dominican Republic lobbied the destination government to improve the sewage infrastructure. Leaking pipes were causing pools of stagnant water where mosquitoes could breed and pass on the dengue fever to humans. The tour operators threatened to pull out of the area unless action was taken, and the government was forced to comply with their demands. The result was that the tourism industry was protected, which in turn guaranteed local jobs. The initiative also improved the health of local people living in and around the resorts (Travelife, 2011).

Following ecological damage caused by a whale-watching boom in the Canary Islands, especially around Tenerife, TUI lobbied at a political level to establish a marine protection area between Tenerife and La Gomera (Travelife, 2011).

Coordinated actions

Coordinated tour operator actions can ensure efficient destination improvement by pooling resources and expertise, avoiding duplication of efforts, and strategically targeting improvement across hotspot destinations and impacts. Some examples of coordinated tour operator actions are provided below.

Several tour operators worked together to conduct a destination stakeholder workshop in the coastal resort of Side, Turkey, to identify sustainability challenges and seek solutions through cooperative action. The dumping of solid waste in the Side sand dunes, near an important archaeological site, was highlighted as an issue for priority action. Partnerships were formed to support a waste management system, and with financial support from the Turkish government, the following benefits were realised:

- a waste separation scheme was introduced
- separate bins were provided to 100 hotels in Side (representing around 20 000 beds),
- training was provided for hotels and key workers dealing with waste management
- a waste handling and recycling scheme was established by the municipality
- a new landfill area was created 30 km inland.

Futouris is an organisation initiated by and composed of numerous tour operator members, including: Airtours, dk-ferien, Gebeco, Kolumbus Tours, Lufthansa City Centre, Neckermann Reisen Germany, Öger Tours, Thomas Cook Austria/Neckermann Reisen Austria, Thomas Cook Travel, TUI AG, TUI Cruises, TUI Germany, TUI Leisure Travel, TUI Austria, TUI Switzerland. The objective of Futouris is to drive sustainability improvement across major tourism destinations through the adminstration of specific improvement projects, with an emphasis on infrastructure development, biodiversity conservation and CO_2 mitigation within the environmental strand of work. Futouris works in collaboration with a dedicated scientific advisory committee to develop project standards, identify relevant sustainability indicators and establish accreditation procedures (Futouris, 2011).

Futouris members organise a number of projects annually, listed on their website (Futouris, 2011). One example of a 2010 project is the 'Tropical forest guardians' project in Cuba. Project goals are listed below.

- Preparation and implementation of reforestation measures in the boundary zones of the Alexander-von-Humboldt National Park.
- Compilation of a seed bank for threatened plant species.
- Establishment of three nurseries with a production of approximately 10 000 seedlings of native species per year.
- Reforestation of 240 ha of forest with native species and remediation of 300 ha of forest with reforestation, erosion and soil protection measures.

Tour operator organisations such as ABTA, ANVR and FAR also assist in coordinated sustainability actions. For example, ABTA Ltd is the United Kingdom’s largest tourism related trade association, consisting of around 750 tour operators and over 4 000 travel agency businesses with a collective turnover in excess of EUR 35 billion annually. ABTA facilitates a Sustainable Tourism Committee which is made up by representatives of 11 of the largest tour operators in the UK who work collectively on shared initiatives. Members of this Committee have signed up to a Statement of Commitment (FTO and ABTA, 2012), binding them to shared values around sustainability and their operations. Destination improvement is a major objective of this Commitment, and article 4.2 and 4.3 specifically prioritise collaboration with destination authorities:

- we seek greater co-operation between the tourism industry and local and national governments in order to further promote and extend sustainable tourism;
- we encourage and seek to co-operate with national and local authorities, local communities and local private businesses or any other interested party, to develop and implement the integrated planning and management of destinations in order to preserve their integrity and ensure their sustainability.

In relation to the above objectives, a relatively new and pioneering area of work for the group is to explore the development of frameworks which provide for all stakeholders within destinations to work collectively on sustainable tourism development. The Committee explicitly recognises the importance of combining bottom-up initiatives with a top-down approach that involves destination authorities who can coordinate projects such as infrastructure development. Thus, the ABTA Sustainable Tourism Committee enables tour operators to work in a coordinated manner with destination governments and authorities to drive sustainable tourism development.

<u>Coordination through NGOs</u>

The Travel Foundation in the UK is an independent charity that operates internationally to help the travel industry develop sustainable tourism in destinations throughout the world (Travel Foundation, 2011). In addition to providing training and guidance for travel companies to manage environmental and social aspects of their operations, the Travel Foundation manages projects that aim to directly improve environmental and social conditions in major destinations. In 2010 – 2011, the Travel Foundation was operating 30 projects in 16 destinations. Funding and benefit-in-kind support is provided by tour operators and other stakeholders including hotel chains and NGOs. In 2010, income was EUR 1.416 million, and charitable expenditure was EUR 1.266 million

The Travel Foundation has supported projects to develop local suppliers, including 900 farmers in the Gambia and a cooperative of Mayan women who supply 'jungle jams' to local hotels (Travel Foundation, 2011). Improvement schemes may also target enterprises within destinations that are not targeted directly by tour operators via environmental standards for suppliers (section 4.2).

Applicability

All tour operators can initiate or support projects to improve the environment in destinations.

- Large tour operators can directly leverage influence over destination managers to implement large-scale improvement schemes.
- Smaller tour operators can contribute to coordinated actions through participation in organisations such as the Travel Foundation and Futouris.
- The influence of all tour operators can be maximised by working with such organisations, through coordination of targeted action and realisation of possible synergies.

Economics

Tour operators may directly fund projects aimed at destination improvement, such as TUI's aforestation programme in Majorca. For larger projects, best practice is for tour operators to offer a long-term business commitment to the destination and greater promotion of the destination to customers, to leverage a commitment to the funding and implementation of these projects by the destination managers. Often, some direct financial or benefit-in-kind support (e.g. provision of expertise or equipment) for large-scale improvement projects is required from tour operators.

As an example, the memorandum of understanding signed by the Travel Foundation and Cypriot authorities responsible for destination management, the Travel Foundation agreed to provide seed funding of up to EUR 50 000 per annum to the CSTI to implement the destination improvement action plan. In 2011, the CTO will provide twice as much funding as the Travel Foundation, and in subsequent years the CTO contribution will be agreed based on progress against the action plan objectives.

Driving force for implementation

The continued success of major destinations, and the tour operators that serve them, depend on sustainable management. Whilst tour operators may work directly with enterprises such as hotels to improve their environmental performance, further improvement by private enterprises may be impeded by the infrastructure and services available within the destination. Therefore, tour operators have a strong interest to leverage their considerable influence beyond direct business partners to improve the environmental (and social) performance of destination managers. In addition, tour operators can play an important role in the preservation of ecologically important areas so that they continue to attract tourism and generate business in the future.

Reference organisations

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4.4 Develop and promote sustainable tourism packages

Description
This BEMP focuses on the development and promotion of sustainable tourism packages. Development of sustainable tourism packages involves a holistic approach that combines best practice in transport management and sourcing (section 4.1), accommodation management and sourcing (section 4.2), destination improvement (section 4.3), and encouraging more sustainable tourist behaviour (section 4.5) with choice editing of locations and exclusion criteria to avoid particularly sensitive locations and damaging transport options and activities. Best practice in promotion of sustainable tourism packages involves prominent advertising of these packages in mainstream promotional material and price incentives.

The definition 'sustainable tourism' encompasses environmental, social and economic aspects. Widely accepted definitions of sustainable tourism from the United Nations Environment Programme (UNEP) and the United Nations World Tourism Organisation (UNWTO) are referred to below (Perrat, 2010).
'A level of tourism activity that can be maintained over the long term because it results in a net benefit for the social, economic, natural and cultural environments of the area in which it takes place' (UNEP);
'*Tourism which leads to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled while maintaining cultural integrity, essential ecological processes, biological diversity and life support systems'* (UNWTO).

Thus, whilst this document is focussed on best **environmental** management practices, efforts to make tourism more sustainable must consider all aspects of sustainability. Figure 4.13 illustrates the potential sustainability trade-off between nature conservation and socio-economic benefits arising from tourism in economically less developed high nature value (HNV) areas, and direct environmental burdens, especially from transport emissions. Different types of holidays are positioned in Figure 4.13 relative to a hypothetical sustainability threshold. In reality, consumer lifestyle patterns strongly affect sustainability. For example, an annual flight package from norther Europe to the Mediterranean, or infrequent long-haul holidays, are compatible with a sustainable lifestyle if the environmental buderns of other choices are relatively low. These factors are outside the control of tour operators, although may be influenced by information provision and offer composition (e.g. exclusion of short-stay flight packages).

Gössling et al. (2005) proposed that the sustainability of different types of tourism could be estimated based on the CO2 emission intensity of each Euro of revenue generated. This eco-efficiency measurement (kg CO2/EUR) depends strongly on transport, and therefore on the destination relative to the tourist point of departure. According to this indicator, long stays are more sustainable than short stays (average CO2 intensities of 0.76 and 1.39 kg per EUR revenue, respectively), and high value tourism more sustainable than budget tourism in general. However, there is considerable variation depending on the type of package. For example, short stays involving short distance and efficient transport are more eco-efficient than long stays in distant locations.

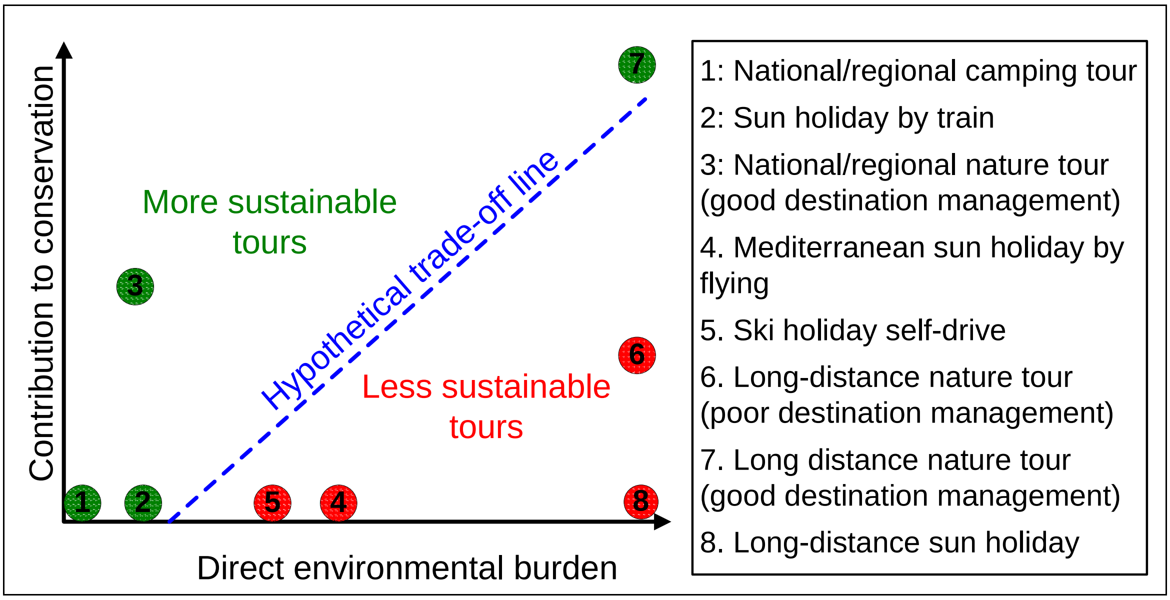

Figure 4.13: Comparison of the overall environmental performance of tours based on the balance between potential positive nature conservation effects and direct environmental burdens

<u>Criteria for sustainable tourism</u>

As alluded to above, defining sustainable tourism in practice is challenging. Table 4.24 summarises environmental hotspots, potential benefits and mitigation options associated with the main components of a typical tour package. The main hotspots can be addressed through:

- destination selection
- transport options provided
- activities offered.

Tours incurring low environmental burdens such as local, regional or international tourism using efficient transport modes (e.g. train or coach) are clearly amongst the most sustainable options (Figure 4.13). Tours to HNV areas with low income and high risk of natural resource degradation through exploitation (e.g. deforestation, overfishing) can **potentially** generate strong environmental and social benefits in the destination by providing economic incentives for the conservation of those natural resources, if sufficient basic infrastructure is present and if well managed. Additional benefits may arise from the education of tourists on the importance of nature conservation, and actions to promote it. These benefits may be sufficient to compensate for the large direct environmental burdens that arise when such tours are located in distant locations, so they may be regarded as contributing positively to sustainability (Figure 4.13).

A number of organisations, including tour operators and ecolabel associations, have proposed criteria for 'eco tourism' or 'sustainable tourism' that provide useful guidance. Forum Anders Reisen is an association of small and medium sized tour operators and travel agencies that claims to offer environmentally responsible tours, and that has produced a set of guiding criteria for tour operator members to develop sustainable tourism packages (Forum Anders Reisen, 2011). Meanwhile, the Austrian ecolabel for travel offers was launched in 2008, and establishes criteria for accreditation of 'ecological' tours. In addition, as referred to in previous sections of this document, the Travelife handbook on supplier sustainability (Travelife, 2006; 2011) offers extensive criteria representing good and best practice throughout tour operator supply chains. Criteria proposed by the aforementioned organisations provide a useful basis for the operational definition of sustainable tourism, and are referred to below.

Table 4.24: Environmental hotspots, potential environmental benefits and mitigation options for sustainable tourism packages

	Destination selection	**Transport**	**Accommodation & food**	**Activities**
	 *Source:* Endemic Guides (2012).	 *Source:* Aviation news.eu (2012).		 *Source:* Ballygunge (2012).
Env. hotspots	– Transport (distant locations) – Degradation of sensitive ecosystems	– GHG emissions – Air pollution	– Water consumption – Waste generation – Food & drink supply chains	– Ecosystem degradation
Potential env. benefits	– Contribution to conservation of natural habitats			– Contribution to conservation – Environmental education
Main mitigation options	– Promote destinations accessible by coach or train – Promote well-managed (e.g. EDEN) destinations – Exclude destinations without adequate infrastructure or protection – Size tour groups and offers according to carrying capacity – Support destination management	– Promote destinations accessible by coach or train – Provide price incentives for bus or train transport – Avoid domestic and connecting flights – Offer flights only for minimum holiday durations (Forum Anders Reisen, 2011) – Provide bus or train transfers to airports – Provide information on environmental impacts of different options	– Include ecolabel accommodation in package offers – Establish minimum criteria for water, waste and green sourcing performance of accommodation	– Exclude high-impact activities from offers (e.g. off-road tours) – Promote low-impact and activities (e.g. cycling, on-trail hiking) – Promote educational activities – Restrict tour group sizes – Use local and trained ecologist guides
Other SRD sections	Cahper 3.1, section 4.3	Section 4.1	Section 4.2	

Achieved environmental benefit

The magnitude of environmental benefits arising from more sustainable tours varies widely depending on the scope and extent of improvements relative to the reference 'average' holiday package. Some indicative values are presented in Table 4.25. It is difficult to quantify biodiversity conservation benefits, but tourism contributes to the conservation of thousands of km^2 of HNV areas globally.

In cases where sustainable tours replace different types of conventional tour (e.g. regional tour instead of long-haul tour) transport benefits may be much greater (a few tonnes CO_2 per person). Reducing or avoiding air transport also leads to reduced emissions of NO_x, VOCs and particulates at high altitude where they are more damaging.

Table 4.25: Indicative magnitude of environmental pressure reductions per person achievable for a 10 day package tour involving transport over 2 000 km

Component	Hotspot pressure	Environmental benefit	
		Low	High
Destination (well managed)	Nature conservation	Minimise biodiversity loss and ecosystem damage impacts	Contribute to biodiversity and ecosystem protection
Activities (avoid high impact)			
Transport (train instead of plane)	GHG emissions	360 kg CO_2 reduction	972 kg CO_2 eq. reduction (RFI 2.7)
Accommodation (best practice levels of water and energy consumption, waste generation and green sourcing)	Water consumption	470 L reduction	3 500 L reduction
	Energy consumption	175 kWh reduction	700 kWh reduction
	Waste generation	3.4 kg reduction	13.4 kg reduction
	Food & drink sourcing	Up to 50 kg of CO_2 emissions, 1 000s of litres of water consumption and biodiversity pressures avoided.	

Appropriate environmental indicator

Development of sustainable tourism packages

Relevant indicators of tour operator performance in the **development** of sustainable tourism packages, from an environmental perspective, are:

- the net environmental burden of packages
- the number of more sustainable packages offered.

The most readily available indicator of front-runner sustainable tours is accreditation with an ISO type-I ecolabel such as the Austrian ecolabel for travel packages. Ecolabel accreditation of individual components of tourism packages is another useful indicator, but must be combined with evidence of the environmental credentials of other components within the package.

In the absence of tour certification, it may be necessary to calculate net environmental burden of a tourism package. As referred to above, this is challenging, especially if positive and negative impacts on nature conservation are incurred. One option is to calculate the package carbon footprint (see below), although this excludes many other important aspects, especially related to biodiversity impacts and conservation. Compliance with comprehensive sets of sustainability criteria, such as Forum Anders Reisen (2011) is the most reliable indicator of sustainable tours. The following criterion from Forum Anders Reisen is a particularly useful indicator of tour sustainability:

- length of stay (days) relative to distance travelled (km).

It is difficult to capture the net biodiversity impact of tours using quantitative indicators. Possible indicators for biodiversity include:

- tourism is a major driver of biodiversity conservation within the destination
- minimisation of biodiversity impacts arising from tourism activities offered within the destination (and avoidance of high impact activities).

Package carbon footprint

Often, single quantifiable environmental pressures, such as GHG emissions, are used as a proxy for overall environmental performance. These should be expressed per person and per day to enable comparison across different types of tours. Given the major contribution of transport to tourism package CO_2 emissions (see section 4.1), carbon footprint calculations focus on this aspect. The Austrian ecolabel for tours awards points in relation to CO_2 emissions expressed per person and per day. The carbon footprint of a tour may not exceed 220 kg CO_2 per person per day, and is calculated according to the methodology described below.

Points = 20 – [0.1 x (*X* – 20)]	
X = *Y* x [d/1000]/t	
X	kg CO_2 per person per day
Y	g CO_2 per passenger per km (Table 4.26)
d	return travel distance (km)
t	duration of tour (days)

Table 4.26: Mode- and use-specific CO_2 emission factors used to calculate the transport CO_2 emissions in the Austrian ecolabel for tourism packages

Mode	Purpose	CO_2 (g/pkm)
Car	Luggage transport	243
Minibus	Return journeys or luggage transport	311
Coach		51
Train		14
Flights	Short distance (<1 500 km)	324
	Medium distance (>1 500 km <3 500 km)	204
	Long distance (>3 500 km)	173
Ship		316

Tour operators may have specific information on fuel consumption and emissions from transport options (e.g. TUI Nordic, 2011). Further information on measuring transport impacts is presented in section 4.1.

Gössling et al. (2005) propose an eco-efficiency indicator for tourism packages of kg CO_2 per EUR revenue generated. Based on average eco-efficiency and IPCC CO_2 reduction targets of 80 %, they propose a sustainability benchmark of 0.24 kg CO_2 per EUR revenue.

Promotion of sustainable tourism packages

Meanwhile, the percentage of front-runner sustainable tourism packages sold is an indicator of tour operator performance in the **promotion** of sustainable tours. These data may not be disclosed by tour operators in some cases for confidentiality reasons. TUI Nordic (2011) report that Blue Train packages account for just 0.3 % (3 420) of TUI Nordic customers.

Benchmark of excellence

Reported sales shares of front-runner sustainable tours vary from less than one percent for large mainstream tour operators to 100 % for specialist 'eco' tour operators. It is therefore difficult to establish an empirically-derived and universally applicable benchmark of excellence based on sales shares. In the first instance, the following benchmark of excellence is proposed.

BM: the tour operator promotes sustainable tourism packages in mainstream advertising material, and front-runner sustainable (e.g. ISO Type-I ecolabelled) tourism packages represent a sales share ≥ 10 %.

Cross-media effects

As referred to above, tourism that leverages environmental benefits by incentivising nature conservation in destinations vulnerable to loss of natural habitats is often associated with high direct environmental burdens from long-distance transport, and may be associated with environmental impacts within the destination itself if not properly managed. Negative impacts include: air emissions, noise, waste generation, littering, water pollution from oil, chemicals and sewage, invasive species brought by travellers, land degradation through development, trampling, increased risk of fires (Perrat, 2010).

These environmental burdens of nature tourism may be outweighed by the conservation benefits where:

- tour operators provide safeguards and support to ensure that nature conservation benefits are maximised in the destination;
- tours that involve flying more than 2 000 km include stays of at least 14 days (Forum Anders Reisen, 2011).

Further information on criteria that may be used to achieve the first aforementioned objective is provided under 'Operational data', below.

Operational data

Ecolabelled tours

In the first instance, tour operators may develop and seek certification for ecolabelled tours. As of 2012, 43 tours operated by four tour operators have been awarded the Austrian ecolabel (Table 4.27). The list of certified tours available from each of these four tour operators is available online at: http://www.umweltzeichen-reisen.at/display/cid/_m005.html

Table 4.27: Tour operators and tours awarded the Austrian ecolabel for travel offers

Tour operator	Number certified tours	Type of tour
Austria Radreisen	1	Austria Radreisen offers a 269 km bicycle tour in Austria, over 8 days, with a carbon footprint of just 4 kg per person per day.
Mondial GmbH & Co. KG	10	Mondial GmbH & Co. KG was the first tour operator certifying tours with the Austrian Ecolabel. They provide 'green' tour packages by combining tourist accommodation certified with the Austrian Ecolabel or another environmental certification with a complementary train ticket for the journey to the hotel (within Austria). These tours are advertised in a 'Fair tour' brochure (Mondial-reisen, 2012) each season.
Mostviertel Tourismus GmbH	5	Mostviertel Tourismus GmbH is a destination management bureau offering alternative tour packages in Lower Austria. Certified tours include a pilgrimage tour, a journey on a light railway through the EDEN-certified Pielachtal-valley, a guided tour through the Austrian 'grand canyon' or a relaxing break in an eco-certified hotel within a natural park.
Oberösterreich Touristik	35	Oberösterreich Touristik specialise in bicycle and walking tours, mostly in Upper Austria or along the river Danube. Tours comprise of a round trip made by bicycle or on foot in regions with rich natural or cultural heritage, and using mainly small accommodation with ecolabel certification or demonstrated high ecological standards.
Source: VKI (2012).		

<u>Destination nature conservation</u>

As referred to in section 2.2, it can be challenging to identify better performing products and services with respect to biodiversity impacts, in part because few product certification schemes include biodiversity criteria. Therefore, it is particularly important that biodiversity protection is included in tour operator code of conduct and procurement rules, and is integrated as a key criterion into the development of sustainable tourism packages. Products, services and activities with clear negative impacts on biodiversity should be excluded from packages, e.g. souvenirs from protected or rare species, visits to dolphinariums, excursions with motorised vehicles into ecologically sensitive areas, wildlife observation not respecting international rules of animal welfare etc. Improving packages involves dialogue with suppliers, both to inform them of the business importance of biodiversity and to obtain feedback that can be used to define concrete and practical procurement rules. Tour operators may train suppliers in biodiversity (and more general environmental) management. See also Annex 1 on biodiversity check criteria.

The development of front-runner sustainable tourism packages requires the leveraging of conservation benefits by tour operators, through financial contributions and provision of other assistance (e.g. access to equipment, expertise) to local populations or organisations that manage and protect natural resources. For example, the UK tour operator Discovery Initiatives offers holidays specifically designed to support wildlife and conservation. Its Ladakh Snow Leopard treks support the Snow Leopard Conservancy research teams who in turn promote grassroots measures that lead local people to become better stewards of endangered snow leopards, their prey, and habitat (Travelife, 2011).

The Austrian Ecolabel for Travel Offers (AFMAFEWM, 2012) awards points for actions incorporated into tour offers that are at least compatible with, or can leverage benefit from, nature tourism (Table 4.28).

Table 4.28: Actions awarded points according to criteria for the award of the Austrian Ecolabel to travel offers

Aspect	Promoted actions
Conservation education	– Visits to research stations – Visits to biodiversity projects – Visits to eco-factories or environmental projects – Visits to nature reserve's visit (with appropriately trained guides) – Guided nature tours – Nature observation
Responsible enjoyment of natural resources	– Climbing – Non-motorized water sports – Riding – Responsible fishing – Cross – Guided hikes – Alternatives to alpine skiing for snow-free periods

In order to be of net benefit to the destination, tours to HNV areas must be managed carefully in order to avoid damage to the often sensitive natural resources in those areas (see 'cross-media effects'). Two critical criteria can be defined to reduce the risk of adverse environmental impacts in the destination:

- potential destinations with pristine ecosystems are excluded if they do not have sufficient tourism-supporting infrastructure or if their carrying capacity is already exceeded (see section 3.2)
- tour groups are sized according to the carrying capacity of natural resources and infrastructure
- tours should be led by trained and authorised guides, and in compliance with all local laws.

The Austrian ecolabel for travel offers allows very small tours of eight people or fewer in pristine, undeveloped destinations (AFMAFEWM, 2012). Forum Anders Reisen (2011) define ecologically sensitive areas as those under environmental protection schemes, or areas where visitation rates are lower than 100 guests per day per km^2, and allow tours in sensitive areas only where the scientifically-defined carrying capacity is respected. Ultimately, tour operators should be able to provide a justification of the benefits of bringing tourism to a HNV area, in relation to the threats posed by that tourism.

Surveys of the local population or staff within destinations may provide useful insight into baseline environmental conditions and problems. For example, TUI use an environmental questionnaire completed by staff within destinations to ascertain the state of the local environment, problems or potential problems, and opportunities for improvement (TUI Travel plc, 2007).

The following example from Travelife (2011) demonstrates the need for careful management of nature tourism. In the early 1990s, TUI was one of the pioneers of whale watching trips in the Canary Islands. There followed a boom in whale watching, and by the mid-1990s studies were indicating a negative impact on the whales. TUI therefore dropped whale watching trips a number of years, but then decided to develop more sustainable whale watching trips owing to continued high tourist demand. TUI is working with the nature protection organisations Sociedad Española de Cetáceos (Tenerife) and M.E.E.R. e.V. (La Gomera and Tenerife) to develop whale watching trips that fully comply with the principles of sustainability and species protection, and raise the awareness of holidaymakers, using specially trained guides. Other examples of nature tourism are provided in Table 4.35, section 4.5.

Transport

Train and coach transport are associated with considerably lower energy consumption and GHG emissions per passenger km. TUI Nordic (2011) reports CO_2 emissions of 0.031 kg per pkm on the Blue Train, and average return-journey emissions of 74.7 kg CO_2 per customer, compared with CO_2 emissions of 0.067 kg per pkm for flights, before multiplication by the relevant RFI (and up to a few times higher on less efficient airlines). The Austrian Ecolabel for travel offers excludes the following tours:

– air travel with a stay of less than 7 days
– air travel with a total flight distance <700 km
– cruises
– tours with cars or campers with a conventional drive
– air tours
– advertising trips.

Meanwhile, Forum Anders Reisen (2011) criteria exclude flights:

– for distances less than 700 km
– for distances up to 2 000 km if the stay is less than 8 days
– for distances up to 2 000 km if the stay is less than 14 days.

Table 4.29 provides a summary of some front-runner sustainable tour packages that avoid flights.

Table 4.29: Examples of front-runner sustainable tours that avoid flying

Tour	Description
TUI Nordic Blue tours	Holiday packages that involve transport from Sweden to resorts across Europe on the 'Blue train' – an overnight sleeper train, considerably reducing the package carbon footprint and other environmental burdens associated with flying. Average transport distance for tourists on TUI Nordic's Blue Train is 2 400 km (return journey).
Ameropa reisen train tours to protected areas	The 'German Railways', in cooperation with the 'Bund für Umwelt und Naturschutz' developed a tour package called 'Fahrtziel Natur'. When booking the tour package, the price of a return ticket from any place in Germany is limited to EUR 69 with the 'BahnCard'. Transfers from the hotel to the train station and guiding tours through the park are included. This tour is offered in the catalogues of the tour operator AMEROPA as well as in brochures of 'Fahrtziel Natur'.
Nederlands Alpenplatform (NAP) –	An 'Alpine Tourism 2005' transnational network including travel organisations and alpine enterprises both in the Alps and the Netherlands, has been created in order to develop and offer a coherent package of eco-friendly and sustainable forms of alpine tourism. Based on 'house to hotel' train and bus transport, including luggage logistics on international trains, discourages tourists from travelling by car. Travel on Saturdays is reduced to avoid peak road congestion and pollution associated with this popular day for travel. Alpine packages also include environmentally-certified accommodation and environmentally conscious mountaineering activities.

Where flights are necessary, connecting flights should be avoided wherever possible. Vehicles such as coaches, minibuses or cars used for travel and activities should be in the most efficient

CO_2 emission band for the relevant category and compliant with EURO 5 emission standards or higher. Preferably, vehicles may use alternative propulsion systems (biogas, compressed natural gas, hybrid, electricity).

Accommodation

Front-runner environmental performance for accommodation components of tours can be ensured by procurement of ISO Type-I ecolabelled accommodation such as the EU Flower or Nordic Swan.

Section 4.2 of this document lists some important environmental certification schemes for accommodation. Accreditation with an internationally recognised EMS is an indicator of good practice but does not in itself represent best practice (see section 4.2). Environmental performance reported according to an EMS may be used as a basis for selecting appropriate front-runner accommodation. Benchmarks of excellence for energy, water and waste propose in this document may be used to indicate front-runners (Table 4.30).

Table 4.30: Benchmarks of excellence for accommodation best practice that could be used to indicate accommodation appropriate for front-runner tours

Aspect	Front-runner indicator
Energy consumption	Total final energy consumption ≤180 kWh/m^2yr
Water consumption	Water consumption ≤140 or 100 L per guest-night, for fully serviced and basic accommodation, respectively
Waste generation	At least 84 % of waste, expressed on a weight basis, is reused or recycled, or unsorted waste is less than 0.16 kg per guest-night
Green sourcing food & drink	≥60 % food and drink products, by procurement value, are certified according to basic or high environmental standards or criteria

TUI Nordic 'Blue Village' hotels are either certified, or are in the process of being certified, according to the ISO 14001 standard, enabling environmental performance to be tracked for each hotel. TUI Nordic has established limits for energy and water consumption for Blue Village hotels, including stringent limits of 15 kWh of electricity plus 5 kWh of heating per guest-night (TUI Nordic, 2011). TUI Nordic is working with Blue Village hotels to make them fossil-free by introducing solar heating and use of biogas in kitchens. Another example of ecological accommodation is provided by 'ecohostels' such Lough Ossian in Scotland (Hostelling Scotland, 2012) or the self-sufficient Monterossa hut in Switzerland (ETH, 2009).

Prohibited activities

Within the destination, transport and activities are based on the use of public transport or cycling, walking, canoeing, etc, as far as possible. Forum Anders Reisen criteria (2011) prohibit the following forms of travel and activity:

- offroad tours by jeep or motorcycle
- snowmobile tours
- sightseeing flights by helicopter
- heli-skiing.

Applicability

All tour operators can promote front-runner sustainable tours. It may be easier for small specialist tour operators to achieve high sales shares for such tours, compared with large mainstream tour operators that are more dependent on price-led customers.

Economics

<u>Tour operator economics</u>

The costs of developing sustainable tour packages, including certification of specific components where relevant, are minor compared with sales turnover. Additional costs of sustainable tour development and procurement may be recouped in sales prices for these value-added packages, and promotion of sustainable tours may have a positive influence on tour operator image and thus overall sales (a 'halo effect').

<u>Destination economics</u>

Tourism can contribute significantly to the economies of destinations, and may represent the main source of income for underdeveloped destinations. Where tourism contributes towards the conservation of natural resources, large economic benefits may be generated as a non-privatised public good (see section 3.2). Braat and ten Brink (2008) estimate that the continued degradation of ecological services up to 2050 could result in a loss of economic value of up to 7 % of global GDP.

Driving force for implementation

Driving forces to develop sustainable tour packages include:

- corporate social responsibility
- green marketing and company image
- brand differentiation
- risk aversion and future-proofing business operations.

A particularly strong driving force is the consumer expectation that tour operators develop more sustainable tours. Two thirds of British consumers find it important for tour operators to develop products with the least possible impact on the natural environment (Travelife, 2012).

Reference companies

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4.5 Encourage more sustainable tourist behaviour

Description

The behaviour of customers and tourists is an essential driving force behind tourism sustainability. Tour operators have a strong influence over the tours that customers choose through advertising and pricing structures, and can have a significant influence over tourist behaviour within destinations. Often tourists are not fully aware of the negative impacts of their holidays, many of which are not immediately visible. Tour operators therefore have a responsibility to make tourists aware of these impacts and how to mitigate them by acting in a responsible manner. This section describes best practice measures to identify less environmentally damaging options to consumers, and to encourage more sustainable tourist behaviour within locations. The first objective overlaps somewhat with the promotion of sustainable tourism (section 4.4).

Influencing package selection

One barrier to selecting more sustainable tours is a lack of information on what constitutes a more sustainable tour, and which tours are more sustainable (see section 4.4). An extensive survey of almost 4 000 tourists (TUI Travel plc, 2010) found that just 20 % of respondents were familiar with the term 'sustainable holidays', but 45 % were interested or very interested in sustainability issues. A quote from one respondent was published in the survey report: *'I would like to have more information about how my holiday impacts, both good and bad, on local communities'.* These results indicate that there is a need for tour operators to provide more information on the environmental impacts associated with tourism, and preferably for individual tour options. The most effective way to achieve this is to promote more sustainable tours (section 4.4), and to include information on environmental burden within mainstream promotional material (e.g. tour catalogues).

Influencing tourist behaviour

Tourists on holiday wish to escape from everyday worries and responsibilities, but may be happy to receive information on how they can do their bit to contribute towards sustainability. Effective communication to tourists draws on marketing techniques, and uses short, positive and engaging messages that stimulate a sense of commitment without provoking sense of guilt. The most successful method is to inspire tourists to act more sustainably by presenting sustainable alternatives as quality products or novel experiences. Relevant words that may be used to promote more sustainable alternatives in a positive way include 'authentic', 'traditional' and 'natural', as relevant, with sustainability credentials explained in secondary material.

Communication of more sustainable choices and behaviour may use any and all media channels available to tour operators, including publicity, brochures, websites, travel documents, magazines and in-flight videos, welcome meetings upon arrival, enquiries after their return, etc. (Travelife, 2012). A practical way to convey more sustainable behaviour to tourists is via a code of conduct that translates the sustainability policy of the tour operator into practical tips for clients. Codes may be specific to certain activities or destinations, and can be included in travel documents sent to clients before departure, or handed to tourists in the destination. WWF have produced a code of conduct for tourists to the Mediterranean (WWF, 2005) that provides criteria for responsible tourism. Some of these criteria involve tour operator actions.

Ultimately, effective measures to influence tourist behaviour must capture tourists' attention and imagination in order to be remembered and acted upon. Best practice thus uses marketing techniques and psychology to influence tourist behaviour, but also goes beyond presentation of information in online and printed material to use activities, games and objects to stimulate behavioural changes (ABTA, 2011). Table 4.31 lists possible best practice measures to influence customer and tourist behaviour, in relation to key factors at different stages of tour packages.

Table 4.31: Some best practice measures to influence customers/tourists at different stages of tour packages

Tour stage	Key factors	Possible best practice measures
Tour selection	– Destination location (travel distance and mode) – Destination condition and carrying capacity	– Indicate and promote more sustainable tours (section 4.4), or aspects such as travel (section 4.1) and accommodation (section 4.2) – Advertise locations accurately to inform correct customer decisions – Highlight environmental and social features of the destination, and any discouraged activities, etc. – Provide carbon footprint information for tours
Transport	– Distance to destination – Mode	– Promote more environmentally friendly transport modes (train, coach) – Provide information on environmental performance of different transport modes
Accommodation	– Water consumption – Waste generation – Energy consumption	– Install prominent notices for guests advising on specific measures, including towel and bedclothes reuse (section 5.3) – Install devices to provide real-time consumption data (including innovative options such as water-pebble, described below)
Eating and drinking	– Type of food and drink selected – Quantity of food and drink chosen/purchased (waste generation) – Local sourcing and revenue	– Promote local, seasonal, organic or other certified food and drink in menus (see section 8.1) – Encourage tourists to frequent local establishments rather than multinational chains – Inform clients about threatened food species found on local menus (e.g. shark in Thailand).
Activities	– Sensitive areas – High impact activities – Illegal souvenirs – Contribute to conservation	– Provide a code of conduct for behaviour and acceptable activities within particular destinations – Promote best practice providers for environmentally sensitive activities (diving, high mountain climbing, visiting protected areas) – Highlight issues such as illegal souvenirs for particular destinations – Promote low-impact and conservation-oriented activities in brochures and on ground (e.g. Forum Anders Reisen, 2011) – Encourage donations to local conservation and social projects – Do not offer high-impact activities
After tour	– Solicit feedback	– Ascertain customer satisfaction, including in relation to sustainability aspects

Achieved environmental benefit

Environmental benefits arising from selection of more sustainable tourism packages can be large, for example reductions in GHG emissions of up to a few tonnes of CO_2 per person per package (see section 4.4). Overall benefits arising from influencing tourist behaviour within destinations vary widely in magnitude depending on the scope and extent of influence.

More quantitative examples include successfully encouraging guests to reduce water use through simple measures. The following small actions would lead to a saving of 320 L per person over a 10 day package holiday:

- reduce shower durations by 1 minute
- turn off water when brushing teeth
- use small flush on dual flush toilets when appropriate

- reuse towels.

Measures to reduce biodiversity impacts and habitat damage can result in very important but difficult to quantify benefits.

Offsetting GHG emissions does not avoid the impact of those emissions, but does contribute to GHG avoidance at the global scale (i.e. a reduced rate of global GHG emission increase) and, depending on the projects invested in, the development of renewable energy technologies or habitat regeneration (see section 4.1).

Appropriate environmental indicator

Management indicators

Indicators of best management practice for this technique include:

- percentage of offers for which clear benchmarkable environmental information is provided;
- clear identification and promotion of more sustainable offers;
- liaison with accommodation providers to inform guests on measures to reduce environmental impacts (e.g. prominent notices, information on more sustainable options in menus);
- effective communication of behavioural measures to reduce tourist impacts in destinations.

Performance indicators

Performance indicators reflecting best practice for this BEMP are strongly influenced by other BEMP techniques, and include:

- sales share of more sustainable tours sold (section 4.4)
- share of more efficient transport modes (train, coach, bus) to/from destinations
- accommodation water consumption, litres per guest-night (section 5.1)
- accommodation waste generation, kg unsorted waste per guest-night (section 6.2)
- accommodation energy consumption, kWh per m^2 per year (section 7.1)
- sales share of more sustainable food and drink, according to criteria in section 8.1.

Benchmarks of excellence

Presentation of environmental information for individual tours is one aspect of best practice. For example, carbon footprint per person per night or per tour may be presented alongside each tour offer in promotional materials. However, such indicators usually only capture specific aspects of environmental performance, and it may be difficult for customers to recognise good performance from such indicators. Therefore, best practice is represented by the following benchmarks for tour operators, the first of which is the same as for section 4.4.

BM: the tour operator promotes sustainable tourism packages in mainstream advertising material, and front-runner sustainable tourism packages represent a sales share ≥10 % total sales

BM: the tour operator employs effective marketing and communication methods to encourage more sustainable choices in the selection of tourism packages.

BM: the tour operators informs all it’s guests with destination specific information and awareness raising to promote correct behaviour in the destination.

Cross-media effects

There are no significant cross-media effects associated with promoting more sustainable tourist behaviour.

Operational data

Effective marketing

Table 4.32 provides an overview of key factors and associated best practice actions for effective communication of sustainability messages by tour operators. An example of good practice is provided by Thomson's 'Holidays Forever' campaign that communicates more sustainable options using social marketing techniques. Aspects of best practice for this campaign included:

- collaboration with partners
- use of multiple communication channels to reach target audience (website, in retail shops, in destination hotels, etc.)
- communication consistency across various supports through strong branding
- ongoing communication through games, events, specific campaigns, etc.
- incentives to encourage guests to take actions (holiday prize, use of celebrity power, games at holiday destinations, etc.)
- stakeholder engagement, including customer feedback requests
- collaboration with NGOs
- identification of KPIs prior launching of the campaign.

Table 4.32: Principle and best practice actions for effective communication of sustainable messages

Key factors to consider	Best practice actions
– Not all communication on sustainability is useful. Poorly designed communication can lead to a negative perceptions or disinterest. – Communication must be supported by action to gain legitimacy and avoid suspicions of green washing. – Communication must target realistic actions and outcomes, accounting for (local) factors such as public policy, infrastructure and facilities available.	–Ensure that your communication is supported by public policy (through economic, regulatory, voluntary or other instruments). –Ensure that necessary infrastructure and facilities are available and convenient. –Make your communication entertaining so that it grabs attention and is memorable. –Make positive behaviour a pleasure to encourage participation. –Tailor different communication channels and messages to defined target audiences (segmentation).
– Develop a message that encourages action. – Avoid potentially counterproductive fear and guilt-based messages, unless clearly associated with positive opportunities and solutions. – Changing behaviour is an incremental process that requires time and effort. Tourists require support and continuous reminders from long-term campaigns.	–Focus on a few clear actions to avoid confusing or overwhelming people. –Use positive communication to empower people by offering solutions. –Present solutions as beneficial and equal to the scale of the problem. –Seek support from an authority to lend legitimacy and importance to the message. –Remind people continuously with long term communication campaigns.

Key factors to consider	Best practice actions
– Effective communication exploits typical psychological characteristics to imprint lasting messages and influence behaviour.	–Include retrieval cues in long-term campaigns to stimulate recall. –Exploit the power of social proof, for example using well known ambassadors to convey messages. –Rely on empathy, a powerful motivator. –Provide feedback to show tourists that their action is making a difference. – Offer rewards to people in return for changing behaviour. –Relate your message to other issues that may be perceived as important by your target audience (health, family, security, etc.).
Source: Perrat (2010).	

Promoting more sustainable packages

There is considerable overlap with section 4.4 which provides guidance on best practice to promote more sustainable tourism packages, and also section 4.1 and section 4.2 regarding the 'greening' of transport and accommodation suppliers. TUI Travel plc (2011) claim that three-quarters of TUI Travel businesses are now highlighting more sustainable holiday options to customers based on the Travelife Sustainability System, by featuring Travelife-awarded properties in brochures and online. Some mainstream examples include:

- TUI Nederland offers over 300 'greener' hotels based on Travelife awards, ISO 14001 and EU Flower certifications;
- First Choice publish a 'Greener Holidays' brochure specifically marketing 'more sustainable' mainstream holidays based on Travelife awarded hotels (First Choice, 2012).

The approach provided by these examples, to clearly differentiate and promote more sustainable options in mainstream literature, is effective. However, these examples focus on more sustainable accommodation, and do not promote more sustainable destinations or travel options.

Where tour operators provide only the accommodation and/or activities of a holiday package, they should inform customers of the environmental impact of different transport options. One way to do this is to include prominent information on the impact of different transport modes in online and hard copy catalogues and brochures. Forum Anders Reisen (2011) suggest that this information should take up at least one quarter of a page. The same can be done for transfers to/from airports.

Promoting more sustainable travel options

TUI Nederland informs customers of more sustainable transport options by displaying green transport labels in international holiday brochures next to packages including train as a means for transport to the destination. Customers are recommended to take the train on ski holidays (Travelife, 2011).

Tour operators may offer discounts for public transport to airports (e.g. provide train ticket or cover the cost of an upgrade to first class) and many tour operators offer bus transfers in destinations at low rates compared with taxi transfers. Van Nood Reizen displays information on local public transport after the booking is made, and offer competitively priced city travel passes for city destinations (Travelife, 2011). ReNatour offers clients buying the special train package to the Cilento region in Italy a one-week travelcard for the use of the public transport that includes walking tours, boat excursions, sightseeing tours and picnics (Travelife, 2011).

Carbon offsetting

Some tour operators provide information on carbon offset schemes in their brochures (Kuoni Switzerland, Guerba, Trips Worldwide, Island Holidays, Naturetrek, The Adventure Company), on their websites (Journey Latin America, The Gambia Experience) or at the agency desk (First Choice NL) and encourage contributions by their customers on a voluntary basis. Other operators, usually at the higher end of the market, include contributions to these schemes in the price of the packages they sell (High and Wild, Greentours, The Expedition Company, Discovery Initiatives, Club Robinson-, South American Experience Ltd, The Last Resort, Wildlife World, Crystal Holidays). The latter approach represents best practice (section 4.1). Where tour operators choose not to do this, customers should be informed of the carbon footprint of their travel options when booking, and be provided with an option to offset emissions during the booking process. This may be administered directly by the tour operator, or could be provided via a link to online carbon offset companies such as Atmosfair, Climate Care, etc.

Promoting more sustainable behaviour in accommodation

Thomson introduced the unique 'waterpebble' in the Sensatori Tenerife hotel as a trial to reduce holidaymakers' water consumption for showering. The 'waterpebble' sits in a shower’s plughole and glows red when too much water is being used – based on the duration of water flow down the plug-hole and calibrated to reduce the duration incrementally at each shower. The waterpebbles are currently being trialled, and guests are given the waterpebble as a gift to take home after their holiday.

NH Hoteles have installed a system in a Madrid hotel that registers information from the central BMS on energy consumption in individual guest rooms on guest loyalty cards at checkout. Prizes are offered for the guests with the lowest consumption (NH Hoteles, 2011).

Table 4.33 provides a list of specific best practice measures for accommodation managers to inform guests of more sustainable options.

Table 4.33: Summary of best practice guest information measures

Aspect	Best practice
Energy consumption	place notice next to room temperature controls to set the appropriate temperature, informing of energy consumption saving (~8 %) per degree avoided heating or cooling place notice on or next to windows to open only when necessary place notice next to window to close curtains/blinds to reduce heat-loss at night, or heat gain during the day in warm climates inform guests of energy consumption per room per night on checkout
Water consumption	place notice in bathroom to place towels on rack for reuse (see section 5.3) place notice next to basin mirror to remind guests of water wasted from taps left open and long showers place notice next to bath encouraging guests to take a shower instead of a bath (refer to average water savings) provide shower timing devices (e.g. 'waterpebble')
Waste generation	provide separate bin compartments for different waste types inform guests that separated waste is sent for recycling
Food and drink	indicate more sustainable options in menus (see section 8.1) do not offer 'all you can eat' buffets, or indicate that guests will be charged for wasted food left on plate

Promoting more sustainable behaviour in destinations

Tour operators can include tips on best practices and activities to avoid by providing tourists with information leaflets enclosed in booking documentation or directly in destinations. This information may be compiled by tour operators, or credible and relevant third parties (e.g.

NGOs). For example, tour operator members of ANVR in The Netherlands distribute WWF flyers on illegal souvenirs via tour reps in destinations, by enclosing them in travel documents, placing them in hotel information books, and by featuring them in in-flight videos and magazines (Travelife, 2011).

In 2005, WWF compiled a code of conduct for tourist best practice specifically for Mediterranean destinations. Relevant widely applicable criteria from this code of conduct are listed in Table 4.34. These are directed at tourists, and may be used by tour operators as a guide for relevant messages.

Tour operators may encourage more sustainable activities within their packages, and discourage participation in damaging ones by not offering them. For example, Forum Anders Reisen (2011) criteria for more sustainable tourism packages propose that tour operators do not offer the following activities: offroad tours by jeep or motorcycle, snowmobile tours, sightseeing flights by helicopter, heli-skiing.

Camping is potentially a low impact form of tourism, but can be associated with habitat damage and increased fire risk. The Travel Foundation (2012) provide guidance particularly relevant for campers to:

- minimise waste by reusing plastic bags
- bring a water filter bottle or purifier
- take used batteries home
- take care with cigarettes and fires (and not light fires in high risk areas).

Other notable activities that may require dedicated local advice include: animal attractions (e.g. safaris, zoos); diving and snorkelling; fishing; hiking; skiing and other winter sports. Since 2002, French tour operators including Voyageurs du Monde, H2O Voyage and Blue Lagoon have supported the development of an International Guideline for Responsible Divers, and distribute a diving code of practice to their clients going on holidays in marine destinations.

Table 4.34: Some widely applicable WWF code of conduct criteria for Mediterranean tourists

Criteria
– Learn about the (Mediterranean) environment before you go. Make your trip an opportunity to learn about nature conservation (in the Mediterranean). – Whenever possible plan your visit during off-peak periods. Peak periods contribute to high resource pressures, especially for water. – View and photograph wildlife from a distance and respect signs. – Leave natural areas the way you found them. Stay on trails during hikes, do not remove plants or feed animals, and never litter. – Choose sports and recreational activities that are compatible with the local nature and landscape, environmental protection and local regulations. – Whenever possible, walk or utilise public transportation or vehicles with the least environmental impact. Share taxis and take shuttles to and from the airport. Encourage drivers of public vehicles to stop engines when parked. – When available purchase ecolabelled products and avoid buying elaborately packaged products, non-returnable bottles etc. – Buy locally made products and handicrafts. By buying local products you contribute to the local economy and reduce product transport distances. – Encourage local conservation efforts. – Choose tours and excursions that provide information on the climate, species, habitats, local peoples and cultures and appropriate behaviour in the areas you will visit. – Make sure that your behaviour complies with international conventions and national, state and local laws in relation to the environment. – At sea do not take any corals, shells, dried fish, starfish, sea-fans or other marine souvenirs. Removal can seriously disrupt eco-systems. – Do not anchor boats on reefs. You can easily break or damage them by anchor, it is better to anchor carefully in sand or rubble patches. Navigation in reef water needs special care. – Do not discharge litter into water: it is environmentally unfriendly and illegal. – Do not buy shells or other animal products as souvenirs. Take particular care to avoid products made from endangered species as forbidden by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). – Reduce the impact of your recreational activities by avoiding sports which have a significant harmful impact on the environment or choose more progressive establishments (e.g. golf courses that include indigenous plants and use greywater for irrigation, etc.). – Respect rules and regulations, pay attention to sign and behave responsibly (e.g. do not light fires where it is forbidden).
Source: Modified from WWF (2005).

<u>Educating tourists about conservation</u>

Tour operators may promote activities within destinations that contribute to tourist education on conservation and other environmental issues. For example, Dolphin Discovery Tours (DDT) operate luxury yacht viewing of marine animals designed specifically to educate and develop awareness about the environment and the need to protect wildlife populations. Information is delivered through comprehensive commentary and access to professional trained guides, all of whom are actively involved in the Dolphin Research Institute. Following a safety briefing, passengers are provided with information on the biology and behaviour of the animals viewed and are informed about the detrimental effects of sealing and other harmful activities (Travelife, 2011).

Customer feedback

The following example provides guidance on best practice in soliciting customer feedback, in order to convince customers of the authenticity of tour operator's sustainability motivation and to improve sustainability measures.

LTU Touristik specialises in package tours to all continents, and invites all customers to provide feedback on environmental issues, in particular problems encountered, positive and negative impressions, and suggestions on how to improve the environment in the visited destinations. A request for feedback is placed in every brochure for LTU brands, inviting customers to send their comments in written form by mail or e-mail. The same request is posted on the company's website. This invitation reaches an estimated 4.5 million people.

The company has received more than 1 000 letters and e-mails from customers in the last five years. Some customers only want to give information, others need explanations, and many ask questions, either prior to their holidays to help them make informed decisions, or after their holidays to better understand their experiences. In some cases, questions also come from people who are not LTU customers. Every customer who sends a message receives a personal reply providing background information and indicating if action has been taken to resolve the issue that they had raised. The process of responding to requests is handled by LTU's Environmental Department, with a human resource investment of up to 10 working hours per week.

Applicability

All tour operators can provide information on more sustainable tour packages, and encourage more sustainable tourist behaviour.

Economics

The additional costs of providing information to tourists on sustainable choices and behaviour are small compared with standard advertising costs. Indicating more sustainable options within promotional material need not incur any significant additional costs.

The economic implications of changing customer choices are highly variable depending on the existing assortment of packages offered by tour operators: more sustainable tours may be associated with higher or lower profit margins. Similarly, any indirect benefits to business arising from enhanced brand image are difficult to quantify.

Costs associated with communicating more sustainable guest behaviour in accommodation may have a short payback period of months if the measures successfully reduce guest water and energy consumption and waste generation.

Driving force for implementation

Encouraging more sustainable customer choices and tourist behaviour is driven by:

- corporate social responsibility
- maintaining attractive destinations and future-proofing business
- improving reputation and image (green marketing).

The last driving force, green marketing, is particularly strong. Long and high profile sustainability campaigns can be highly effective at improving a company's brand image by demonstrating commitment to sustainable practices.

In fact, there is a high expectation for tour operators to include more information on the sustainability of different tour options. ANWB Omnibus research has found that 82 % of Dutch consumers like to see sustainability information as a key part of travel brochure descriptions (Travelife, 2012).

Reference companies

In addition to tour operators mentioned above, other tour operators implementing good practice are referred to in Table 4.35.

Table 4.35: Examples of tour operators communicating to customers about more sustainable behaviour

Target audience	Description
All	TUI Deutschland's catalogues contains information on 'Nature and Environment' for each holiday region, including a disclosure of environmental problems such as shortcomings in waste management or beach cleaning, as well as exemplary environmental initiatives managed by local authorities and regions. The 'Holiday and environmental compatibility' page in all of the German-language TUI brochures helps consumers choose their holidays by publishing a transparent declaration on environmental criteria for hotels, destinations and modes of transport.
	The Travel Foundation have developed a range of 'Insider Guides' distributed to British tourists through high street travel agencies, explaining how travellers can make a difference. 'Make a difference when you travel' and 'Sustainable Tourism: Travel that makes a positive difference' are guides for everyone, while 'Make a difference while you party' targets 18 – 30 year olds. The travel Foundation also distributes destination-specific Insider Guides.
	TUI Nederland began an 'Environmentally Aware Tourism' project in 1999 that provides customers with information on responsible travel and sustainable products at various stages of their holidays, to promote well-informed choices for more sustainable island holidays. The project began with Bonaire and Curaçao, Netherlands Antilles islands in the Caribbean. Destination information is provided in the brochures of TUI Nederland's brands Arke and Holland International. Once a client has chosen a holiday to Bonaire or Curaçao, TUI Nederland provides tips for environmentally sound practices in the voucher booklet. During the flight, KLM, a project partner, shows a video about the sustainable excursions and activities that are promoted in the project. Upon arrival, trained TUI Nederland hostesses introduce guests to the sustainable excursions and activities that are available, and the TUI Nederland resource book available in hotel lobbies directs guests towards sustainable excursions, activities and attractions. The Dutch touring club ANWB and the Antillean Department for the Environment co-ordinate the project activities. As the largest provider of organised holidaymakers to Bonaire and Curaçao, TUI Nederland plays an active role in the project. Financial support is provided by the Netherlands Ministry of Agriculture, Nature Management and Fisheries, the Antillean Department of Environment, and the Netherlands Centre for Sustainable Development.
Children	'Hatch' is an animated Hawksbill turtle that is featured in a colourful and fun activity booklet and has been launched in conjunction with the Born Free Foundation and the charity's partners – First Choice, MyTravel, Thomas Cook and Thomson, who distributed the booklet in a pilot for the summer 2006. First Choice are now handing out 'Hatch' to in-flight customers, while MyTravel, Thomas Cook and Thomson are all distributing the booklet in various destination Kids' Clubs. This booklet integrating sustainability messages into a 'Play & Puzzle Book' makes sustainability fun.
Divers and snorkellers	The Accor hotel group distributes leaflets with guidance on protection of coral and the marine environment to customers at its hotels on the Red Sea.
	On-the-go Tours dictate the 'Red Sea Commandments' to all divers and snorkelers whilst in transit to dive sites. Reminder signs have also been placed at selected coastal points.
Mediterr-anean tourists	TUI Deutschland also produced an eight-page leaflet for clients explaining the causes and consequences of forest fires in the Mediterranean and neighbouring regions, and the actions TUI has taken to help affected areas.
Pristine areas	Hapag-Lloyd Kreuzfahrten (HLK) specialises in expeditions and luxury cruises around the world, particularly in sensitive and pristine areas such as the Arctic, Antarctica, the South Pacific Islands and the Amazon basin. To minimise the environmental impacts of its tours and improve the experience of its customers, HLK has also developed a 132 page illustrated handbook for travellers to Antarctica. In addition to receiving the handbook, each passenger and crew member receives a copy of Recommendation XVIII-1, adopted at the Antarctic Treaty Meeting in Kyoto 1994, and attends a presentation on how to behave in Antarctica. A group of experienced lecturers and naturalists is always on board each ship. The handbook is given to each passenger prior to departure. On-board lectures during the cruises are given by biologists, geologists,

	glaciologists, marine biologists, historians and others who also accompany passengers ashore to answer questions and ensure that the Guidelines are respected. HLK has also developed handbooks for travellers to the Arctic and for its Amazon River Cruises.
Wildlife watching	Archipelago Azores (UK) communicates whale watching regulations to whale watching tourists, including 14 points relating to whale watching from a motor boat, from sailing boat, feeding whales and swimming next to whales.
	Exodus has a Code of Conduct for visiting the Wild Mountain Gorillas, which is published on their website and provided to customers travelling to see them.
	Thomson supports the voluntary Turtle Protection Society of Zakynthos. The group educates and entertains visitors with a talk and slide show on board the Thomson Turtle Island Cruise, sells turtle themed gifts, and enables guests to adopt a turtle or turtle's nest. The Turtle Protection Society campaign to ban water sports in the Laganas Bay and have successfully protected several beaches on the island that are home to nesting Loggerhead Turtles, contributing to a stabilisation in turtle numbers. The turtles are a prime attraction to the island, and through their work with the Society, Thomson combines a profitable excursion with environmental protection and tourist education.
Tourists on flight packages	The Thomsonfly website and the flights section of the Thomson site provide information on travel by public transport to all the airline's destinations and information about how to access the UK airports by public transport. Thomson's Your Holiday Your Choice option allows customers to book a coach transfer in many destinations.
Source: Travelife (2011).	

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4.6 Efficient retail and office operations

Description

The aggregate environmental impact of tour operators' retail operations is small compared with the aggregate impacts arising from the tourism packages sold. Nonetheless, retail impacts are non-negligible and can be directly controlled by tour operators. TUI Nordic (2010) report that energy consumption from offices and shops generated a total of 1 256 tonnes of CO_2 in 2009, equivalent to 1.1 kg per customer. More importantly, measures to reduce the environmental impact of retail operations can provide visible examples of tour operators' commitment to sustainability, and provide a positive meassge to customers.

Lighting accounts for 25 % of office energy consumption, HVAC 60 %. Best practice mesasures for these aspects are described in more detail in other sections of this document, and in the SRD for the retail trade sector (EC, 2011), as summarised in Table 4.36. Specifically, measures to reduce lighting energy consumption include use of natural light, installation of efficient light bulbs, and intelligent lighting control (section 7.5). Measures to reduce HVAC energy consumption include intelligent (automated or human) HVAC control (section 7.3), use of thermostats, insulation and good building selection or design (section 7.2). Similarly for water consumption, many relevant best practice measures are described elsewhere in this document (Table 4.36). More specific impacts related to the operation of offices and retail areas arise from consumption and disposal of consumable materials, especially paper and ink, used in operations and advertising, and also from energy consumed by office equipment. This section therefore focuses on:

- green procurement efficient office equipment
- implementation of a material management plan to minimise consumable consumption and waste
- green procurement of more environmentally-friendly (certified) consumables and services.

Table 4.36: Best practice measures for office and retail operations, and cross-links to relevant BEMP descriptions within this document (measures described in this section highlighted in bold)

Aspect	Best practice measures	Cross-links
Carbon footprint plan	**Implement a GHG management plan for all operations**	**Sections 3.1 and 4.1**
Material consumption	**Green procurement efficient office equipment**	Section 3.2
	Implement a material management plan to minimise consumable consumption and waste	Section 3.2 and 6.1
	Green procurement of more environmentally-friendly (certified) consumables	Section 3.2
	Separate waste for recycling	Section 6.2
Mobility	**Implement a staff mobility management plan**	
	Minimise staff work transport requirements	
	Encourage efficient staff transport and offset emissions	Section 4.1
Energy	Implement an energy management plan	Section 7.1, EC (2011)
	Build/retrofit/select efficient building envelope	Section 7.2, EC (2011)
	Install optimised HVAC system	Section 7.3, EC (2011)
	Install heat-pump or use renewable energy	Sections 7.4 and 7.6, EC (2011)
	Install efficient controlled lighting system	Section 7.5, EC (2011
Water consumption	Implement a water management plan	Section 5.1
	Install low flow fittings and low-flush toilets	Section 5.2
	Install a rainwater harvesting system	Section 5.7

Where relevant data on energy and water consumption are available, they are used to support benchmarks of excellence.

Achieved environmental benefit

The reduction of the grammage of the paper for commercial publications results in reduced CO_2 emissions and water consumption. Furthermore, the substitution of coated paper with supercalendered paper results in reduced consumption of chemical additives such as talc, glue, kaolin, binding agents, etc.

The careful selection of printing shops that consider environmental aspects contributes to minimised emissions of e.g. VOCs during the printing processes.

Appropriate environmental indicator

Appropriate indicators

Table 4.37 contains relevant environmental indicators for office and retail operations. Whilst it is more usual for pressures arising from office operations to be normalised against employee numbers in EMS, normalisation per customer or per million EUR turnover provides a more accurate and comparable performance indicator for performance benchmarking. The data necessary to derive such indicators should be readility available to tour operators and travel aganets. TUI Nordic (2010) for example already report average GHG emissions per customer arising from retail and office operations.

Table 4.37: Relevant environmental indicators for different aspecst of office and retail operations

Aspect	Indicators
GHG emissions	– kg CO_2 per customer – kg CO_2 per million EUR tunrover
Material consumption	– grams paper consumed per customer – the percentage of paper that is recycled or environmentally certified – the percentage of paper used in advertising that is coated – the percentage of outsourced paper printing occurring in print shops certified according to EMAS or ISO 14001
Mobility	– average annual km travelled by employees (also expressed per customer) – percentage staff travel (passenger km) by bus or train – average fleet CO_2 emissions – staff-travel-related kg CO_2 per customer
Energy consumption	– kWh/m^2yr office and retail space – office and retail consumption (kWh) per customer – percentage energy from renewable sources (see section 7.6) – percentage energy-efficient office equipment – BREEAM, Passive and MINERGIE building energy standards
Water consumption	– m^3/yr water consumed per office employee – percentage low flow water fittings

Benchmarks of excellence

The following benchmark is proposed to capture pertinent aspects of materials management related to retail and office operations.

BM: hard copy office and promotional material: (i) is avoided wherever possible; (ii) uses 100 % recycled or environmentally-certified (e.g. ecolabelled, FSC, PEFC) paper; (iii) is printed by environmentally-certified (e.g. EMAS, ISO14001) printing services.

Data on electricity and total energy consumption for offices were unavailable, but chaper 3 of the SRD for construction and buildings (EC, 2012) contains some information on the distribution of heating energy consumption in office buildings, indicating that better peforming extsing buildings consume less than 150 kWh/m^{2}yr for heating. Data from TUI Nordic (2010) indicate average heating and electricity consumption of 100 and 113 kWh/m^{2}yr, respectively for retail and office operations in the financial year 2009/10. Electricity consumption specifically for administration operations was reported at 128 kWh/m^{2}yr. These figures appear to represent good practice, and may be used as an orientation of achievable performance, but cannot be verified with sufficient data to support a benchmark of excellence. Consequently, the following benchmark is proposed in the first instance.

BM: energy and GHG management plans are implemented and energy and GHG emissions arising from retail and office activities are reported and expressed per m^2 retail and office space per year, and per customer.

CIRIA (2006) propose a best practice benchmark for water consumption in office buildings based on UK data. In the absence of additional more specific or recent data, this is proposed as a relevcant benchmark of excellence.

BM: water consumption ≤2.0 m^3 per employee per year.

Cross-media effects

Care must be taken to ensure that any measures to reduce the environmental impact of office and retail operations do not increase more environmentally significant downstream operations in the transport, accommodation and activities components of tour packages sold. For example, staff transport emissions arising from environmental auditing of accommodation premises may be more than offset by the contribution of this activity towards accommodation energy efficiency. A lifecycle perspective is required that prioritises improvement actions, as indicated by the sequence of techniques within this chapter.

Operational data

For operational aspects of best practice in retail areas, see the SRD for retail trade sector (EC, 2011). Operation data relating to best practice measures for accommodation to reduce water consumption, waste generation and energy consumption described elsewhere in this document are also relevant: see relevant parts of Chapters 5, 6 and 7, respectively. Some key points and specificities for tour operator retail and office operations are referred to below.

Materials planning

Key points for reducing environmental impacts associated with material consumption and waste are listed below, based on criteria contained in the Travelife Sustainability System (Travelife, 2011).

- Paper and ink use is minimised through: e-invoicing; internet advertising; double-sided printing; reduced size printing; black and white printing where colour not required; re-using paper printed on one side; purchasing low grammage density paper used (e.g. <49 gr/m^2).
- Single-use disposable items are avoided where possible (e.g. plastic bin liners are avoided, toner/ink cartridges are refilled and rechargable batteries are selected).

- Paper is recycled or environmentally certified – ideally ecolabelled (to include production and bleaching impacts), but at least FSC- or equivalent certified to indicate sustainable management of feedstock forests.
- The company has implemented packaging material reduction measurements and is not using non-recyclable or non biodegradable package materials.
- Filtered tap water and reusable glasses are provided for drinking, to avoid the use of non-recyclable plastic bottles, unnecessary water transport, and disposable drinks cups.
- All recyclable materials (including glass, paper, organic waste and plastics) are separated for collection by recycling services. Where recycling collection services are not provided by local authorities, the enterprise contracts appropriate service providers (in collaboration with neighbouring enterprises if required to generate a critical mass and realise collection efficiencies).
- Cleaning materials are non-hazardous, non-eutrophic and bio biodegradable (ecolabelled where possible).
- Sanitary paper is chlorine free and includes at least 30 % recycled paper.

Mobility
Key points for minimising environmental impacts associated with mobility are listed below.

- Staff related travel is monitored according to type, distance and purpose, and associated GHG emissions are calculated by applying relevant emission factors for different modes (and applying vehicle- or fleet- specific emission factors for transport by company cars).
- GHG emissions arising from staff travel are compensated through a certified offset scheme or the tour operators own carbon offset initiative (see setion 4.1) .
- Employees are encouraged to use public transport or sustainable transport such as bicycles through reward and benchmarking schemes.
- Transport requirements are minimised through provision of tele-working and tele/video meeting options.
- Compensation for lease cars is restricted to cars of the lowest emission class (e.g. lowest emission categories in respective countries), and financial compensation for the use of private cars does not compensate higher fuel consumption. In Ireland, Class A efficient vehicles are defined as having an CO_2 rating <120 / km, whilst in the UK, Class A efficient cars are defined as having an EU CO_2 rating <100 g / km.

Energy
Key best practice points for energy management are referred to in the Travelife Sustainability System (Travelife, 2011). An amended list of key criteria is presented below.

- Energy consumption for heating and electricity is measured, sources indicated and total GHG emissions are calculated using relevant emission factors. Different periods are compared with the aim to increase efficiency.
- New buildings are specified to achieve the Passive Haus standard with respect to heat and total demand (i.e. $\leq$15 and 120 kWh/m^{2}yr, respectively: see section 7.2).
- A building energy audit has been conducted and its advice is implemented.
- Sustainable energy is purchased where available (see section 7.6 on the definition of verifiable 'additional' green energy).
- CO_2 emissions arising from retail and office operations may be compensated using certified or tor operated initiated carbon offset schemes, as detailed in section 4.1.

- At least 75% of lighting is energy efficient (including outdoor lighting) – using an appropriate density (related to task-related lumen requirements) of compact fluorescent and LED lamps (see section 7.5).
- Lighting is controlled intelligently, using timer, movement and ambient light sensors, and is switched off completely at night.
- All equipment is switched off after office hours (i.e. not left in 'standby' mode).
- Low energy equipment is selected based upon highest standards of EC Directive 2003/66/CE, Energy Star or equivalent regulations.
- All equipment is set-up to work in energy saving mode as standard.

<u>Water</u>
The following measures are recommended to reduce water consumption across tour operator retail and office areas:

- all bathroom areas should have flow restrictors or aerators on the taps, and flows should be controlled by infra-red sensors;
- toilets should have a dual flush mechanism, with full/half flush volumes ≤ 3 / 6 L (provising the bowl is of an appropriate design);
- ensure that an effective periodic inspection and maintenance system is in place to detect malfunctioning toilets, leaking taps, excessive water flow and high consumption.

Applicability
The above mentioned measures are relevant to all tour operator retail and office operations. Building envelope and HVAC optimisation may be restricted by building lease agreements – best practice in this case may be the selection of more efficient office space. Purchasing energy efficient equipment can be incorporated into equipment renewal schedules (e.g. computers may be renewed every ~5 years).

Economics
Minimising the consumption of energy, water and consumables (and associated waste) required for office and retail operations can reduce costs and increase effficency. Similarly, minimising travel requirements avoids transport costs and enables more productive use of staff time.

Green procurement of environmentally certified consumable materials and services may incur a price premium, but this may be more than offset by reduced consumption (above), and represents a negligible cost compared with turnover.

Green procurement of bulk-packaged products can lead to reductions in procurement and waste disposal costs.

Driving force for implementation
As referred to above, redcuing the environmental impact of office and retail operations is associated with potential cost savings.

Retail operations are visible to potential customers, and therefore are an important show case for tour operators' green credentials. Measures referred to in this section can therefore play an important role in green marketing and in enhancing corporate image.

Corporate social responsibility is a driving force for 'hidden' measures, such as green procurement of office paper. Nonetheless, office measures can also convey an important message to staff regarding the organisation's priorities, and consequently may increase job satisfaction and productivity.

Reference companies

A few examples of good practice are listed below.

REWE Group

The REWE Group calculated a corporate climate footprint, covering all retail activities (including REWE Tourstik) in 2009 and 2011, in collaboration with the Öko-Institut and Austrian Federal Minsitry of the Environment. REWE is now commited to reducing its carbon footrint by 30 % by the year 2015 (relative to 2009). More than half of all CO_2 emissions were found to orinate from generation of consumed electricity. Therefore, improving energy efficiency and generating power from renewable sources were identified as key improvement measures. In fact, since 2008, 100 % of the company's energy requirements are covered by certified green electricity (with regards to additionality, in Germany 25 per cent of renewable power supply must be from plants younger than three years) (REWE Group, 2012).

TUI Travel plc (energy efficient buildings)

In 2009/10, 36% of our businesses had a third-party (externally) certified environmental and/or building energy management system in place. For example, head offices for TUI Deutschland, Sportsworld and Danibus Travel are ISO 14001 certified and offices for TUI Marine, YMT and Travcoa are Gold LEED certified. In 2010/11 TUI Nederland will build a new head office to BREEAMi Excellent standard.

TUI Nordic plc (GHG and energy reporting)

As referred to above, TUI Nordic report on total heating and electricity consumption, and associated GHG emissions, for office and retail operations (TUI Nordic, 2010). Results are presented for each final year compared with previous years from 2007 onwards.

TUI UK & Ireland (reducing paper)

TUI UK & Ireland reduced brochure paper in 2009/10 by 5% and Jetair reduced the quantity of its 2010 Summer brochure print run for the eighth consecutive year, by 3.8%. In a further effort to reduce paper, TUI Ski switched to e-invoicing in March 2010 for agents and direct customers, which is expected to reduce costs by over EUR 100 000 annually.

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5 MINIMISING WATER CONSUMPTION IN ACCOMMODATION

Tourism and water stress

A tourist's water consumption is higher than a resident's water consumption. A European tourist consumes around 300 litres per day compared with a European resident consumption of 100 – 200 litres per day, averaging approximately 150 litres (EEA, 2009; EC, 2009, Eurostat, 2011; Gössling et al., 2011). There are a number of reasons for higher tourist water consumption in accommodation enterprises, including maintenance of grounds (irrigation), daily room cleaning, daily laundry, maintenance of swimming pools, intensive kitchen activities, and a 'pleasure approach' to showers and baths (Eurostat, 2009). However, statistical data relating to water use in tourism are lacking (Eurostat, 2009; Gössling et al., 2011).

Tourism is highly concentrated in destinations, so that although tourism's share of global total water consumption is less than one percent (Gössling et al., 2011), tourism contributes significantly to water stress in hotspot areas, especially the Mediterranean within Europe (see section 1.2.2). The impacts of water extraction can be particularly high in sun destinations for the following reasons:

- water resources are more likely to be scarce;
- water demand is usually higher owing to the operation of large swimming pools and irrigation of green areas and golf courses.

According to Ringbeck et al. (2010), average tourist water consumption in European sun-holiday destinations in 2007 ranged from 149 L per guest-night on the Spanish Balearic Islands to 450 L per guest-night on the Greek Agean islands, but water consumption up to 880 L per guest-night is quoted for luxury tourists on Majorca (UN, 2004).

Water consumption across accommodation types

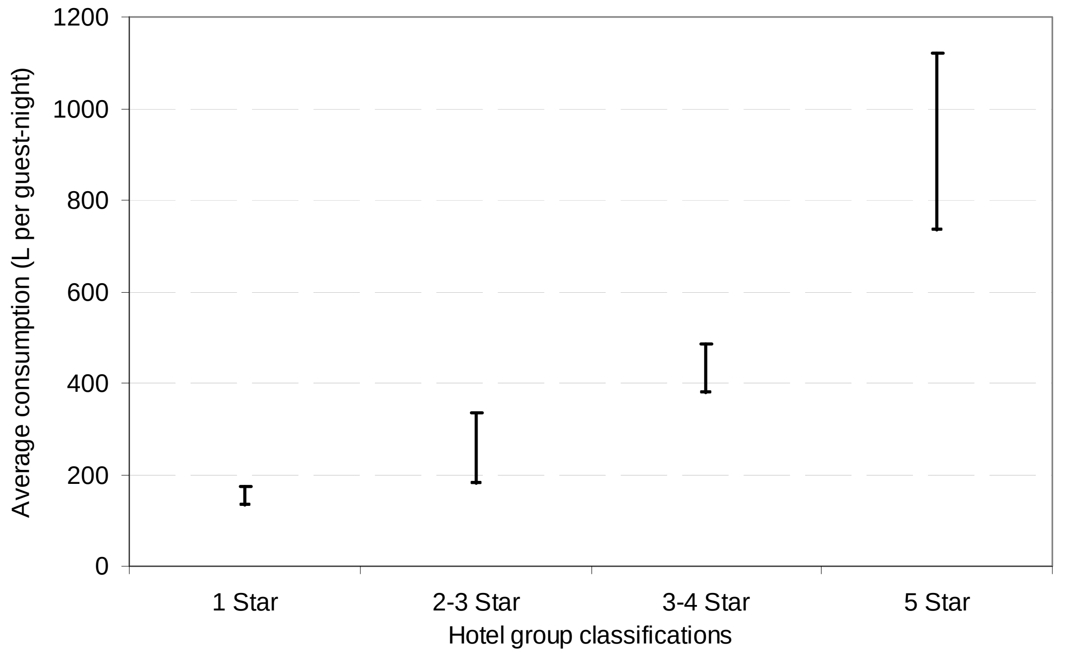
Water typically accounts for approximately 10 % of utility bills in hotels, but can vary considerably across different types of accommodation (Table 5.1).

Table 5.1: Water use across different accommodation types, based on a sample of 375 enterprises in Austria and Germany

Accommodation type	Specific water consumption
	(L/guest-night)
Hotel	312
Holiday house	273
Bed & breakfast	226
Campsite	148
Group accommodation	115

Source: Ecotrans (2006).

Specific water consumption per guest-night, and the distribution of that consumption across water using processes, also varies within accommodation types according to a range of factors. One factor is the number of services and degree of perceived luxury (Figure 5.1). Data presented in CIRIA (2006) indicate 60 % less water consumption per bed space in 1-star compared with 3-star accommodation, and 111 % more water consumption per bed space in 5-star compared with 3-star accommodation. The provision of en-suite bathrooms is an important factor affecting water consumption. Ecotrans (2006) estimated that swimming pools increase water consumption for hotels and campsites by the equivalent of 60 L per guest-night.



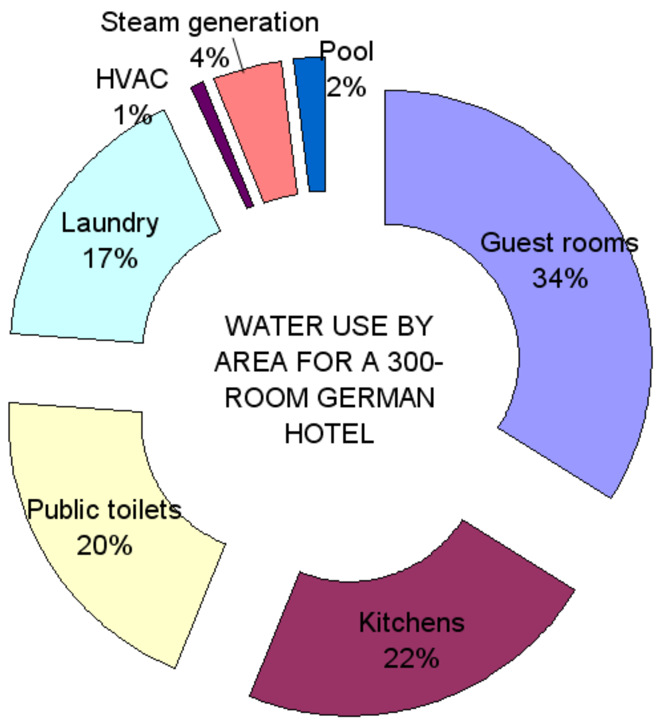
NB: Assumes 1.4 guests per occupied room.

Source: Accor (2010).

Figure 5.1: Average water consumption for hotel brands within a large European hotel chain according to star rating (highest and lowest brand averages displayed for each rating)

Processes responsible for accommodation water consumption

The major areas of water consumption in accommodation are guest bathrooms, kitchens and laundry facilities, and communal toilet facilities, as indicated for a German hotel in Figure 5.2. Swimming pools and the irrigation of green areas can contribute an additional 10 – 15 % and 20 – 25 %, respectively (Eurostat, 2009), and room cleaning approximately 12 – 47 L/guest-night according to Gössling et al. (2011). Employees can also contribute significantly to water use, with average water use for an office employee reported at 16 L/day (CIRIA, 2006) – primarily in toilet facilities used by staff. Depending on the cooling system installed, cooling towers may be responsible for a further 10 – 25 % of water consumption in a hotel (Smith et al., 2009).



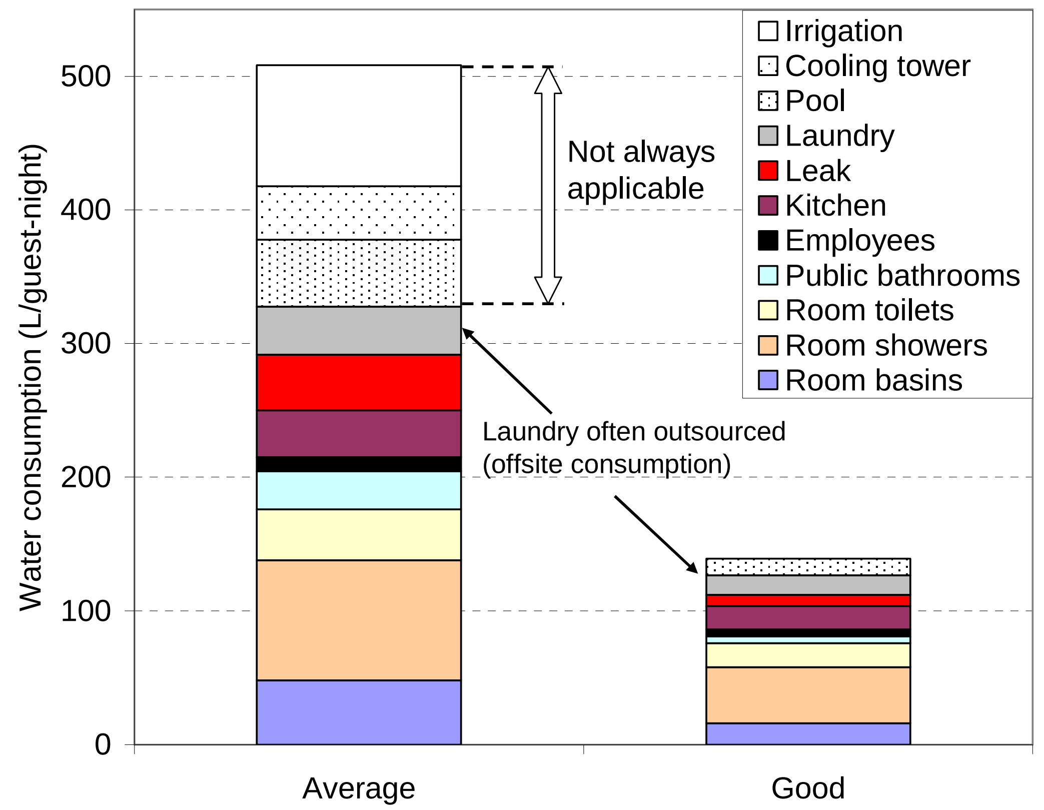
Source: ITP (2008).

Figure 5.2: Water use from sub-meter data in a 300-room hotel in Germany using 620 litres of water per guest-night

Opportunities to reduce water consumption

There is great potential for water reductions across accommodation enterprises. Water-inefficient hotels can typically reduce water consumption by over 50 % (Figure 5.3). A large portion of potential savings can be achieved through relatively simple and inexpensive installation of efficient water fittings which have a relatively high frequency of replacement (EC, 2009).

This chapter describes best environmental management practices to minimise water consumption in guest areas, laundries and pool areas. Best practice for other important water using processes, such as dish washing in kitchens and irrigation of green areas, are addressed in Chapter 8 and Chapter 9, respectively (Table 5.2). Optimisation of HVAC systems can also be important to reduce water consumption in cooling towers (section 7.2).



NB: Assumes 80 % room occupancy (20 % double occupancy). Average and good performance based on average and benchmark data presented for best management practices described in this chapter.

Figure 5.3: Modelled specific water consumption per guest-night in a 120 bed hotel implementing average and good management across water using processes

Table 5.2: Portfolio of techniques important for the minimisation of water consumption

Technique	Measures	Section
System maintenance	– Optimisation of system design to avoid excessive water pressure and heat loss – Regular inspection and maintenance of water fittings and leak 'hotspots' (e.g. heat exchangers) – Monitoring of water consumption, including sub-metering of important water-using areas and benchmarking	Section 5.1
Installation of efficient water fittings in guest areas	– Installation of low-flush and dual-flush toilets – Installation or retrofitting low-flow showerheads or retrofitting pressure regulators and/or aerators – Installation of low-flow faucets and retrofitting with pressure regulators and/or aerators – Installation of low-volume baths and basins – Installation of thermostatic shower controls – Provision of guest information to encourage lower water consumption – Installation or retrofitting of controlled flush or waterless urinals – Installation of sensors or timers to control faucets and showers in public areas (toilets and changing rooms)	Section 5.2

Efficient housekeeping operations	– Green procurement of room textiles, especially bedclothes and towels, to minimise lifecycle impacts – Implementation of bedclothes and towel reuse schemes to reduce laundry volumes – Staff training in efficient cleaning techniques that minimise water and chemical consumption – Inspection and reporting of leaking water fittings – Green procurement of room consumables – Housekeeping measures to reduce energy consumption	Section 5.3
Optimised small-scale laundry processes	– Green procurement of efficient washing machines – Installation of holding tanks and programme modification to reuse rinse water – Optimised laundry sorting and loading – Optimum washing machine programming to minimise water, chemical and energy consumption – Measures to reduce energy consumption during washing, drying and ironing (efficient equipment, heat recovery, etc.)	Section 5.4
Optimised large-scale laundry processes	– Optimisation of continuous batch washer programming to minimise water, chemical and energy consumption – Optimised laundry sorting and loading – Press and rinse water reuse and wash water recovery where economically viable – Measures to reduce energy consumption during washing, drying and ironing (efficient equipment, heat recovery, etc.)	Section 5.5
Optimised pool and spa area operations	– Appropriate pool sizing – Optimisation of backwashing operations – Use of pool covers – Optimisations of pool management to maintain an appropriate temperature and reduce chemical consumption	Section 5.6
Rainwater and greywater recycling	– Installation of rainwater collection and internal distribution system – Installation of separate greywater collection and internal or external distribution system	Section 5.7
Water management in kitchens	– Installation or retrofitting of low-flow high pressure spray valves for prewashing – Green procurement of efficient dishwashers with water reuse and heat recovery – Implementation of efficient washing and cooking techniques	Section 8.3
Environmental management of green areas	– Planting of green areas with indigenous species to minimise irrigation requirements – Installation and maintenance of efficient irrigation system – Use of wastewater for irrigation	Section 9.2
Water management on campsites	– Reuse of greywater for irrigation and toilet flushing	Section 9.5

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5.1 Water system monitoring, maintenance and optimisation

Description

Leaking water pipes and appliances can increase water consumption considerably, and in the process incur significant costs. A leaking toilet can waste up to 750 litres of water per day (ITP, 2008), compared with 30 litres per day required for five full flushes of a low-flush toilet in a guest bathroom. A dripping tap can waste up to 70 litres of water per day, and it has been estimated that in a typical large hotel, leaking taps alone can increase total water consumption by 5 % – equivalent to 15 litres per room-night (Smith et al., 2009). A survey of eight hotels in Bulgaria found that leakage accounted for between 32 % and 68 % of water consumption (EC, 2009). Kitchens are also a significant source of water consumption and leakage, addressed specifically in section 8.3.

Water wasted through leakage can be detected by an effective monitoring and maintenance programme that involves the following.

- Daily checks and reporting procedure by housekeeping staff to detect obvious leaks, such as leaking taps or toilets.
- Detailed periodic inspections to detect hidden leaks, including inspection of pipe joints, appliances, and heat-exchanger units. On large premises, technicians may perform detailed testing that may include use of leak-detection cables and portable clamp-on flow-meters.

Monitoring and benchmarking of water consumption is the first step to improving water use efficiency. Monitoring of water use can be performed at varying levels of detail depending on resources available and the size of premises. At the most basic level for small premises, annual water consumption may be recorded and compared with the number of guest-nights in order to benchmark performance against comparable accommodation premises and identify performance improvement potential. An audit of water-using equipment in all areas can be used to identify possible measures to reduce consumption – for example through targeted implementation of the BEMP techniques described subsequently in this chapter. For larger premises, sub-metering of different areas, such as the kitchen, pool and spa area, and accommodation zones, can help to identify leaks and improvement options, and may enable the benchmarking of water consumption per functional unit for specific water-using processes (described in sections 5.2 – 5.6 and section 8.3). Sub-meters may be connected to a central automatic recording system, or Bullding Management System (BMS), that continuously records consumption and provides detailed data on water use patterns throughout the premises.

Donestic hot water (DHW) heating accounts for a significant portion of energy used on accommodation premises (section 7.1). Effective system monitoring and implementation of identified water reduction measures can significantly reduce energy use for water heating. Further, monitoring can be used to accurately control water heating so that hot water production matches demand, in terms of quantity, timing and temperature. DHW is often heated to more than 80 ºC on accommodation premises, compared with a requirement of only around 45 ºC to supply most needs (Lamei, 2009) – although at least periodic heating to 60 ºC may be required to minimise the risk of legionnella bacteria colonising the system. Effective pipe insulation reduces water consumption by: (i) reducing the time required for hot water to arrive at opened faucets; (ii) by reducing heat loss from hot water moving through the pipes. These two factors enable less water to be heated to a lower temperature, thus significantly reducing water consumption and considerably reducing energy consumption.

Table 5.3: Measures to monitor and maintain water systems in accommodation

Measure	Description	Applicability
Water audit and benchmarking	Assess water use on a seasonal basis and draw up inventory of main water using equipment. Calculate water consumption per guest-night in different seasons. Identify priority measures to reduce water consumption.	All accommodations
Periodic monitoring	Record water consumption periodically (daily, weakly, monthly), and check consumption during quiet times (e.g. early hours of the morning) to detect leaks.	All accommodations
Sub-metering	Divide premises into zones, install sub-meters and periodically monitor water consumption.	All accommodations
Continuous monitoring	Install complete continuous monitoring system, with automatic recording of flow at all sub-meter locations.	Large hotels
System inspection and maintenance	Regularly inspect equipment. Housekeeping inspection of taps, toilets and drain plugs. Technician inspection of valves, pipes, pipe-insulation, aerators, and equipment such as heat-exchangers. Repair or replace damaged equipment.	All accommodations
Avoid excessive pressure	Install pressure reducers at relevant points and adjust to the minimum pressure sufficient to supply the maximum flow rate required at those points.	All accommodations
Water conditioning	Install an electronic water conditioning system to 'soften' hard water by removing excess calcium and magnesium ions.	All accommodations
Adequate insulation	Make sure that all water pipes are adequately insulated to minimise heat transfer heating and cooling energy requirements.	All accommodations

Achieved environmental benefit

Leak avoidance

Even small individual leaks with barely perceptible flow rates can result in significant water wastage over a year, whilst modest leaks that may still be undetectable in accommodation premises can result in large wastage of hundreds of m^3 per year (Table 5.4). A number of small leaks throughout accommodation premises can contribute substantially to total water consumption, and easily result in cumulative wastage of thousands of m^3 per year in larger premises. Leaking toilet cisterns are common in accommodations. Analysis of data from a water monitoring study of eight rooms in one hotel led to the discovery of a leaking cistern in one room losing 380 litres per day that had gone undetected for at least the 90 days of the study.

Table 5.4: Water flow rates and daily/annual wastage from different types of leak

Leak description	Flow rate		Daily water loss	Annual water loss	Annual cost
	L/min	L/hour	L	m^3	EUR
One drip per second	0.003	0.17	4	1.5	2.92
Drips break to stream	0.063	3.8	90	33	65.70
1.5 mm diam. stream	0.22	13.3	320	117	232.36
3 mm diam. Stream	0.68	41	985	360	719.06
6 mm diam. Stream	2.43	146	3500	1 278	2 555.00
Source: Derived from data in Cridge (2000).					

Consequently, the avoidance of leaks through monitoring, inspection and maintenance can reduce water consumption dramatically. Figure 5.4 presents the monthly water consumption for a large hotel in central Paris over a period of four years, and indicates the quantity of water wasted by one single major leak detected in October 2010. In this case, a large diameter valve in a void space behind a wall was left open, letting 100 m^3 of water from a supply pipe flow directly into a wastewater pipe undetected. The leak represented 30 % of total water consumption in 2009, and was discovered during renovation work. More detailed monitoring and benchmarking of water consumption (e.g. tracking consumption per guest-night) may have resulted in more rapid detection of the leak. An increase in specific consumption of 9 % per guest-night between 2007 and 2008 (Figure 5.4), despite a 10 % increase in guest-nights (the relationship between guest-nights and specific consumption is usually negative), reflects the impact of the leak on specific water consumption.

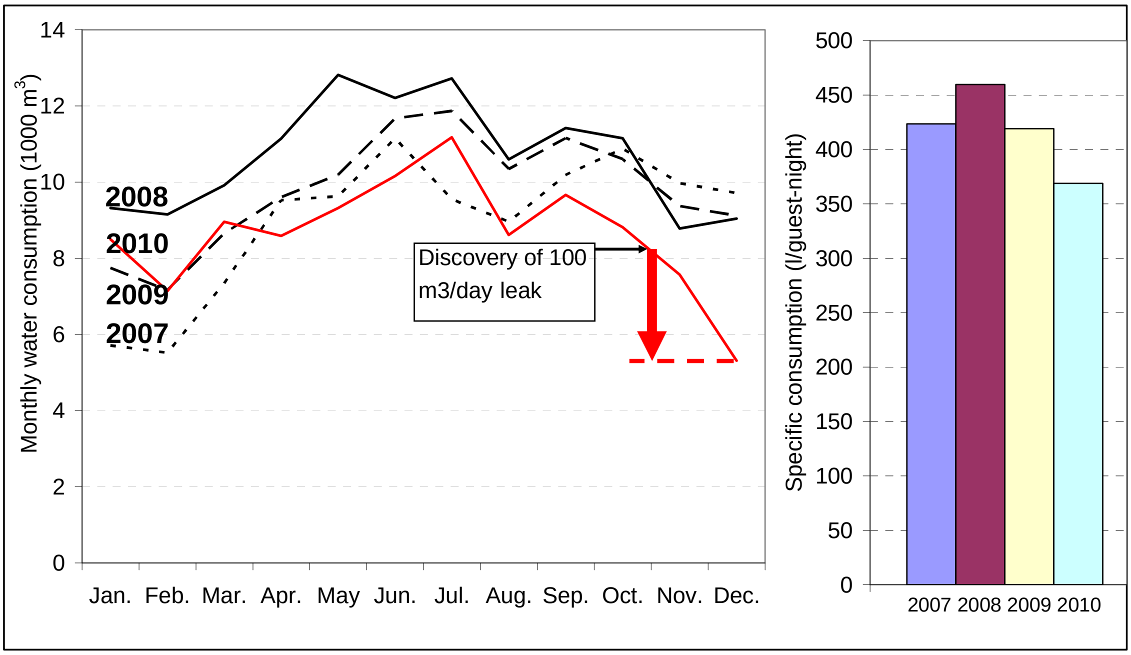


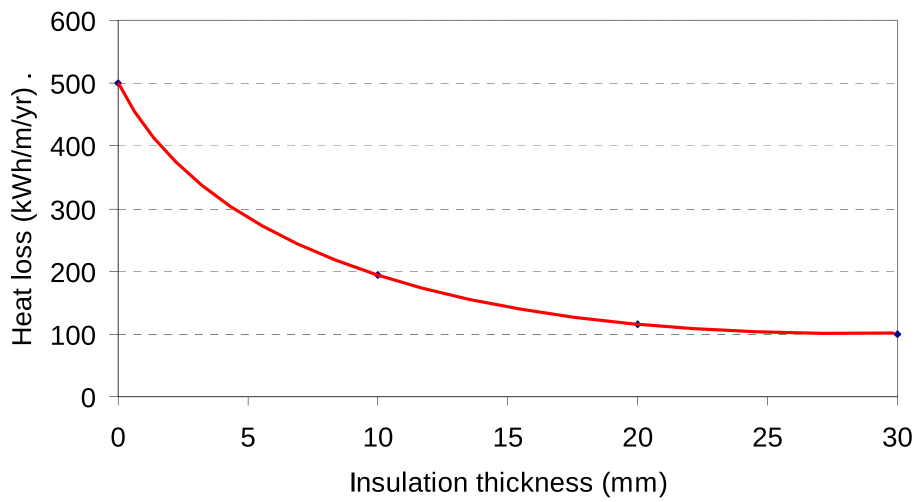
Figure 5.4: Monthly water consumption over four years for a large conference hotel (left), annual specific consumption (right), and the reduction in water consumption after repair of a major leak

<u>Water management plans</u>

Monitoring and reporting of water consumption is an integral component of water management plans with defined targets that can achieve substantial reductions in water consumption over time. For example, Accor have set a target to reduce water consumption by 10 % per occupied room between 2006 and 2010 in owned and leased hotels (Accor, 2011). Meanwhile, Scandic have been monitoring specific water consumption across hotels since 1996, and can consequently report that average water consumption per guest-night decreased by 25 % between 1996 and 2010 (see Figure 2.3 in section 2.1). The difference between the top tenth percentile of performers and median performance across mid-range hotels displayed in Figure 5.7 is 50 litres per guest-night, equivalent to 1 825 m^3 per year for a 100-room hotel.

<u>Energy savings</u>

For every m^3 reduction in hot water consumption, approximately 52 kWh of energy is saved, assuming water is heated by 45 ºC. Meanwhile, 20 mm of insulation can reduce heat loss by almost 400 kWh per year for every metre of large diameter (5 cm) piping (Figure 5.5).



Source: Derived from data in TUI Travel Plc (2011).

Figure 5.5: Effect of insulation thickness on heat loss from a 5 cm plastic pipe carrying water at 60 °C in an ambient air temperature of 25 °C

Appropriate environmental indicator

Performance indicators

The most appropriate environmental indicator for water use efficiency is water consumption per guest-night. The number of overnight guests is the primary determinant of water consumption for showers, toilets and basins, laundry processes and kitchen processes (Bohdanowicz and Martinac, 2007). 'Fixed' water use for some processes – e.g. pool maintenance and irrigation of green areas – can lead to an inverse relationship between water use per guest-night and occupancy rate (Gössling et al., 2011).

The EU Flower ecolabel for tourism stipulates that *'the tourist accommodation shall have procedures for collecting and monitoring data on overall water consumption (litres)…Data shall be collected where possible, monthly or at least yearly, for the period when the tourist accommodation is open, and shall also be expressed as consumption per overnight stay and per m^2 of indoor area'.*

Calculating water use per guest-night is a simple task:

$C_{GN} = (C_T \text{ x}1000)/N_{GN}$	
C_{GN}	Consumption (L) per guest-night
C_T	Total consumption in m^3 for the period of calculation (from utility bill or water meter readings)
N_{GN}	Number of guest-nights over the same period of calculation

To provide a robust average of water use efficiency that smooths out any seasonal variability, it is recommended to calculate water consumption per guest-night over an entire year. Note that water use is usually expressed in m^3 on water meters and bills and is multiplied by 1000 to be converted into litres. Where guest-night data are not available, occupied rooms or simply number of beds may be used as denominators (though the added value of the latter denominator is small).

Trends in specific water consumption over time provide a useful indication of progress in improving water efficiency. Figure 5.6 shows the distribution of trends for 97 hotels in a hotel group, and the trend in aggregate specific water consumption for the group, over a 10 year period. A wide range of performance can be observed, including deteriorating water efficiency for a significant portion of hotels, perhaps reflecting the installation of additional water-using facilities or more luxurious water fittings.

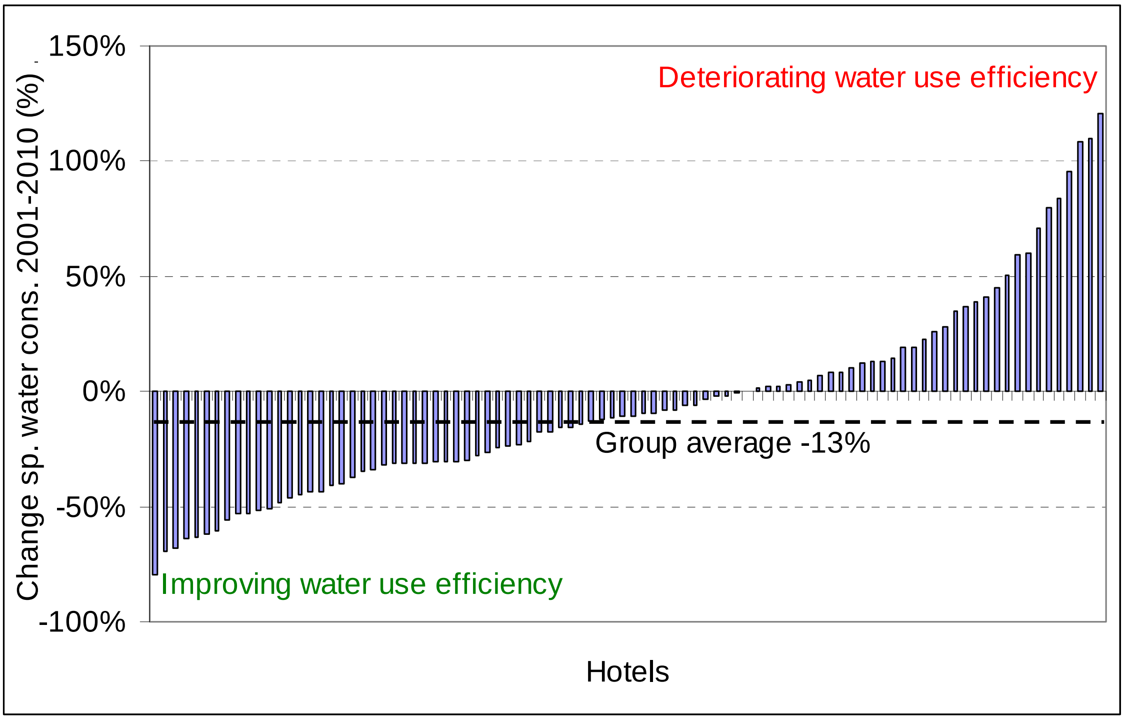


Figure 5.6: Change in specific water use for 92 hotels in a hotel group, and the change in total group specific water consumption, between 2001 and 2010

Management indicators

In addition to the above performance indicators, management indicators of best practice include:

- regular monitoring and recording of consumption;
- installation of water sub-metering for major water-using areas and processes (i.e. laundry, kitchen, pool and spa areas, cooling tower);
- establishment of an action plan to reduce water use, with measurable and scheduled; targets;
- all pipes carrying heated or chilled water are insulated;
- regular inspections are carried out to check for leaks;
- staff training to reduce water use (see sections 5.3 and 8.3, on housekeeping and kitchen water use, respcetively).

Benchmarks of excellence

Two benchmarks of excellence are proposed for this BEMP, the first of which is a management indicator and the second of which is a performance indicator. The first benchmark is:

BM: implementation of a site-specific water management plan that includes: (i) sub-metering and benchmarking all major water-consuming processes and areas; (ii) regular inspection and maintenance of water system "leak points" and appliances

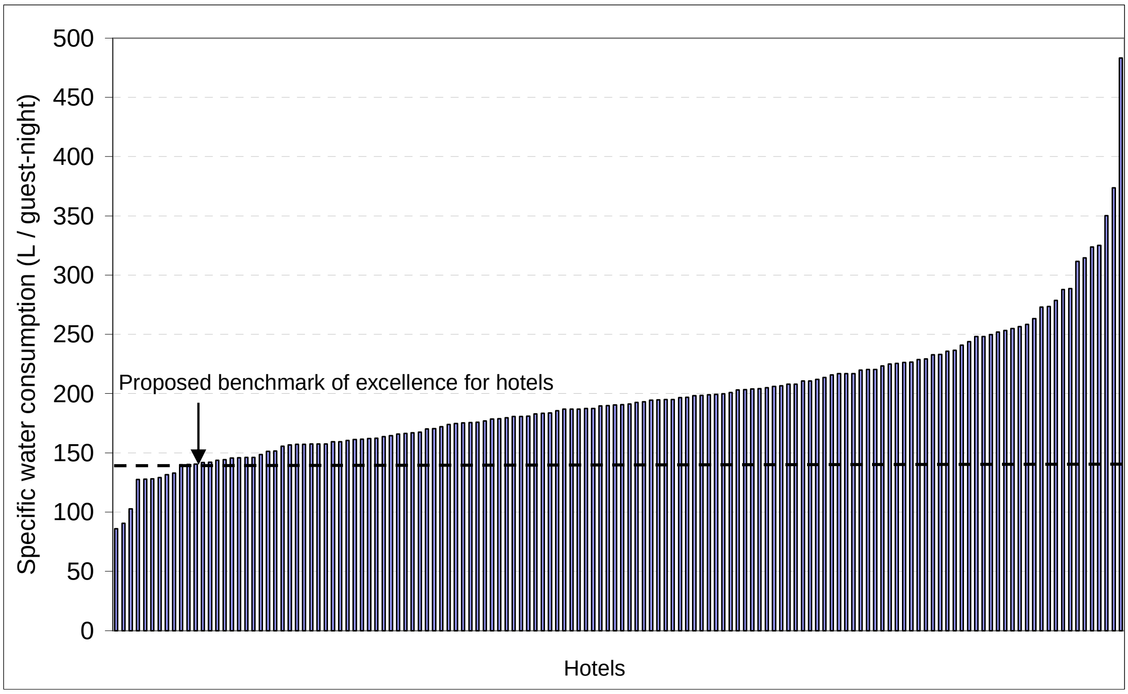
Various benchmarks have been proposed for overall specific water consumption in tourist accommodation, for example within *'Environmental, Health and Safety Guidelines for Tourism and Hospitality'* published by the World Bank's International Finance Corporation within (IFC, 2007) (Table 5.5). Other benchmarks for accommodation water use efficiency include those contained within the Nordic Swan ecolabel, ranging from 200 L/gn for basic ('Class C') accommodation to 300 L/gn for fully serviced ('Class A') accommodation. Ecotrans (2006) also propose benchmarks for different types of establishment.

Table 5.5: A selection of benchmarks proposed for water use in different types of accommodation

Accommodation type	Source	Benchmark (temperate)	Benchmark (Mediterranean)
		Litres per guest-night	
Camp sites	Ecotrans (2006)	96	
Bed and breakfast	Ecotrans (2006)	133	
Small serviced hotels	Ecotrans (2006)	213	
	IFC (2007)	200	220
	Nordic Swan (2007)	200	
Mid-range serviced hotels	IFC (2007)	350	450
	Nordic Swan (2007)	250	
Luxury serviced hotels	IFC (2007)	500	600
	Nordic Swan (2007)	300	

Figure 5.7 summarises the performance of individual hotels within a mid-range European hotel chain, and Hostelling International hostels in Switzerland. Based on tenth percentile best performers, and other values for mid-range hotels (Accor, 2010; NH Hoteles, 2011), the following benchmarks of excellence are proposed for total water consumption in fully serviced hotels with restaurants predominantly serving residents, and mid-range hostels.

BM: total water consumption ≤140 L per guest-night in fully serviced hotels, and ≤100 L per guest-night in accommodation where the majority of the bathrooms are shared across rooms (e.g. hostels).



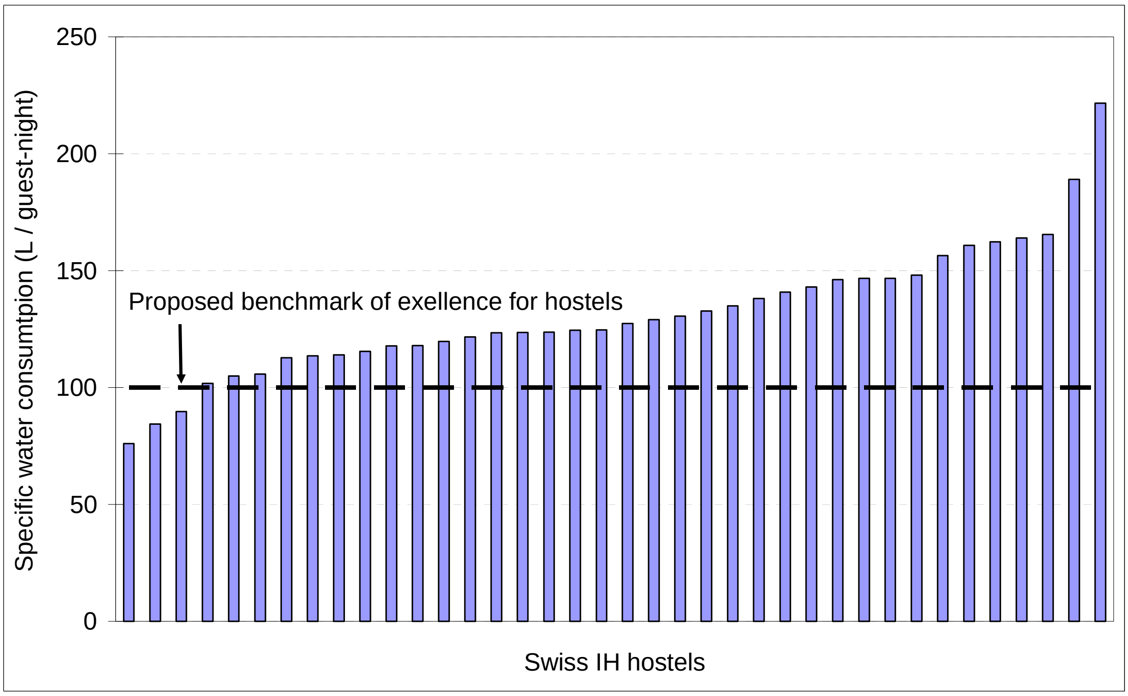


Figure 5.7: Distribution of water consumption, expressed per guest-night, for individual hotels within a large European hotel chain (above) and for Swiss hostels (below) used to derive benchmarks of excellence

The above benchmark for hotels may not be achievable where hotels have large swimming pools or restaurants serving a high proportion of non-residents. For one German hotel, water consumption is 146 L/gn within the dedicated accommodation area, but this increases to 204 L/gn including consumption in the kitchen that serves 216 400 non-resident diners per year (46 % of diners), and further increases to 256 L/guest-night including consumption in the swimming pool and spa area (Figure 5.8).

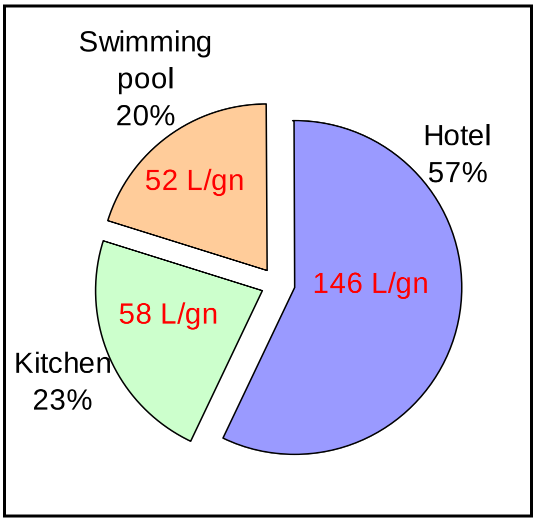


Figure 5.8: Water consumption in three areas of a German hotel

Cross-media effects

There are no significant cross-media effects associated with this technique. Reducing water consumption leads to a reduction in the quantities of chemicals and energy required to treat and pump water. Reducing hot water consumption leads to a considerable reduction in energy use for water heating.

Operational data

Monitoring and leak detection

Managers in all types of accommodation may perform a basic audit of water using equipment to compare with water consumption data in order to draft a water balance. For the water inflow, annual water consumption can be taken from water bills (actual rather than estimated readings should be used). Flow rates from taps and showers can be easily measured according to the following procedure: (i) turn on the tap or shower to full flow; (ii) place a container of known volume (e.g. 5 litres) under the flow; (iii) time how many seconds it takes to fill the container to the indicated volume mark; (iv) calculate the flow rate using the following equation:

$F = (V/t) \times 60$		
F	flow rate	L/minute
V	volume of water in container	L
t	time taken to fill container	seconds

This process can be performed for the different types of fittings throughout the premises and can be multiplied up by the number of such fittings and estimated use rates (average frequencies and durations of use). Water consumption for processes occurring in large equipment such as washing machines and dishwashers can be estimated from technical information and estimates of usage rates. The information obtained from this procedure can be tabulated or inserted into a flow-chart, and compared with best practice water consumption for different fittings and processes (e.g. contained in this document) in order to identify priority measures to reduce consumption. Water consumption data can be divided by the number of guest-nights in order to benchmark performance, as described under 'appropriate environmental indicator'. These benchmarks should be used as a basis for continuous improvement targets.

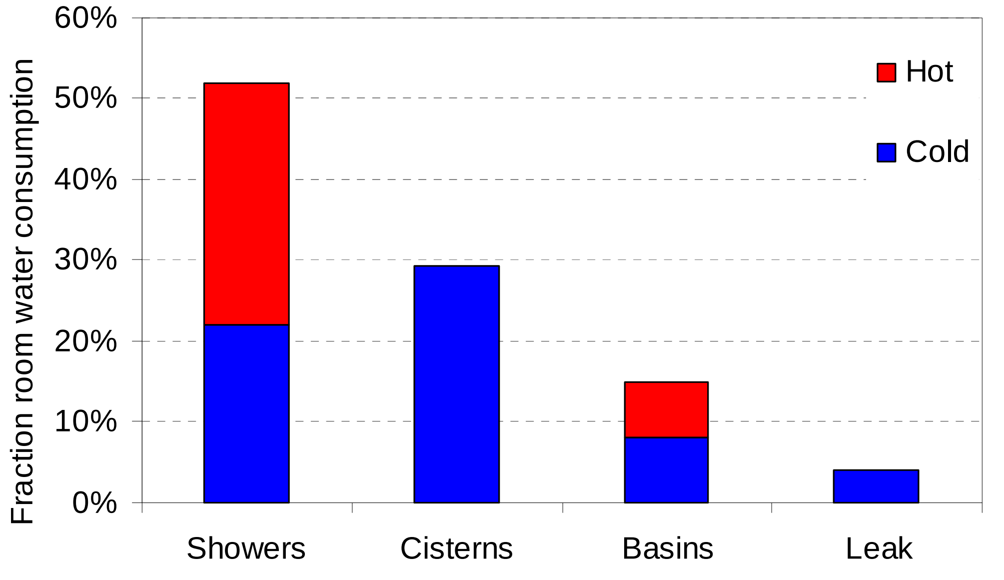
For more detailed auditing of water consumption and leak detection in larger premises sub-metering is required. Inexpensive mechanical water meters can be fitted at fixed positions within the distribution system and require periodic replacement.

Ultrasonic meters are relatively expensive, but may be clamped on to the outside of pipes and moved to different positions in order to audit consumption in different zones or to check for leaks. Flow meters should be installed or clamped at the inflow points to different zones within the hotel, and preferably attached to electronic recorders in order to provide information on daily patterns of water consumption that help to isolate the effect of different processes or leaks.

Records of water consumption should be analysed monthly to identify any irregular patterns. In addition to the main accommodation zone(s), priority zones for water sub-metering include:

- kitchens
- laundry areas
- public toilets
- pool areas
- feed lines to steam heat-exchangers.

Figure 5.9 presents results of an intensive sub-metering study of eight guest rooms in one hotel performed by engineers from the Polytechnic University of Valencia. Ultrasonic meters were clamped to all feeder pipes in the eight bathrooms in order to monitor hot and cold water consumption across all fittings. Data were logged automatically, providing insight into the frequency, duration and intensity of water consumption across different fittings, and demonstrating water savings achievable from the installation of low-flow fittings (see section 5.2).



NB: Aerators fitted to showers and basin taps.

Figure 5.9: Breakdown of water consumption across eight rooms in a hotel obtained from a study employing sub-metering of flow rates through pipes to individual fittings

Water systems and equipment should be inspected at least every six months, including all fittings (Business Link, 2011). Points for particular attention include:

– toilet cisterns

– all taps
– basin drain plugs
– urinal flush-control systems
– HVAC circuits (especially heat exchangers)
– dishwashers.

On small premises, inspections may be performed by managerial or cleaning staff. Cleaning staff should be trained to identify and report leaks during the cleaning routine. Leaking toilets (e.g. flapper valves) are common but difficult to detect. Food colouring may be added to the cistern water to identify slow leaks into the toilet bowl. Water meters can also be checked late at night (~00:00) and early in the morning (~05:00) to identify unexpected water consumption during low water use periods that may indicate leakage.

On larger premises, visual inspection of accessible fittings may need to be supplemented with more sophisticated inspection to detect leaks within extensive piping networks. Methods for such inspection include the use of leak detector cables and highly absorbent sensing tape to detect small leakages (EC, 2012).

Automatic leak detection systems based on detector cables, or 'water fuses' that cut-off water when unexpected flows occur, may also be installed alongside water piping during construction or extensive renovation of large premises. Water fuses can detect low continuous flows down to two litres per hour (Environment Agency, 2007).

Accor in France pool resources across the hotel group to target priority hotels. A national team composed of specialised regional technicians periodically congregate at specific hotels within the group identified by group-wide benchmarking as having high specific water consumption. The team conducts an intensive inspection of the hotel's systems and water-using equipment.

<u>System optimisation and maintenance</u>
The water flow rate from fittings is exponentially related to pressure (pressure is related to the square of velocity according to Bernoulli's equation). Even where flow restrictors are fitted, system pressure can significantly influence flow rate (see Table 5.10 in section 5.2). Higher system pressure can increases the risk and magnitude of leaks. Most fittings, such as bathroom fittings in guest rooms (including high-performance low-flow fittings), operate well with a system pressure of one bar. Even fittings and appliances that may require higher pressure to operate effectively, such as pre-rinse spray valves in the kitchen or pressure-assisted flush toilets in public areas, do not require more than two bar pressure (see section 5.2). The main reasons to maintain high pressure, above two bar, in the distribution system are to:

- ensure an adequate flow rate at times of peak demand – which can be high on accommodation premises owing to the potential for simultaneous demand across a large number of rooms (e.g. morning or evening showers);
- enable the use of smaller diameter pipes, resulting in lower heat loss through reduced lag run time.

Extensive specification of low-flow fittings can considerably reduce peak water demand and thus enable lower-bore pipes and/or lower system operating pressure. Larger diameter pipes lose more heat than smaller diameter pipes (Figure 5.10), and result in longer lag times, but potentially lose less heat per L flow. Careful specification of pipe sizes and layout (e.g. number of fittings served by individual pipes) during plumbing installation is a critical factor to ensure efficient operation in terms of: (i) meeting the pressure needs of all appliances, even at peak demand; (ii) minimising lag times by avoiding over-sized pipes; (iii) reducing the risk of leaks and excessive flow rates by reducing operational pressure. Pressure reducers may be installed at strategic points within the distribution system in order to avoid excessive pressure at fittings.

Heat losses from pipes are proportionate to the temperature difference between the water inside and the surrounding temperature (Figure 5.5), so that in an ambient temperature of 20 ºC water at 60 ºC loses twice as much heat energy per metre of piping as water at 40 ºC. Reducing excessive water temperature is an effective measure to reduce heating energy demand. A water temperature of 40 ºC at the point of use is sufficient for guest bathrooms, and regulations in some countries restrict the maximum temperature of hot water in commercial and public buildings. Separate boiler systems should be installed for hot water and central heating systems to avoid overheating of hot water based on heating system temperature requirements. One universally applicable best practice measure is to ensure adequate thermal insulation of all hot water pipes (see Figure 5.5).

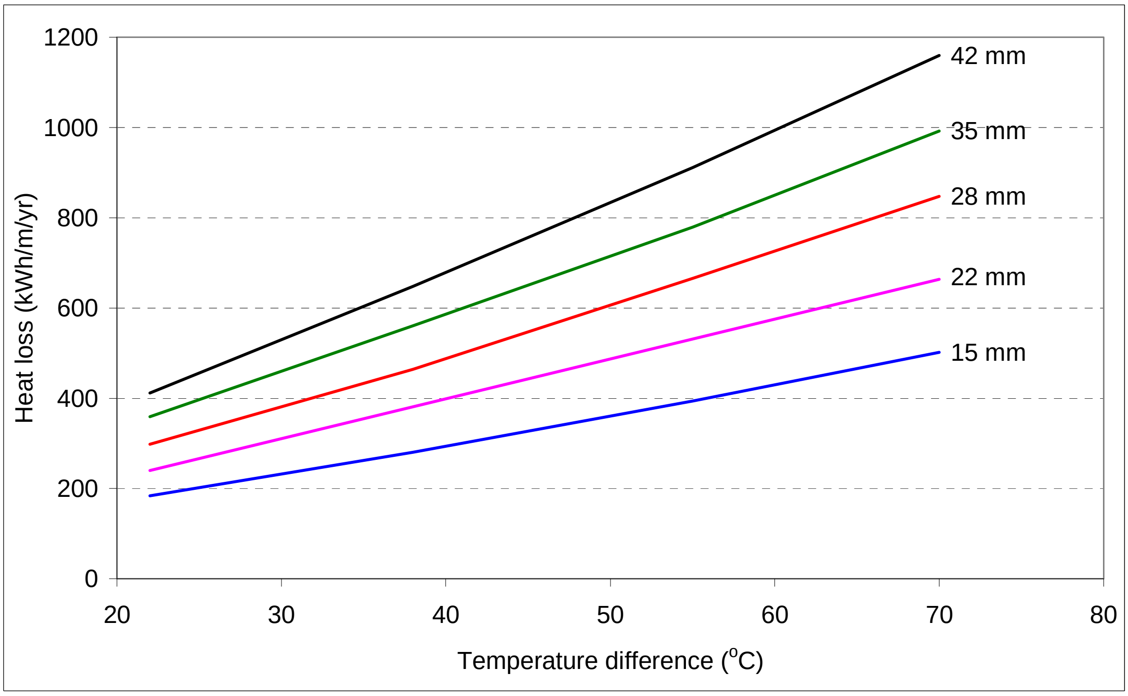


Figure 5.10: Heat loss from un-insulated copper piping of various diameters according to the temperature differential between the water flowing through them and surrounding air

It is imperative to refer to relevant national legislation on water system hygiene, particularly with respect to the minimisation of risk from Legionella bacteria. Usually, water systems above a specified capacity must be heated to at least 60 ºC, though this may be implemented periodically.

Another important best practice measure is to install a water conditioning system, especially where water contains significant levels of carbonates. This is recommendable on all premises, and can significantly increase the lifetime and efficiency of water appliances. In the absence of a centralised system, individual water conditioning systems are required for appliances such as dishwashers (section 8.3).

Other measures that can improve overall system efficiency and reduce leaks include:

- installation of taps with ceramic disc valves instead of screw-down valves with rubber washers that are more susceptible to wear and eventual leakage;
- fitting of long-life rubber O-rings when replacing worn seals or (retro-)fitting plumbing fittings;
- routine replacement of aerators, at least every six years;
- ensuring that basin drain plugs have a good seal, so that guests can use the basin for tasks such as shaving instead of leaving a tap running.

Applicability

Monitoring and maintenance is applicable as a best practice technique for all types and sizes of accommodation. In small organisations (SMEs), monitoring may simply involve recording total water consumption at (at least) monthly intervals based on meter readings.

The Henllys (Old Couthouse) Hotel in Wales provides an example of an SME benefitting from monitoring. The management of this small 10 room hotel noticed an unusual consumption pattern and inspected their water system. A 900 L/day leak was tracked down to a leaking pipe that supplied an out building. Fixing the leak saved 330 m3 of water per year and GBP 270 per year in water supply costs (the hotel is not connected to the mains sewer network).

Economics

A mechanical flow meter costs in the region of EUR 300[5] whilst a portable ultrasonic flow meter can cost approximately EUR 2000[6], whilst flow monitors cost approximately EUR 400[5]. These investments may be recouped within a few years where monitoring helps to reduce excessive water consumption and avoid leaks.

At a water supply and disposal price of EUR 2.50 per m3, a single leaking toilet wasting 750 litres per day could cost over EUR 684 per year, whilst reducing consumption by 5 % in a typical 100 room hotel with an average consumption of 200 L per room per night could save EUR 913 per year. In the example presented in Figure 5.4, the cost of the 100 m3 per day leak was almost EUR 100 000 per year, at a water price of EUR 2.73/m3.

Cost savings from reductions in hot water consumption are considerably higher. For an average food and hospitality business, the full cost of water use and disposal was found to be almost ten times higher than the supply cost alone, with 80 % attributable to heating (assuming electric heating to 60 ºC) (Smith et al., 2009). The cost of water use, and value of water savings, can be calculated from the following equation (elaborated in Table 5.6) :

$$C_T = V_T \text{ x } (C_S + C_D) + V_H \text{ x } (\Delta T \text{ x } SC_W \text{ x } (1/E_{EN}) \text{ x } C_{EN})$$

Table 5.6: Elaboration of terms in the water cost equation

Term	Abbrev	Unit	Typical values
Total cost	C_T	EUR	
Total volume consumed	V_T	m^3	
Supply cost	C_S	EUR/m^3	EUR 2 – 4 (EU average EUR 2) combined supply and disposal cost (EC, 2009)
Disposal cost	C_D	EUR/m^3	
Volume heated	V_H	m^3	
Heating temperature increase	ΔT	ºC	30-80 ºC
Specific heat capacity water	SC_W	kWh/m^3/ºC	1.16
Heating efficiency	E_{EN}	Fraction	0.85 (oil boiler) to 0.99 (electric heater)
Cost of energy	C_{EN}	EUR/kWh	EUR 0.06/kWh for gas up to EUR 0.22/kWh for electricity (Energy.EU, 2011)

[5] http://www.kimray.com/LinkClick.aspx?fileticket=qOCSQItnW7U%3D&tabid=192&mid=749

[6] http://www.globalw.com/catalog.html

Driving force for implementation

The main driving force for implementation of monitoring and maintenance is to identify water use efficiency options and to detect and prevent leaks, thereby reducing costs associated with excessive water consumption and wastage, and reducing costs associated with water heating (see 'economics' section). In addition, it is becoming common for hotels to report their specific consumption in annual sustainability reports, which requires monitoring.

National, regional or local governments may provide incentives in the form of subsidies or tax breaks to encourage installation of water efficient fittings. For example, in the UK, the Enhanced Capital Allowance scheme allows business to deduct the capital cost of water-saving equipment from taxable profit in the year of purchase (http://etl.decc.gov.uk/). Equipment covered by the scheme relevant to this technique includes:

- flow controllers
- meters
- leakage detection
- pipe work insulation.

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5.2 Efficient water fittings in guest areas

Description

Guest areas are defined as guest rooms, public toilet and gym/spa changing areas within accommodation enterprises. The installation of efficient water fittings also applies to public areas in other tourism establishments, such as bars and restaurants, and is cross-referenced by section 9.4 dealing with water efficiency in campsites. In a non-optimised hotel, water consumption in guest rooms can be over 200 litres per guest-night, and represents almost half of the total water consumption (Figure 5.2), assuming flow rates of 12 L/min for taps, 15 L/min for showers and 12 L/flush for toilets. These flow rates can be up to twice as high, depending on the equipment installed. High end luxury hotels may provide multi-head or large-head showers using in excess of 20 L/min and large bath tubs (>300 L) as part of their premium offer. Eurostat (2009) attribute comparatively high water use in hotels to 'a pleasure approach' taken by tourists to showering and bathing. Showers can account for over 50 % of direct water use by guests in hotels (Smith et al., 2009).

Water consumption in public spaces is highly variable, and depends on the services offered in the hotel and the number of day visitors, but can make a considerable contribution to total water consumption. For example, one urinal flushing continuously four times per hour can consume over 400 L/day, and a leaking toilet in a public area can waste up to 750 L/day (ITP, 2008). Meanwhile, showering facilities provided in pool, spa and gym areas can be associated with intensive water consumption. Taps in public areas may be left open or not fully closed.

In addition to maintenance and optimisation of the water system (section 5.1), there are four approaches for accommodation managers to reduce water use in guest areas, for a given level of service:

- install efficient water fittings;
- retrofit flow restrictors (aerators and/or pressure regulators);
- encourage guests to save water through information notices;
- train staff to save water during cleaning operations.

The installation of efficient water fittings selected through green procurement is the most effective approach, owing to the high saving potential of more efficient fitting types and the relatively high frequency of replacement (EC, 2009). The latter two approaches are described in more detail in section 5.3 that addresses housekeeping. Table 5.7 provides an overview of the main fittings that may be installed to reduce water consumption, and their applicability. Selection of the most efficient fittings during construction or renovation offers high saving potential. For example, new low-flush toilets are available with flush volumes of four litres for a full flush (Plumbing Supply Services, 2011), urinals are available that do not require any water for flushing (Green building store, 2009), taps are available with flow rates as low as two litres per minute and showerheads are available with flow rates as low as five litres per minute. However, there are also many retrofit options that enable considerable savings to be realised at relatively low cost, most notably aerators, flow-restrictors and efficient showerheads (Table 5.7). Figure 5.11 presents measured flow rates before and after the installation of aerators in the fittings within a hotel. Some of these options may not be applicable where water pressure is low or electric showers are used, as is common in the UK and Ireland for example.

Where low flow fittings are installed, guests may be notified of the benefits of these devices. Guest behaviour is an important driver of water consumption. One reason for higher water consumption in hotels and other accommodation establishments is a 'pleasure effect' – i.e. guests like to relax under a hot shower or in a bath during their stay (Eurostat, 2009). Reusing towels and bed linen is an important way to reduce water, energy and chemical consumption that is described in section 5.3. Other ways that guests can reduce water consumption include:

- taking a shower instead of a bath (where there is a choice)

- taking shorter showers
- turning off taps when brushing teeth and shaving
- selecting the low flush option on dual-flush toilets.

These messages can be conveyed to guests by putting up prominent notices in bathrooms.

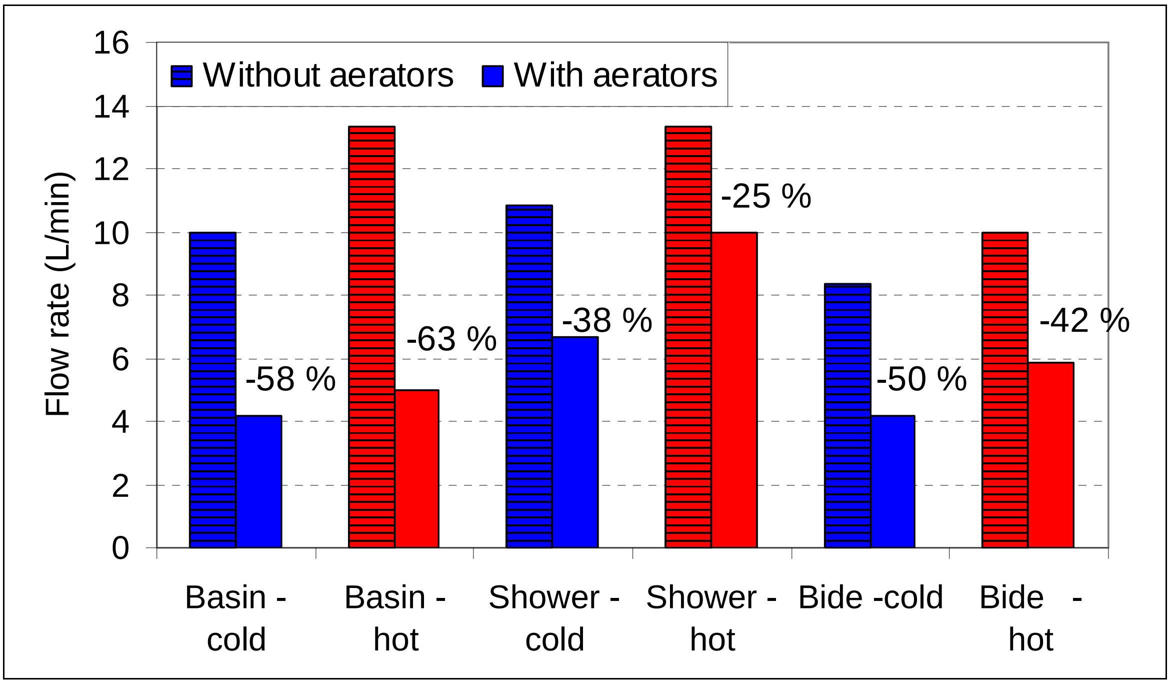


Figure 5.11: Measured cold and hot water flow rates from hotel fittings before and after installation of aerators

An innovative solution to reduce shower water consumption that recognises the 'pleasure effect' sought by guests is to install a water recirculation system into the shower. After washing using a standard low-flow showerhead, the guest may choose to close the drainage valve in the deep shower tray, activating a pump that recirculates the water through a large overhead 'rainshower' head via an electric heater, thus enabling water use to be curtailed for the non-washing fraction of the shower, and for showers to be prolonged without increasing water consumption.

Rainwater may be used for toilet flushing and even showers, and greywater for toilet flushing. Water recycling is described in section 5.7.

Table 5.7: Summary of the main fittings that can be installed as either simple retrofits to existing fittings, or as complete new fittings during construction/renovation to reduce water consumption in guest areas

Feature	Fitting	Description	Saving	Applicability
Showers	Aerator/flow regulator	(Retrofit) Aerators are simple vacuum valves with an air intake that can be easily retrofitted between the tap and hose, or between the hose and showerhead. They introduce air into a pressurised water flow that expands when exiting the valve to create the feeling of higher flow rate, whilst generating less splashing to achieve a greater wetting efficiency. They may be combined with flow regulator valves that adjust flow space in response to pressure, ensuring a set maximum flow rate.	Up to 50 % reduction (6 L/min) in flow rate	Universal where pressure at least one bar
	Low-flow showerheads	(Retrofit) Low flow showerheads may incorporate aerators, or nozzle designs that generate fine droplets in an efficient spray pattern.	Up to 50 % reduction (6 L/min) in flow rate	Universal, when fitting new showers
	Thermostatic mix valves	(Renovation) Thermostatic mixer valves are fitted during shower installation, and adjust the ratio of hot to cold water to ensure a constant temperature, potentially reducing water wastage during temperature adjustment.	Up to 3 L per shower(*)	
	Push-button timers	(Renovation) Push-button timers are mechanically operated by a pinhole within a diaphragm, and close after up to 30 seconds.	27 L per shower(**)	Spa and pool areas, hostels, campsites
	Water recirculation	A pump recirculates water collected in a deep shower basin to an overhead rainshowerhead via an electric heater, activated by the user closing the drainage valve in the shower basin.	27 L per shower**	
Toilets	Low-flush	(Renovation) New low-flush gravity toilets with optimised cistern and bowl designs use between four and six litres per full flush.	6 L per full flush	Universal, when fitting new toilets
	Dual flush mechanism	(Retrofit) Dual flush mechanisms are usually incorporated in new low-flush toilets, but may also be retrofitted to existing cisterns. These mechanisms consist of two buttons that allow the selection of a full flush (e.g. 6 L) for solid materials or a half flush (e.g. 3 L) to flush urine. Average water use is calculated assuming one third of flushes are full flushes and two-thirds are half-flushes.	33 %	Universal, new or retrofit
	Cistern displacement device	Bags of water, granules or pebbles may be inserted into the cistern to reduce the water volume, or the float-arm may be adjusted to reduce the fill level.	0.5 – 2 L per flush	When fitting new frequent use public toilets
	Delayed action inlet valve	Delayed action inlet valves delay inflow into the cistern until the outflow valve is closed, reducing flush volumes by up to one litre	Up to one L per flush	Older high-volume cisterns

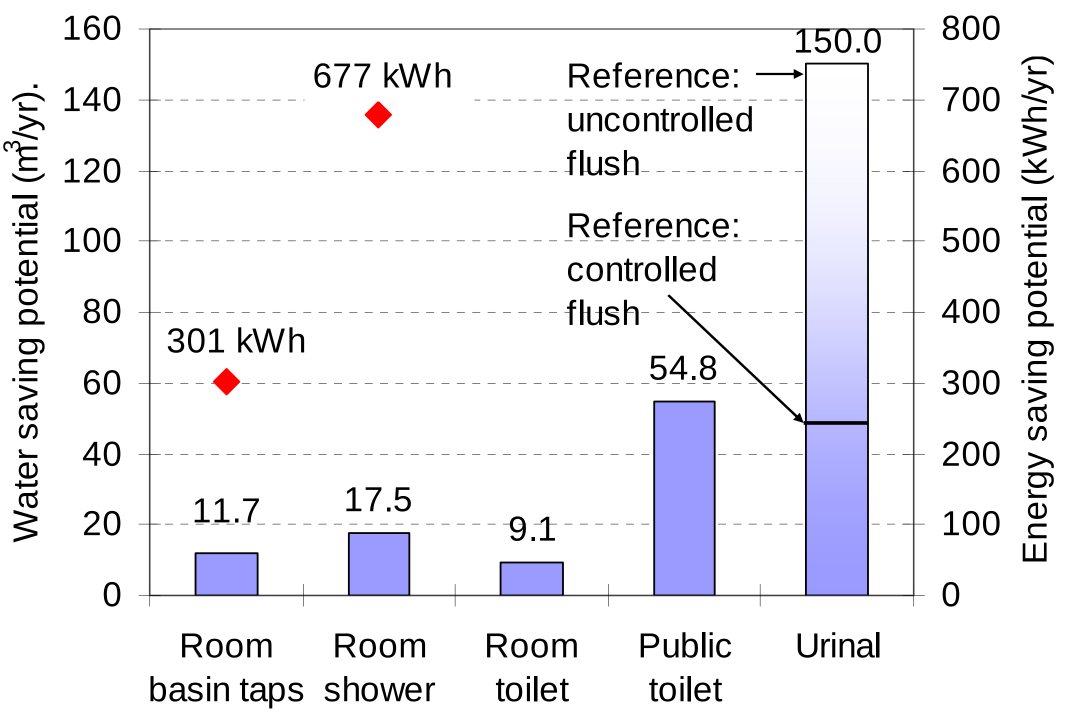
Feature	Fitting	Description	Saving	Applicability
	Siphon-valve	(Renovation) Cisterns with siphon valves instead of simple push ('flap') valves controlling water flow into the bowl are more expensive but less prone to leakage.	Up to 150 L/day(***)	
	Pressure-assisted	(Renovation) Pressure-assisted toilets can either use a sealed plastic tank containing pressurised air separated by a rubber diaphragm to maintain supply pressure, or an adjustable volume-control valve that directly feeds off the pressurised water supply to flush the bowl (at least 3/4 inch pipe and 2 bar pressure required). These are particularly suitable in heavily used public toilets.	Up to 8 L per flush	
Taps	Aerator/flow regulator	(Retrofit) As for showers, aerators with or without flow regulators can be easily retrofitted by screwing on to the ends of taps to reduce the flow rate whilst maintaining wetting effectiveness and perceived flow.	Up to 50 % reduction in flow rate	Universal where pressure at least one bar
	Spray taps	(Renovation) Spray taps integrate flow regulators and aerators with a spray pattern that maximises wetting effectiveness and flow perception, enabling flow rates as low as 2 L/min.	Up to 80 % reduction in flow rate	
	Self-closing taps	(Renovation) Self-closing valves are activated by a simple push-button or passive infra-red sensor, and are mechanically controlled to close after one to 30 seconds. They can be installed on taps in public areas and in showers in lower grades of accommodation to reduce flow times.	Variable(****)	Spa and pool areas, public toilets, staff toilets, hostels and campsites
Baths and basins	Low volume designs	Select low volume basins with optimised design basins, and bath tubs (e.g. body shaped) where necessary, for installation. Accounting for an average body volume of 70 L, low-volume baths require 60 L to fill compared with up to 230 L for some baths.	Up to 170 L per bath	
Urinals	Low-flush urinals	Low-flush urinals require a maximum of 1.5 L per flush, and may be bought new or installed through retrofitting of existing urinal cisterns to reduce flush volume as described for toilets (above).	Up to 3 L per flush	Public toilets (and staff facilities) in hotels and restaurants, toilets in hostels and campsites
	Flush timing control	Various mechanisms can be installed to control the timing of flushes, including detection devices based on infrared sensors or hydraulic valves, user-operated valves, or timers set at regular intervals during operating hours (as few as four flushes per day may be acceptable).	Up to 300 m^3 per urinal per year	
	Waterless urinals	Waterless urinals may be bought new or installed through the retrofitting of existing urinal systems. Waterless urinals are designed to drain urine with no flushing while maintaining hygienic conditions and containing odours, using either: (i) a spring-loaded flap; (ii) a layer of oil floating on the surface of the trap liquid; (iii) plastic pads impregnated with chemicals to destroy bacteria and odours, inserted into the S-bend; (iv) weak negative pressure in the waste pipe induced by a small fan.		

(*)Assuming reduction of 20 seconds in temperature adjustment, at 9 L/min.
(**)Assuming reduction of three minutes in (non-recirculated) shower duration at flow rate of 9 L/min.
(***)Up to 750 L/day from leaking toilet (ITP, 2008), approximately 20 % of toilets leaking.
(****)Depends on use pattern, user behaviour assumptions for user-controlled taps, and settings (in some circumstances, use can be higher than for user-controlled taps: EC, 2009).
Source: EC (2009); Environment Agency (2007); ITP (2008).

Achieved environmental benefit

In terms of total water savings in guest areas, installing low-flow showers throughout all guest rooms can achieve the greatest total savings, reducing typical guest water consumption by almost 10 % (Figure 5.3). This is followed by replacing bathroom taps (reduces total water consumption by approximately 5 %) and toilets (reduces total water consumption by approximately 3.5 %).

However, expressed **per fitting**, the greatest savings are associated with the installation of waterless urinals (up to 150 m3 per urinal per year) and low-flush (including dual flush) public toilets (up to 55 m3 per toilet per year) (Figure 5.12). Savings for individual low-flow showers, low-flow basin taps and low-flush toilets equate to annual savings of 17.5, 11.7 and 9.1 m3/yr, respectively. Reduced use of hot water in low-flow taps and showers can save 301 and 677 kWh per fitting, respectively (Figure 5.12), conservatively assuming that on average the temperature of water used in showers and taps and showers has been elevated by 30 ºC and 20 ºC, respectively, using a 90 % efficient boiler.



NB: Assumes five toilet flushes (includes cleaning flush), six minute shower and six minutes use of basin taps per guest-night (includes two minutes cleaning use), 80% occupancy (of which 25 % double occupancy), 30 flushes per day for public toilets.

Figure 5.12: Annual water savings (m^3) and energy savings (kWh) per fitting achievable by implementation of best practice compared with average practice

Appropriate environmental indicator

The most appropriate environmental indicator for water efficiency of taps and showers is flow rate expressed in L/min, as provided in technical specifications or measured. For example, Accor (2007) recommend maximum flow rates of 6 L /min for taps and 12 L / min for showers. The effective flush volume of toilets is the most useful indicator of the design efficiency of installed toilets that accounts for flushing reductions achieved by dual flush mechanisms. The BREEAM sustainable building standard for offices specifies a maximum effective flush volume of 4.5 L per flush, whilst Accor (2007) recommend a maximum flush volume of 7 L for toilets. Meanwhile, compulsory criteria for the award of the EU Flower ecolabel to tourist accommodation (2009/578/EC) and camp sites (2009/564/EC) require that: (i) flow rates do not exceed 9 L/min for taps (excluding kitchen and bathtub taps) and showerheads; (ii) All urinals shall be fitted with either automatic (timed) or manual flushing systems so that there is no continuous flushing.

Energy consumed to heat hot water is also an appropriate environmental indicator, although it may be difficult to isolate energy consumption for heating of hot water used in guest areas from other demands for hot water, including kitchen, laundry and space heating (depending on system design). ITP (2008) propose benchmarks for water heating of 4.5 and 4.0 kWh/guest-night for luxury hotels located in temperate and Mediterranean areas, respectively.

Table 5.8: Proposed benchmarks of excellence for water use in guest areas

Aspect	Best practice	Quantitative benchmark
Shower fittings	Low-flow showerheads, aerators and flow-restrictors	Average shower flow rate ≤7 L/min
Retrofitted tap (except bath)	Aerators and flow-restrictors	Average tap flow rate ≤6 L/min
New tap fittings(*) (except bath)	Spray taps	Average flow rate ≤4 L/min
Toilet	Low-flush, dual-flush	Average effective flush ≤4.5 L
Urinal	Waterless urinals	Average urinal water use ≤2.5 L/person(**)/day
Guest information	Prominent notices in all bathrooms on water-saving measures	NA
Total water use in guest areas	Implementation of all above measures	Average water use in guest areas ≤100 L/guest-night(***)
Energy for heating water in guest areas	Implementation of above measures and system optimisation (section 5.1)	3.0 kWh/guest-night(****)
(*)Recent retrofit. (**)Based on average use rate. (***) See Figure 5.3. (****) based on heating 60 L water by 40 ºC.		

The information above is distilled into the following benchmarks.

BM: water consumption, and associated energy consumption for water heating, of ≤100 L and 3.0 kWh per guest-night, respectively, for ensuite guest bathrooms.

BM: shower flow rate ≤ 7 L/min, bathroom tap flow rate ≤6 L/min (≤ 4 L/min new taps), average effective toilet flush ≤ 4.5 L, installation of waterless urinals.

The former benchmark does not apply to accommodation where the majority of bathrooms are shared across rooms (see separate benchmark for such accommodation in section 5.1). Energy consumption in the former benchmark may be estimated based on hot water consumption in guest areas (see Table 5.6 and associated equation in section 5.1). In practice, it may not be possible to measure performance in relation to the former benchmark (depending on the level of sub-metering in place), in which case the latter benchmark indicates best practice.

Cross-media effects

Reducing water consumption in guest areas through installation of efficient fittings can also significantly reduce energy consumption for water heating, and is not associated with any significant cross-media effects. Correctly installed and operated waterless urinals do not require significant additional quantities of cleaning chemicals.

Operational data

Green procurement

Green procurement of water fittings and building specifications decided during design, construction and renovation are critical to reducing water consumption. Accor's International Sustainability Guidelines document (Accor, 2008) contains a section with recommended efficient fittings and fixtures, including the installation of flow regulators to all basin taps and showers to achieve maximum flows of 6 L/min, and the installation of infra-red sensors on public toilet urinals and taps.

Showers

A range of installation features related to the water system, mixer controls and showerhead control water use in showers (Table 5.9). Shower mixer valves may be controlled by manual operation of taps, or via a thermostat. Control of both shower flow and temperature via hot and cold taps is imprecise and can be time consuming, thus wasting water. The risk of scalding is also higher. Thermostatic mixers maintain a specific water temperature, adjusting for flow and pressure variations, according to calibrated settings. They enable precise and rapid temperature control at different flow rates, allowing water flows to be stopped and restarted quickly – e.g. to apply shampoo (Environment Agency, 2007). Thus, the relatively high investment cost for thermostatic mixers (compared with other bathroom fittings) is justified in terms of guest comfort and reduced water consumption.

Table 5.9: The main fixed features that affect water use in showers

Supply system	Controls	Head design
– Boiler warm up time – Pipe dead-leg – System pressure (and stability)	– Precision and speed of temperature adjustment – Compensation for pressure and flow	– Flow restrictor – Aeration – Droplet size – Spray pattern – Size

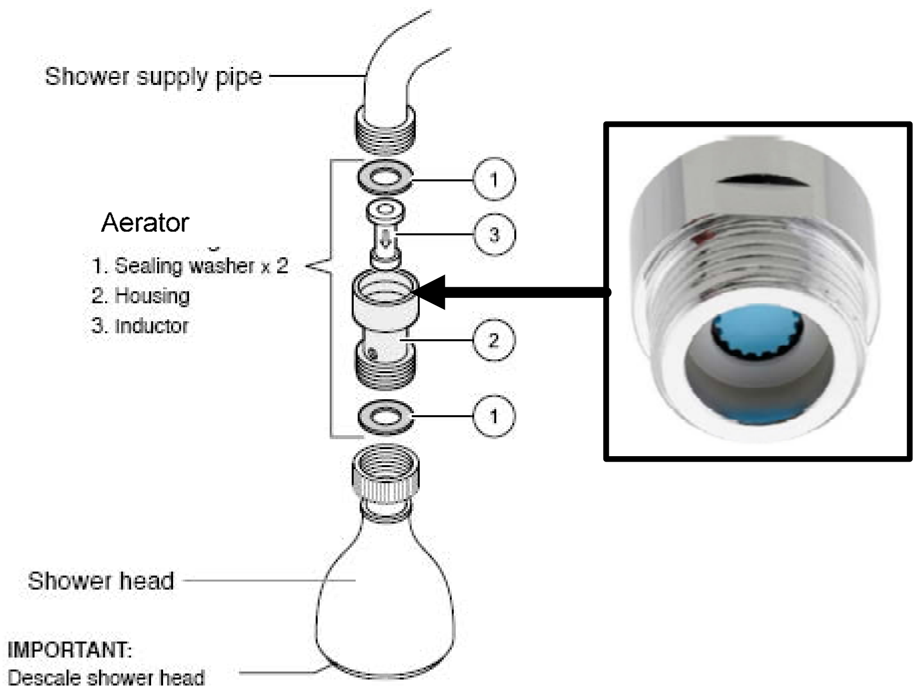
Ceiling fitted rain showers consume large quantities of water, and should be avoided. For example, Accor (2008) recommend maximum flow rates of 9 – 12 L/min for normal showers and 20 L/min for ceiling rain showers. Low-flow showerheads can be purchased and retrofitted onto existing showers, and typically achieve flow rates of 5 – 9 L/min. Design features include in-built aeration and sometimes flow restrictors, nozzles to minimise water droplet size, and spray patterns that match the body cross-section. Designs that produce small droplets are sometimes associated with 'cold feet' owing to rapid droplet cooling. The performance of low flow showerheads varies, partly in response to pressure, and it is important to test a type of showerhead on the premises before deciding to install it widely. A pressure of at least one bar is required for effective operation, and low-flow showerheads may not work on electric-showers or gravity-fed systems that are extensive in the UK and Ireland. Flow rate is exponentially related to pressure (pressure is related to the square of velocity: Bernoulli's equation), and system pressure therefore has a dramatic effect on flow rate in most showerheads that do not contain pressure restrictors. Even low-flow showerheads with inbuilt flow-restrictors can still use two-thirds more water than necessary when system water pressure is high (Table 5.10). These points emphasise the need to:

- regulate system pressure (section 5.1)
- trial low-flow fittings, especially showerheads, before committing to a specific type/model for the entire premises.

Table 5.10: Flow rate in response to pressure from a low-flow showerhead with flow restrictor

Pressure (bar)	0.5	1.0	1.5	2.0	2.5	3.0
Flow rate (L/min)	3.6	5.1	6.3	7.0	7.9	8.6
Source: Grohe (2011).						

A lower cost option to reduce shower flow rates is to install aerators with built-in flow restrictors. These are small devices that can be screwed into standard fittings, between the fixed pipe and hose, or between the hose and showerhead (Figure 5.13). These devices are inexpensive but require periodic cleaning and replacement as they can become blocked (especially where water is hard).



Source: Challis (2011) and Bristan (2011).

Figure 5.13: Installation of an aerator in a shower feed

Push valves are a useful mechanism to control shower duration in public areas such as pool and spa changing areas, or hostel and campsite showering facilities. They may comprise a pinhole or cartridge control mechanism. Cartridge mechanisms are self-cleaning, but pinhole mechanisms are susceptible to blockage, especially in hard water areas, so periodic inspection and cleaning is required (Envirowise, 2007). Water conditioning is important in hard water areas (section 5.1).

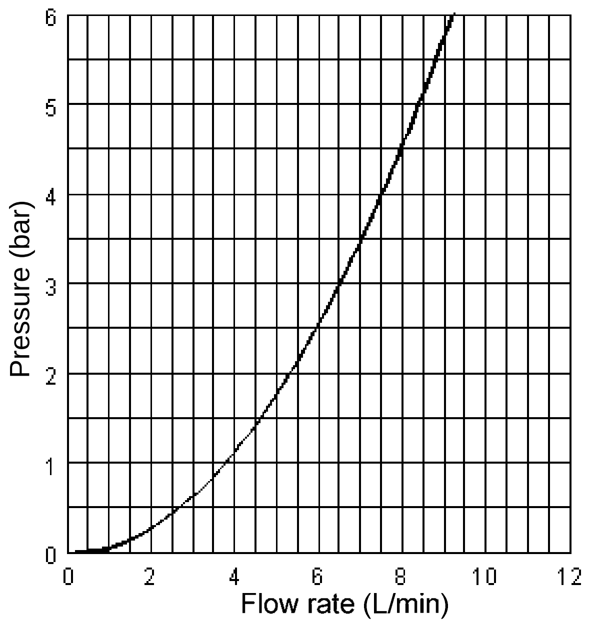
Recirculating showers are bought and installed as a unit (e.g. Hotel Gavarni in Paris), but are expensive and do not pay back in terms of water and energy savings at current prices.

<u>Taps</u>

Low-flow taps achieve flow rates of 2.5 – 6 L/min through design features including flow restrictors, aeration and spray design. Even low flow taps are sensitive to system pressure (Figure 5.14), again highlighting the importance of water system optimisation (section 5.1). As for showers, although careful selection of the best products during installation can achieve the lowest flow rates, a number of retrofit options are available – primarily flow restrictors and aerators that screw onto the end of most standard ½ inch taps. Alternatively, or in addition, isolating ball valves may be installed in bathroom feed pipes to restrict the flow rate in high pressure systems (Envirowise, 2007).

Taps in public areas may be fitted with self-closing push valves or infrared sensors. The savings associated with such devices depend heavily on the users and timing. In some cases, push taps have been found to increase water use compared with screw down taps (EC, 2009). Infrared sensors are the preferred option as they have hygiene and precision advantages.

Aerators may become blocked over time, and require periodic inspection, cleaning and replacement. In all cases when installing taps or shower fittings, long-life O-rings resistant to over-tightening should be fitted (and over-tightening avoided) in order to minimise the risk of leaks and future maintenance requirements.



Source: Grohe (2011).

Figure 5.14: The effect of pressure on flow rate for a ½ inch (127 mm) bathroom mixer tap

Toilets

Standard gravity tank toilets are the most common type of toilet installed on accommodation premises, and do not require high water system pressure. Of these, button-operated flap valve cisterns offer the lowest installation costs, but are vulnerable to leakage from small particles preventing a seal and worn rubber seals (Environment Agency, 2007). Leaks occur in up to 20 % of installations, and can waste considerably more water than is used in actual flushing, but are difficult to detect. Regular inspection of toilets, including new low-flush toilets, is therefore important (section 5.1). In addition, flap valve cisterns allow refill water to flow through the cistern during the flushing, increasing flush volumes by up to 17 % (Environmental Agency, 2007). Cisterns containing siphon-controlled outflows are more expensive to buy and result in slower cistern refilling that can in some cases restrict their practicality in commercial settings, but result in a considerably reduced leakage rate. Low and dual flush toilets with siphons are available (Green Building Store, 2009), and may prove cost-effective when lower leakage rates are considered over the installed lifetime.

Cistern displacement devices can be inserted into cisterns to reduce water volume, or the float-arm may be adjusted to lower the fill level. Cistern displacement devices may be purchased, or improvised from e.g. bags of pebbles. When inserting cistern displacement devices it is important:

- to take care not to damage the cistern inlet or outlet valves
- not to restrict outflow
- to avoid objects that introduce debris or small particles into the cistern (that could prevent flap valve from sealing shut)
- not to reduce flush volume below hygienic (i.e. effective full flush) volume.

Dual flush toilets should be clearly labelled so that guests know how to operate the low flush (e.g. which button to press). Reassurance should be sought from the relevant authorities that the local sewer system is compatible with low-flush toilets: i.e. that installing such toilets will not significantly increase the risk of blockages (EC, 2009).

Valve-operated flush toilets are more expensive to install than gravity-tank toilets, but do not require any refill time and are therefore appropriate where the frequency of use is high (for example common toilet areas). They cannot be easily retrofitted and should therefore be specified during construction or renovation. Valve-operated toilets require a system pressure of at least 1.8 bar, and should be fitted to bowls designed for shorter, higher pressure flushes (EC, 2009). Valves are fitted directly to the water supply system and are manually adjusted to produce the correct flush volume at the location-specific pressure, resulting in a low volume when correctly adjusted (periodic checking required).

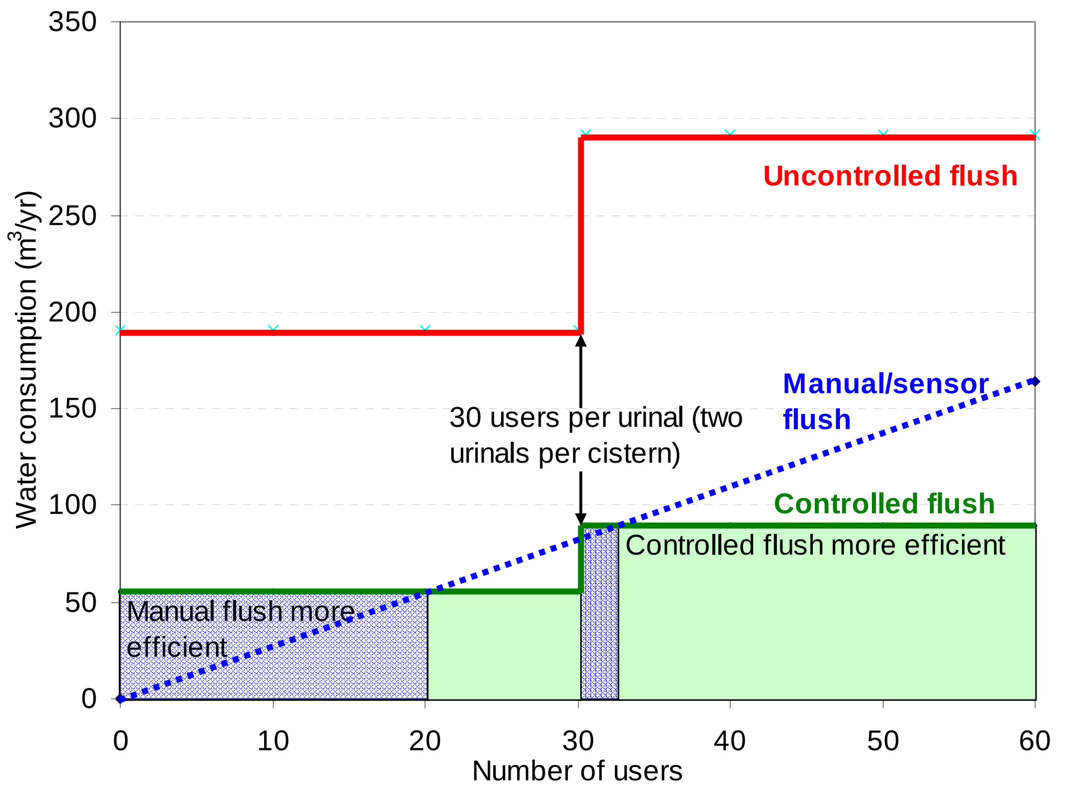
Pressurised tank toilets are also more expensive than gravity-tank systems, and have comparable refill times, produce a more effective flush and enable lower flush volumes. They comprise a sealed plastic tank containing pressurised air behind a diaphragm that is compressed by water from the pressurised supply system (at least 1.8 bar required). Pressurised tanks can be retrofitted, but are easier to install during construction or renovation.

In all cases, it is important that flush effectiveness be maintained otherwise water savings can be negated or even reversed by repeated flushing. For pressurised flushes, it may be necessary to change the toilet bowl to achieve best results.

<u>Urinals</u>

Urinals may be in the form of individual bowls or multi-user troughs, with a cistern or direct feed flush, with manual flush control, timed flush control, usage flush control, or they may be uncontrolled (i.e. flush when cistern is refilled). A controlled urinal flushing four litres of water six times per hour can use 105 m^3 per year if operating 12 hours per day, whilst an uncontrolled urinal with a flush operational 24 hours per day could use up to 500 m^3 per year. A single urinal can serve up to 30 users per day (Environment Agency, 2007), and at up to 20 users per day it is more efficient to have a manual or sensor-controlled flush than a timer-controlled flush (Figure 5.15). However, at higher user rates, a timer-controlled flush is more efficient. With a use demand of 60 users, water use per person ranges from 4 L/day for a controlled flush urinal to 13 L/day for an uncontrolled flush urinal. Therefore, unless installing waterless urinals, it is important to base the method of flush control on the expected use rate. For both uncontrolled and timer-controlled flushing, the flushing system should be deactivated outside hours of use (e.g. overnight).

A number of types of sensor are available to activate flushes after use. The most common is a passive infrared sensor that detects the user at the urinal and activates the flush valve when the user leaves. Other types of sensors include door switches or hydraulic valves that activate the cistern valve in response to water flow or a pressure drop from water used elsewhere (e.g. taps opened to wash hands).



NB: In all cases, assumes 16 hours of operation per day, 365 days per year. For manual flush urinals, an average of 5 flushes of 1.5 L per user is assumed.
Source: Derived from Environment Agency (2007).

Figure 5.15: Annual water consumption for uncontrolled, controlled and manual/sensor flush urinals serving different numbers of daily users

The best solution to reduce water consumption for urinal flushing is to install waterless urinals. These operate using a spring-loaded trap, a layer of barrier oil floating in the trap, or chemical-impregnated plastic pads inserted in the trap. Best environmental practice is to use 'chemical-free' waterless urinals (e.g. Culu, 2011). One new design uses a low power fan to generate negative pressure in the waste pipe (Green Building Store, 2009). Prior to installation, waste pipes should be assessed and modified to remove any flow restrictions, and thoroughly cleaned where retorfitting. Where urinals are being converted to waterless operation, best practice to avoid legionella risk in 'dead-leg' pipe work is to isolate the redundant water supply pipes, using either an existing valve or by cutting the supply spur as close to the T-joint as possible and installing an isolation valve and stopper (so that supply may be restore if required) (Waterless Urinals, 2011).

Waterless urinals require specialist cleaning with compatible chemicals, and in some cases replacement of the barrier liquid or pad once every one to two weeks (Business Link, 2011; Culu, 2011). Correct maintenance is critical to satisfactory operation of waterless urinals. Where microbiological systems are installed, it is important to avoid use of drain clearing acids that kill useful microbes that degrade organic matter and prevent, and that degrade gels or liquids used in barrier systems (Waterless Urinals, 2011).

An intermediate solution is the use of plastic sleeves empregnated with enzymes that break down odours, enabling flush controllers to be set to just four flushes per day, saving up to 90 % of water used in controlled flushing systems (ITP, 2008).

<u>Basins and baths</u>

It is important to ensure that basins are installed with an effective drain plug (that is periodically inspected and replaced where necessary: section 5.1) so that guests can use them for washing and shaving without leaving water running. When selecting basins for installation during construction or renovation, functionality should be a priority. Basins should be sized and shaped so that guests can comfortably wash their hands and shave. Very large and deep basins should be avoided.

Baths are not a standard feature in hotels and other accommodation premises, and often space and water can be saved by avoiding the installation of bath tubs in guest bathrooms. In high end establishments or suites where baths are provided, bath tubs of an efficient size and shape should be selected. Bath tub volumes range from 130 to 300 L. Care should be taken to compare volumes on a like-for-like basis; i.e. the volume required to fill the tub to the mid-point of the overflow outlet (Environment Agency, 2007) – some manufacturers subtract a typical body volume (70 L) from quoted fill volumes. Well designed bath tubs are shaped to follow body contours, and therefore reduce water volume.

<u>Guest information</u>

The most effective manner to convey information on water use to guests is with notices prominently placed at the point of use – e.g. on bathroom walls or mirrors in front of basins. Information that can be included is:

- how guests can indicate they would like to reuse towels, for example by hanging them after use (see section 5.3);
- how guests can save water by turning off taps when washing teeth and shaving;
- how guests can save water by taking a shower instead of a bath;
- water savings associated with the above actions;
- any low-flow fittings installed and the amount of water they save.

The operation of dual flush toilets should be clearly indicated on or above the cistern (see above).

Emerging techniques
Toilets with 1.5 L flush are being developed (Environment Agency, 2007).

Applicability
Table 5.7 refers to the applicability of various techniques. The following are key points relating to applicability.

- Aerators and flow restrictors are inexpensive and suitable for retrofitting where water system pressure is at least one bar and low-flow fittings are not installed. They are not applicable to gravity-fed water systems common in some member states (e.g. UK and Ireland).
- Low-flow showerheads can be fitted or retrofitted where water system pressure is at least one bar, but should be tested on the premises before widespread installation. They are not applicable to gravity-fed systems or some electric showers.
- Themostatic mixers for showers can be fitted in place of basic mixer taps during construction or renovation.
- Low-flow taps can be fitted or retrofitted in almost all situations, but work more effectively under water pressure of at least one bar. They should be tested on premises before widespread installation.
- Toilet retrofits such as cistern displacement devices and dual-flush mechanisms are universally applicable where existing flush volumes are greater than 6 L.
- Low-flush gravity-tank toilets can be fitted or retrofitted in all situations. Flush-valve and pressure tank systems can be fitted during construction or renovation.
- Waterless urinals are universally applicable, and can be realised through retrofitting existing urinal pods or troughs with modified traps or waste-pipe fans.

Economics
Installation of efficient fittings reduces water supply and disposal costs, and also energy costs where consumption of heated water is reduced (showers and basin taps) – see Table 5.6 and associated equation in section 5.1.

Table 5.11 provides an overview of fitting costs and annual savings where average fittings are replaced by efficient fittings conforming to the benchmarks specified above. Labour costs associated with installation will vary depending on whether in-house maintenance staff or external plumbers carry out the tasks, and have been excluded from the calculations. Retrofitting options are simple and would typically require ten to 30 minutes labour per fitting.

It is important to note that attributing the entire cost of new fittings to water efficiency provides a **worst case indication of payback period** as efficient fittings will usually be specified when undertaking construction or renovation work, and the additional costs compared with less efficient fittings will be a fraction of the fitting prices quoted in Table 5.11. Accounting for these caveats, information in Table 5.11 supports the following conclusions.

- All retrofit options offer short payback periods, ranging from two to 10 months.
- Fitting combined flow-restrictors and aerators can realise almost immediate payback.
- Selecting (or retrofitting) efficient bathroom taps and showers can save a considerable amount of money through reduced water and energy consumption.
- For guest bathrooms, selecting low-flush toilets during construction or renovation can save a significant amount of money: enough to justify bringing forward replacement by a few years, or spending 30 – 50 % more on an efficient model.
- For public areas, selecting (or retrofitting) low-flush toilets and waterless urinals can save a considerable amount of money through reduced water consumption.

- For public areas, considerable water and energy reductions associated with shower timers result in a short payback period of 6 – 8 months, justifying retrofitting.

In addition to information presented in Table 5.11, passive infrared sensors for urinals can be installed for a total cost of approximately EUR 280 per urinal (Ecosys, 2007), resulting in payback time of nine months.

Recirculating showers are not included in Table 5.11. They represent an innovative but so far expensive option for reducing water consumption. The full cost of installing a recirculating shower unit is EUR 7 000 (Hotel Gavarni, 2011). This should be compared with the full costs of installing a conventional shower, including basin, tiles and all fittings, but still represents a considerable premium. Recirculating showers are therefore appropriate for hotels particularly committed to environmental protection, but not yet widely applicable across the sector.

Table 5.11: Annual financial savings and worst-case payback estimated for replacement of average water fittings with efficient water fittings

Fitting	**Cost**	**Saving**			**Payback**
		Water	**Heating (oil)(*)**	**Total**	
	EUR	EUR/yr			Months
Low-flow basin taps(**)	100 – 200	29	24	**53**	**23 – 45**
Combined flow-restrictor and aerator	10	22	18	**40**	**3**
Low-flow showerhead	20 – 50	44	54	**98**	**2 – 6**
Combined flow restrictor and aerator	10	44	54	**98**	**1**
Shower push-button timer	150 – 200	164	203	**367**	**5 – 7**
Low-flush toilet(**) (bathroom)	70 – 150	23		**14**	**36 – 78**
Cistern displacement/dual-flush retrofit (bathroom)	20	23		**14**	**10**
Low-flush toilet (public)(**)	150	137		**137**	**13**
Bathroom cistern displacement/dual-flush retrofit (public)	20	137		**137**	**2**
Urinal flush control (from uncontrolled)	200	375		**375**	**7**
Waterless urinal (from controlled flush)	150	375		**375**	**5**

(*)For energy savings, it was assumed that water used in showers and taps has temperature elevated by, on average, 30 ºC and 20 ºC, respectively, fed by a 90 % efficient oil-fired boiler.
(**)Cost of new fittings provides a worst case cost estimate where recently installed existing fittings are replaced by efficient new fittings.

Source: Alaris Avenue (2011); Bathroom Supplies (2011); Not Just Taps (2011); Plumbing Supply Services (2011); Plumb World (2011); Discounted Heating (2011); Waterless Urinals (2011).

Driving force for implementation

Measures to reduce water use in guest areas are associated with significant cost savings, attributable to reductions in both water and energy consumption. Measures to reduce water consumption can also be readily conveyed to guests to promote an environmentally conscious image.

In some Member States regulations specify minimum efficiency standards for new water-using devices installed in buildings. For example, the UK Water Fitting Regulations (1999) stipulate that:

- no flushing device shall be installed for a toilet pan that produces a volume greater than 6 L per flush;
- non-automated urinal flushing systems should be switched off overnight or when building not in use;
- automatically operated urinals should use no more than 10 L per hour per single bowl or 7.5 litres per hour per bowl or per 700 mm of trough fed by a cistern serving more than one urinal;
- manually or automatically operated pressure flush valves should use no more than 1.5 L per flush.

A list of relevant regulations is presented in EC (2009). National, regional or local governments may provide incentives in the form of subsidies or tax breaks to encourage installation of water efficient fittings. For example, in the UK, the Enhanced Capital Allowance scheme allows business to deduct the capital cost of water-saving equipment from taxable profit in the year of purchase (http://etl.decc.gov.uk/). Equipment covered by the scheme relevant to this technique includes:

- efficient toilets
- efficient taps
- rainwater harvesting equipment.

Reference organisations

Examples of extensive low-flow fittings include: Hotel Gavarni (Paris), Ibis hotels, Scandic hotels.

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5.3 Efficient housekeeping

Description

Housekeeping is a critical component of accommodation services, a key control point for service quality, and provides a link between accommodation management and guests. The major functions of housekeeping are to:

- make up beds and replace used bedclothes;
- replace used towels and floor mats in bathrooms;
- clean bathrooms and bedrooms;
- replace all consumables (food, drinks, soaps, shampoos, etc.);
- remove rubbish.

Section 6.1 deals with green procurement to minimise waste, such as the use of soap dispensers instead of single-use soaps, and section 6.2 addresses best practice for waste sorting to minimise waste sent for disposal. This section deals with the first four points in the above list, and is located within the water management chapter of the document because of the importance of these points, in particular laundry reduction, to water consumption.

The provision of clean, crease-free bedclothes is a particularly important quality control point for accommodation establishments: unclean or creased bedclothes can give guests an instant bad impression. Hotels launder 2 kg to 6 kg of bed linen and towels per room per day[7], in the process consuming up to 100 litres per occupied room – almost as much water as all other service activities combined in a best practice hotel (see Figure 5.3 in section 5). Bedroom laundry comprises sheets, pillow cases, duvet covers, towels and bath mats. Laundry represents a major potential source of saving for water, energy and chemical consumption within accommodation enterprises. Before laundry operations are optimised (sections 5.4 and 5.5), considerable savings can be achieved through the minimisation of laundry volumes. Bed linen and towel reuse programmes can reduce laundry volume by half (Smith et al., 2009). Management and housekeeping staff play a key role in the effective design and implementation of such programmes. Green procurement of textiles to reduce their lifecycle impact is also an important control point.

Guest room and bathroom cleaning is a major source of chemical consumption within accommodation establishments, and a significant source of water consumption. Chemical use can be minimised through; (i) appropriate dilution of cleaning agents usually purchased in concentrated form; (ii) efficient cleaning technique; (iii) use of microfibre clothes. Regular staff training on chemical handling is very important, from a health and safety and environmental perspective. Selection and green procurement of less environmentally harmful cleaning agents, such as those that have been awarded an ISO Type-I ecolabel (e.g. EU Flower, Nordic Swan: section 2.2), can significantly reduce the impact of cleaning. Meanwhile, Gössling et al. (2011) estimate that room cleaning consumes 12 – 47 L/guest-night of water. Water can be saved by:

- turning off taps during cleaning
- flushing toilet not more than once.

The water saving associated with actions depends on the water efficiency of the fittings (section 5.2), but is in the region of 6 – 15 L/min and 2.5 – 12 L per flush, respectively.

Finally, housekeeping staff are positioned to influence guest behaviour, and to ensure efficient operation of equipment within rooms. For example, where solar gain is high (e.g. windows

[7] Accor (2010) refer to 4 kg per room per night; O'Neill et al. (2002) refer to median laundry of 5.4 kg per room per night from a US study, ranging from 2.4 to 15.8 kg per room per night; Alliance for Water Efficiency (2009) refer to example of 5 lb (2.3 kg) per room per night; Bohdanowicz and Martinac (2007) refer to an average of 2 kg per guest-night for Scandic hotels and 3.7 kg per guest-night for Hilton hotels.

exposed to direct sunlight during summer months), housekeeping staff may close shutters or curtains in order to prevent excessive heating of the rooms. Similarly, where unoccupied room temperature is not controlled by a centralised building management system (section 6.1), housekeeping staff may reset temperature controls to values that maintain guest comfort whilst minimising energy consumption. Housekeeping staff can check for leaking water fittings (section 5.1) and other damaged equipment that can increase water or energy consumption (e.g. damaged seals on fridge doors). Table 5.12 summarises best practice for housekeeping operations.

Table 5.12: Portfolio of housekeeping measures to reduce environmental impact of accommodation

Aspect	Measure	Description
Efficient housekeeping all	Staff training	Staff are provided training in relevant operational tasks to maximise (environmental) efficiency, and tasks are explicitly linked with the organisation's environmental objectives (see section 2.1).
Reduce laundry water, energy and chemical consumption	Bedclothes reuse	Implement a schedule to change bed linen once per specified number of days for the same guest, unless a more frequent change is requested. Implement a top-to-bottom sheet change.
	Towel reuse	Implement an on-request towel change, with the procedure to indicate towel washing clearly conveyed to guests.
	Textile green procurement	Purchase bedclothes and towels that combine low supply chain environmental impact with good use-phase (laundry) environmental performance.
Reduce cleaning water and chemical consumption	Green procurement	Avoidance of environmentally damaging chemicals, selection of ecolabelled cleaning agents and microfibre clothes.
	Efficient cleaning	Train staff on safe and efficient use of cleaning agents and chemical-free methods (e.g. one-flush toilet cleaning and microfibre cloths).
Reduce energy consumption	Energy check	Switch off appliances, close windows, reset temperature controls
Reduce waste	Avoidance of single use soaps	See section 6.1 on waste avoidance
	Waste sorting	See section 6.2 on waste sorting and recycling.
Other	Green procurement consumables	Purchase lower environmental impact consumables such as toilet paper, tissue paper, writing paper and magazines for rooms (e.g. ecolabelled or FSC certified paper)

Achieved environmental benefit

Green procurement

Increasing the useful life of textiles by specifying appropriate durable textiles with lower laundry (in particular drying) requirements significantly reduces resource depletion and energy consumption, and a range of other impacts associated with textile production such as water pollution, climate change, ecotoxicity. Kalliala and Nousiainen (1999) concluded that the potential lifetime of 50/50 cotton-polyester fabrics is twice as long as similar fabrics made of pure cotton in hotel textile services, resulting in 42 % less production energy. Mixed fabrics also require 20 % less laundering energy than pure cotton.

Green procurement of textiles, paper, cleaning agents and food based on ISO Type-1 ecolabels and organic certification results in lower production impacts compared with average products (Table 5.13).

Table 5.13: Key criteria and associated environmental benefits represented by various product labels

Product and label	Key criteria	Environmental benefits
Cleaning agent, soap and shampoo ecolabels	– Excluded toxic chemicals – Aquatic toxicity limits represented by critical dilution volumes – Limited quantities of non-aerobically biodegradable surfactants – Limited concentrations of volatile organic compounds and phosphorus – Avoidance of propellant spray packaging – Clear user instructions provided on packaging	– Reduced human toxicity and ecotoxicity – Reduced eutrophication and oxygen demand in receiving waters – Reduced air pollution – Reduced resource depletion and waste generation
Textile ecolabels	– Toxic residue limits in final product, fibres and dyes – Water pollution thresholds for production (e.g. COD removal requirements) – Air pollution thresholds for production (e.g. VOCs, N_2O) – Biodegradability requirements and restricted lists for processing agents – Restricted substances for dying and flame retardants – Requirements for fabric durability in terms of shape-holding and colour fastness	– Reduced human toxicity and ecotoxicity – Reduced eutrophication and oxygen demand in receiving waters – Reduced air pollution – Reduced resource depletion and waste generation
Toilet paper ecolabels	– Excluded substances in final products and during production/processing (e.g. chlorine gas, azo substances) – Reduced air emissions of sulphur and greenhouse gases during production – Water pollution thresholds for production (e.g. chlorine compounds and organic waste) – Air pollution thresholds for production (e.g. Sulphur and nitrogen oxides, carbon dioxide) – Reduced energy consumption during production – Use of recycled fibres or virgin fibres from sustainably managed forests	– Reduced human and ecotoxicity – Reduced eutrophication and oxygen demand in receiving waters – Reduced air pollution – Reduce global warming potential – Reduced resource depletion and waste generation
Textile and food/drink organic labels	– Limits to quantities of nutrients applied during cultivation – Restrictions to types of fertilisers applied (only organic nutrients and some natural minerals allowed) during cultivation – Restricted range of plant protection agents allowed during cultivation and processing – Limits for animal stocking densities – Specifications for animal feed – Restricted substances used in food processing	– Reduced resource depletion – Reduced human and ecotoxicity – Reduced on-farm biodiversity impacts – Reduced eutrophication
Source: EC (2007); EC (2008); EC (2009); EC (2011).		

Laundry reuse programmes
The environmental benefit of laundry reuse programmes is dependent upon: (i) the quantity of laundry avoided; (ii) the eco-efficiency of the laundry process (see section 5.4 and section 5.5). Water and energy savings can be calculated fro the following formula:

$Q = N_R$ x (O/100) x (P/100) x V_L x C_L x N_D		
Q	Quantity of water saved Quantity of energy saved	L/yr kWh/yr
N_R	Number of rooms	N
O	Average annual occupancy rate	%
P	Average participation rate	% of occupied room nights
V_L	Average laundry volume per room per change	kg
C	Average specific consumption of water Average specific consumption of water	L/kg laundry kWh/kg laundry
N_D	Annual business operating period	Days/yr

Thus, for a 100-bed hotel with a 75 % occupancy rate and a participation rate of 30 %, a room laundry volume of 3 kg and a laundry use efficiency of 7 L water and 1.5 kWh energy per kg laundry, the annual water saving would be:

$$100 \text{ x } 0.75 \text{ x } 0.30 \text{ x } 3 \text{ x } 7 \text{ x } 365 = 172\,463 \text{ L, or } 172 \text{ m}^3$$

For the same hotel, annual energy savings would equate to 86 231 kWh.

Efficient cleaning
Efficient cleaning techniques use less than half the water and chemicals of inefficient techniques. For example:

- applying a single low flush of 3 L on a dual flush toilet during cleaning, instead of two full flushes, can save up to 9 L per guest-night, representing approximately 7 % of best practice specific water consumption;
- turning off taps during cleaning, rather than leaving a tap on for 90 seconds during cleaning, can save between 5 and 20 litres of water, representing up to 15 % of best practice specific water consumption;
- using microfibre mops in place of wet mops can reduce water and chemical consumption by 95% (Espinozal et al., 2010);
- application of best practice techniques can reduce chemical consumption by at least 50 % (see Figure 5.16).

Energy management and maintenance
Energy management, maintenance and reporting during housekeeping activities can make important contributions towards energy and water minimisation. For example, reducing thermostat settings by just 1 ºC in winter can reduce heating energy consumption by 10 %, and similar savings in cooling energy consumption can be achieved in summer by correct thermostat adjustment. In addition, closing shutters or curtains to avoid unwanted solar gain during the day can reduce or avoid cooling energy consumption. Meanwhile, reporting leaking water fittings so that they are fixed promptly can reduce room water consumption by hundreds of litres per day (see section 5.1).

Appropriate environmental indicator

Indicators
Table 5.14 summarises environmental indicators relevant to housekeeping best environmental management practices.

Table 5.14: Relevant environmental indicators for different aspects of housekeeping

Aspect	Relevant indicators
Textiles	– Percentage of bedclothes made from polyester-cotton mix or linen – Percentage of room textiles made from organic material or awarded an ISO Type-1 ecolabel
Bathroom consumables	– Percentage of bathrooms that use ecolabelled soap and shampoo – Percentage of bathrooms with soap and shampoo dispensers
Laundry	– Average specific laundry requirements (kg) per guest-night – Percentage of occupied room nights that involve towel and bedclothes reuse – Percentage reduction in laundry achieved through towel and bedclothes reuse programmes
Cleaning	– Total chemical use within the hotel, expressed in relation to guest-nights (see Figure 5.16) – Regular staff training on safe chemical handling and efficient cleaning that minimises water and chemical use – Automatic dilution of cleaning chemicals, and clear instructions on dilution – Precise procedures in place for chemical-free cleaning methods, such as use of microfibre cloths – Proportion of the amount of chemical products used for regular/general cleaning that are ISO Type-1 ecolabelled (%)
Energy	– Regular staff training on energy management procedures to be performed during housekeeping

Some aspects of efficient housekeeping are captured by key performance indicators and associated benchmarks described in other sections. For example, measures to reduce water use during cleaning are reflected in water consumption per guest-night (section 5.1), and measures to reduce energy consumption are captured in energy consumption per guest-night (section 7.1).

Benchmarks of excellence

The following benchmarks of excellence are proposed specifically in relation to housekeeping.

BM: at least 80 % of bedclothes are cotton-polyester mix or linen, and at least 80 % of bedroom textiles have been awarded an ISO Type 1 ecolabel or are organic.

BM: consumption of active chemical ingredients within the tourist accommodation of ≤10 grams per guest-night.

BM: reduction in laundry achieved through reuse of towels and bedclothes of at least 30 %.

BM: at least 80 % by active-ingredient weight of all-purpose cleaners, sanitary detergents, soaps and shampoos used by the tourist accommodation shall have been awarded an ISO Type I ecolabel[8].

[8] Based on EU Flower optional points criteria (EC, 2009)

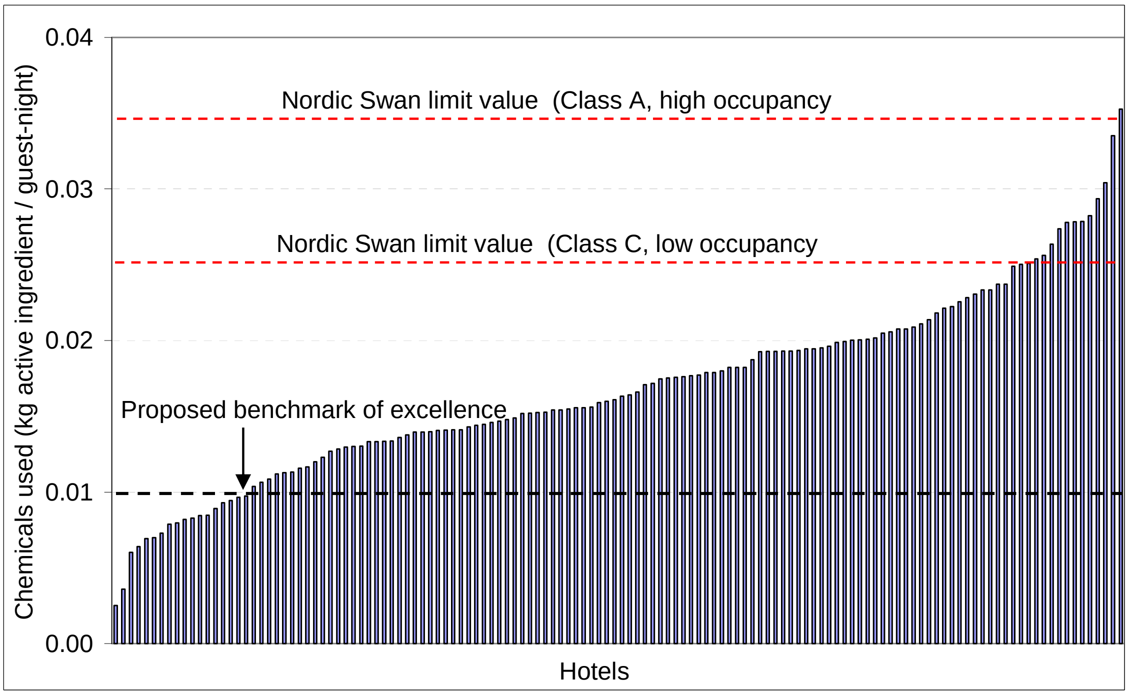

Figure 5.16: Specific consumption of active chemicals reported by a range of anonymous hotels, with Nordic Swan ecolabel limits and the proposed benchmark of excellence indicated

Cross-media effects

Care should be taken to ensure that environmental criteria used in green procurement of textile products reflect use phase impacts in addition to production impacts.

There are no significant cross-media effects for laundry minimisation, use of ecolabelled detergents, soaps and shampoos (cleaning effectiveness is accounted for in ecolabel criteria), or housekeeping measures to reduce energy consumption in rooms.

Espinoza et al. (2010) assume that microfibre mops must be washed after every room cleaned, resulting in seven times higher washing energy requirements than for conventional mops. However, the additional water, energy and chemical consumption for washing is less than the 95 % reduction in water and chemical consumption achieved during room cleaning by microfibre mops.

Operational data

Green procurement

Textiles may be rented out from laundry service providers (Carbon Trust, 2009). Where textiles are bought, it is important to have sufficient stock to cover peak service use whilst allowing sufficient out-of-service time for laundry operations. The life expectancy of most textiles is determined by the number of laundering cycles they are exposed to, but the useful lifetime of hotel towels is usually constrained by the rate they go missing and the rate of rejection due to permanent soiling (Kalliala and Nousiainen, 1999). It is essential that the correct specifications and quantities be purchased, and it is recommended to test textiles for compatibility with laundry processes prior to placing an order, and to retain at least three items unprocessed for nine months in case of quality problems arising (DTC LTC, 2011).

The lifecycle environmental performance of textiles is determined by: (i) production impacts; (ii) durability; (iii) servicing impacts (energy, water and chemical requirements for laundering). Table 5.15 summarises important features of textiles made from different fibres with respect to lifecycle environmental performance. Green procurement must also consider the dominant purchasing criteria of perceived quality and price. The perceived quality (appearance, density, size, softness and breathability) of bedclothes and towel textiles has become major marketing feature for hotels. Polyester bedclothes may not be acceptable from a perceived quality perspective for some hotels – despite their high durability and low servicing energy requirements. Meanwhile, linen bedclothes are expensive and less readily available than cotton and polyester bedclothes. Thus, cotton and cotton-polyester blends are the preferred options for accommodation establishments. Meanwhile, for towels, cotton is the preferred type of textile owing to its high absorbency and perceived quality.

The high environmental impacts of cotton and polyester can be considerably reduced by selecting organic cotton and recycled polyester (MADE-BY, 2011). The EU Flower for textile products may be used to select textiles with lower manufacturing impacts – criteria include: avoidance of harmful substances during manufacture, reduced water and air pollution during manufacture, shrink resistance during washing and drying, colour resistance to perspiration, washing, wet and dry rubbing and light exposure, no inorganic fibres, no harmful substances such as azo dyes and solvents (2009/567/EC: EC, 2009). Durability is a critical factor as it is directly related to the quantity of production for bedclothes. The energy consumption of 50/50 cotton-polyester over 100 laundering cycles is 42 % lower than for pure cotton sheets, owing to the durability of polyester (Kalliala and Nousiainen, 1999).

Above: Towels made from organic cotton in the Gavarni Hotel, Paris. The beige colour allows the towels to be washed at 30 ºC.

Taking into account the above considerations, the following is recommended as best practice for room textile selection:

- Towels: select organic cotton or ecolabelled cotton, and avoid excessive sizing. Consider non-white towels that can be washed at lower temperature.
- Bedclothes: select durable polyester-cotton blends or linen. Specify recycled polyester, organic or ecolabelled cotton and organic or ecolabelled linen.
- Carefully check product specifications and test products before buying in bulk.

Table 5.15: Summary of environmental performance of textiles made from different fibres during production and servicing, and perceived quality

	Production	Durability	Servicing	Perceived quality
Cotton	High impact. High water, pesticide, fertiliser consumption during cotton cultivation. Water pollution from processing (MADE-BY, 2011; Muthu et al., 2011).	Low durability. Vulnerable to damage when wet and at high temperature. Half the lifespan of polyester-cotton sheets (Kalliala and Nousiainen, 1999).	High energy requirements. Cotton absorbs a large amount of water and becomes wrinkled, so has high drying and ironing requirements.	High. Pure cotton is soft, absorbent and perceived as high quality – especially at high thread numbers (400 threads per square inch or more). Variable price, but high quality cotton is expensive.
Polyester	High impact. Non-renewable resource depletion, energy consumption and ecotoxicity impacts (MADE-BY, 2011; Muthu et al., 2011).	High durability. Strong fibres, resistant to distortion, but can become discoloured and more likely to become permanently stained.	Low energy requirements. Low water absorbtion and drying requirements. However, may require more chemicals to remove stains, and an extra cooling rinse to avoid creasing during spinning.	Low. Polyester does not absorb moisture well, can feel hard, and has low perceived quality. More sophisticated fiber production has improved the softness and feel of some new polyester fabrics. Inexpensive.
Linen (from flax)	Low impact. Less energy than polyester and cotton, less water than cotton, low ecotoxicity (MADE-BY, 2011; Muthu et al., 2011).	High durability. Strongest natural fibre, 2 – 3 times stronger than cotton, and excellent resistance to washing wear owing to high wet strength. Can become damaged along frequent crease lines (e.g. from repeated folding).	High energy requirements. Absorbs a lot of water, and can become creased, so requires careful ironing.	Very high. Linen is highly absorbant and breathable – especially well suited to warm conditions. It becomes softer with time. Relatively inexpensive.
Cotton-polyester	High impact – see above.	High durability. The lifetime of 50/50 cotton-polyester fabrics is twice as long as pure cotton fabrics in hotels (Kalliala and Nousiainen, 1999).	Relatively low energy requirements. 50/50 cotton-polyester fabrics require 20 % less laundering energy than pure cotton in hotels (Kalliala and Nousiainen, 1999).	High. Softness and perceived quality similar to pure cotton. Expensive.

Above: EU Flower ecolabelled cleaning detergent in the Gavarni Hotel, Paris.

Where possible, best practice is to avoid chemical use through use of microfibre cloths and mops. Cleaning products are one of the product groups in which ecolabels are most highly represented. ISO Type-1 ecolabels, such as the EU Flower, Nordic Swan and Blue Angel consider a range of lifecycle environmental impacts, including ecotoxicity and energy consumption, alongside cleaning effectiveness. Labelled products represent front-runners in terms of environmental and cleaning performance. ISO Type-1 ecolabels are therefore the best guide to green procurement.

Best practice for non-ecolabelled cleaning agents is based on Nordic Swan ecolabel criteria for accommodation (Nordic swan, 2007). Establishments must declare that 95 % of non-ecolabelled substances used:

- are not classified as environmentally dangerous according to Directive 99/45/EG;
- do not contain specified chemical constituents including alkylphenolethoxylates (APEO) and alkylphenol derivatives (APD), dialkyl dimethyl ammonium chloride (DADMAC), Linear alkylbenzene sulphonates (LAS), Reactive chlorine compounds (exemption if required by authorities for hygiene reasons);
- only contain surfactants that are readily biodegradable in accordance with method 301 A-F in OECD Guidelines for testing of chemicals.

Housekeeping operations include the replacement of toilet paper, complimentary soaps and shampoos, and food and drinks offered within the room (e.g. in 'mini-bar' refrigerators). As for cleaning chemicals, ecolabels are appropriate guides for green procurement of toilet paper and soaps and shampoos, as specified in Nordic Swan and EU Flower ecolabel criteria for accommodation (Nordic Swan, 2007; EC, 2009). The use of soap and shampoo dispensers instead of individually wrapped items is an important measure to avoid waste described in section 6.1. For food and drinks, a wide range of labels and certification standards are relevant depending on the product group (see section 8.1). The most extensive relevant standard is organic certification, indicated by various labels compliant with Commission regulation EC 889/2008.

Left: A sample of organic drinks and snacks contained within the room selection offered to guests in the Gavarni hotel, Paris.

Laundry minimisation.

There are three key points for successful implementation of towel and bedclothes reuse schemes:

- guests are provided with clear information and instruction
- adequately sized and easy to use towel rails are installed
- staff training.

Cards or notices to encourage guests to reuse sheets and towels should be placed in prominent locations in the room/bathroom and hotel information booklets. Important information to present on such cards or notices includes:

- the value of water and the need to conserve it
- the reduction in water use achievable through reuse
- a request for guests to help the establishment conserve water by reusing sheets and towels
- a brief but clear description of the procedure for reusing sheets and towels
- information on any environmental scheme funded by laundry savings.

Typically, guests are requested to indicate towel reuse by hanging towels on a towel rail in the bathroom, while sheet reuse may be indicated by not actively requesting a sheet change (Alliance for Water Efficiency, 2009).

The policy on bed linen changes varies across establishments. The most common changing regimes are for bedclothes to be changed once every day to every three days for longer-stay guests. One variation is to implement a 'top to bottom' change method in which the top sheet is reused as the bottom sheet and a fresh sheet used for the top-sheet (Travel Foundation, 2011).

One of the most important factors for success is the provision of adequate and easy to use towel rails for storing and drying towels between reuse (Alliance for Water Efficiency, 2009). These should be sized to accommodate towels once-folded, and positioned within easy reach of guests (average waist to shoulder height where space allows).

Towel and bedclothes reuse schemes are only as effective as the housekeeping staff implementing them. It is essential that staff are trained to follow the established procedures, so that if a guest hangs a towel on the rail for reuse it is not replaced by a fresh one. Good record keeping is essential, and daily checklists for each room should include changing dates for bedclothes.

Finally, guests are more likely to participate in reuse schemes when they believe it is motivated by environmental protection and not cost saving by the hotel. Reference to water, chemical and energy savings helps, but the best schemes invest laundry cost savings into environmental programmes – and clearly convey this to guests. For example, savings made by Accor's towel reuse programme are invested into the UN Environment Programme's 'Plant for the Planet' project. One tree is planted with the money saved from five towel reuses, and Accor has a target to fund three million tree plantings by 2012 (Accor, 2011).

<u>Low impact cleaning.</u>

In the first instance, best environmental management practice is for accommodation management to implement green procurement of microfibre cloths and mops, and ecolabelled or less harmful cleaning chemicals (above). Chemical use can be considerably reduced through staff training in chemical management and efficient cleaning techniques, and investment in chemical-free cleaning equipment. Staff training in chemical management should include health and safety and environmental criteria. A written list of all chemical products should be kept and updated on regular basis (at least yearly), and accommodation management should ensure that clear and easily understood instructions for staff regarding the dosage and handling of chemical products are readily accessible close to mains points of storage and uses. Safety data sheets should be available for all chemicals used in languages spoken by employees.

Staff training should be offered within the first month of service, and should be regularly updated. Large hotels such as The Savoy in London hold daily briefing sessions with staff in which issues such as chemical management are discussed. Particularly important aspects of housekeeping cleaning operations are: (i) the use of the correct cleaning products for different tasks; (ii) the use of correct dilution ratios; (iii) the use of efficient techniques that minimise water and chemical consumption.

- Toilets only need to be flushed once after leaving cleaning chemicals in contact with the bowl for sufficient time.
- Whilst it is more efficient to purchase cleaning chemicals in concentrated form, if these are not diluted as per instructions they will be over-consumed and/or ineffective. Ideally, an automatic dosing system should be installed. Otherwise, in addition to training and signage, clear marking of fill levels on spray bottles can reduce the incidence of incorrect dilution. Dilution volumes should be adjusted for water hardness.
- Correctly diluted cleaning agents should be applied directly to the surface and left as necessary before rinsing off with a cloth rinsed in clean water. Taps should not be left running during cleaning.
- The use of fragrances should be avoided where possible, e.g. rooms should not be routinely sprayed with air freshners.
- Staff in the Gavarni Hotel in Paris regularly apply an ecolabelled deblocker to toilets that uses enzymes to prevent blockages, avoiding the need for periodic deblocking with strong, environmentally damaging chemicals.

The monitoring of chemical use and record keeping are important components of good chemical management. EU Flower ecolabel criteria for accommodation require establishments to submit a declaration detailing all ecolabelled and non-ecolabelled active substances delivered, measured in kg. Figure 5.17 provides an example of monthly reporting on chemical use. Best practice includes management intervention to:

- audit the consumption of and access to consumables, chemicals and hazardous materials in housekeeping operations;
- prepare an action plan with measurable, scheduled targets to reduce material and chemical consumption and to integrate environmental considerations into purchasing procedures;
- assign resources, appoint responsibility and provide training to ensure correct implementation of the action plan;
- record the type and quantity of all chemical purchases, and indicate whether they are ecolabelled.

Housekeeping is an important control point for waste management, particularly with respect to waste sorting and recycling. This is described in more detail in section 6.2, but the main points are summarised here:

- use room bins that do not require a plastic bag liner
- separate waste from guest rooms into fractions sent for recyclable fractions.

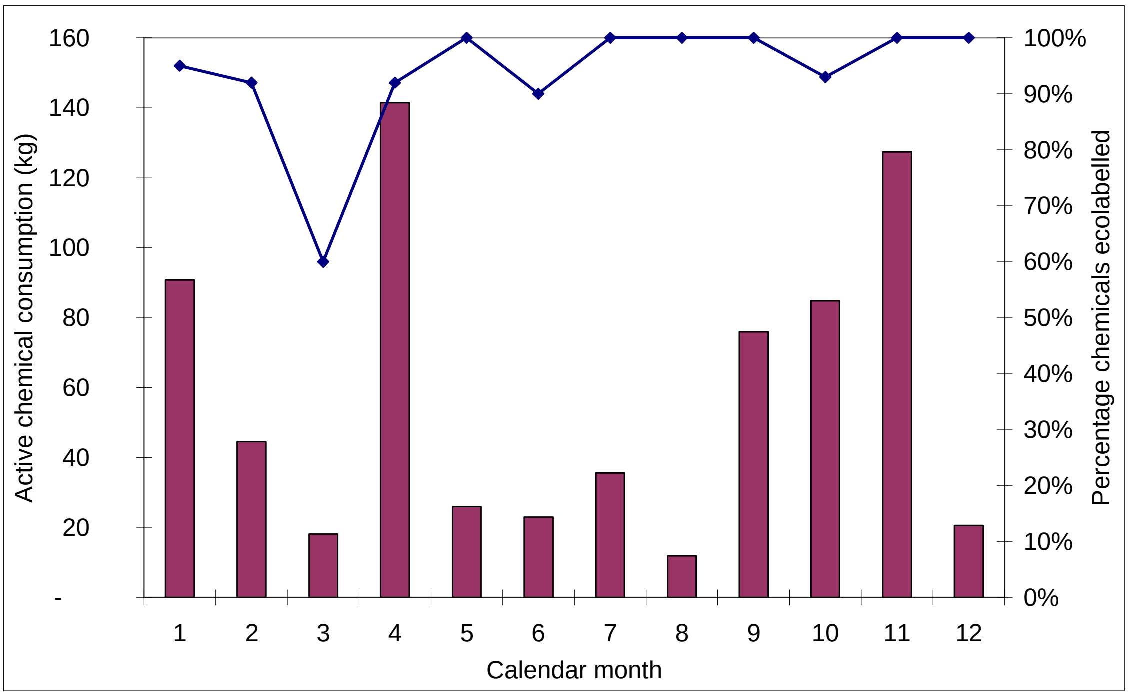

Figure 5.17: An example of monthly chemical consumption, measured as kg active ingredient, and the percentage of those chemicals that are ecolabelled, for a 160 room hotel (average consumption 0.013 kg per guest-night in 2010)

<u>Energy management and maintenance.</u>
Housekeeping staff are responsible for room condition on a day-to-day basis, and constitute a key control point for energy management and maintenance. Continuous staff training and clear reporting procedures are essential. The following key check points are relevant:

- turn off unnecessary equipment in guest rooms, including lights, TVs on standby, air conditioning and heaters;
- where it is policy to leave heaters or air-conditioners on for guest arrival (and in the absence of a building management system: section 7.1), housekeeping staff should adjust these to an appropriate temperature, i.e.:

- ◦ 26 ºC when cooling
- ◦ 18 ºC when heating
- check for poorly fitting doors, windows, any draughts etc., and report to maintenance;
- check for malfunctioning toilets, excessive water flow, leaking plugs (see section 5.1).

Applicability

Efficient cleaning, use of ecolabelled detergents, soaps and shampoos, green procurement of textiles, and housekeeping measures to reduce energy consumption are applicable in all serviced accommodation enterprises.

Towel and bedclothes reuse programmes to reduce laundry are applicable in all serviced accommodation establishments, but will achieve small savings where a high proportion of guests stay only one night (e.g. motels and airport hotels).

Economics

Green procurement

Consider the lifecycle cost of textiles, accounting for durability and washing requirements. Cotton-polyester sheets last approximately 200 laundry cycles, compared with 100 for pure cotton sheets. Annual laundry costs can be calculated using the following equation:

$C_A = (C_P/(150/D_N) + 150 \times C_L$	
C_A	Annual cost (EUR)
C_P	Purchase cost (EUR)
150	Estimated number of washes per item per year
D_N	Durability expressed in number of washes
C_L	Laundering cost (EUR per wash)

Laundry consumable costs vary widely depending on, in particular, the efficiency of laundry processes, chemical prices (type of chemicals used) and energy prices (related to energy source) – see Figure 5.22 in section 5.4. Nonetheless, laundry costs dominate annual servicing costs for sheets (Table 5.16). Purchasing a EUR 5 cotton-polyester sheet instead of a EUR 5 cotton sheet can save EUR 6 over a year through durability and reduced drying energy. For a EUR 10 sheet, this saving would increase to EUR 9.75.

Table 5.16: Annual purchase and laundering costs for cotton-polyester and cotton sheets bought for EUR 5 each

	Purchase	Laundering	Total
	Annual cost (EUR)		
Cotton-polyester	3.75	35.25	39.00
Cotton	7.50	37.50	45.00

Green procurement of organic or ecolabelled cotton towels incurs a variable price premium, typically in the region of 20 %. The useful lifetime of cotton towels is typically around 50 laundry cycles, but cotton towels cost about half the price of sheets, and laundry costs still dominate lifecycle costs. Laundry and purchase cost savings achieved by downsizing from excessively large towels could easily cover the price premium of organic or ecolabelled towels.

Green procurement of chemicals also incurs a price premium, but this is relatively small compared with other costs such as labour, and can be more than offset by training staff in efficient cleaning methods.

Laundry reductions

Laundry volumes per room vary according to bed size, towel size, textile density, and number of items provided per room – often in relation to accommodation rating. Accor (2007) refer to 4 kg per room night, O'Neill et al. (2002) refer to values of between 2.4 and 5.8 kg per room night in the US. Annual room textile laundering costs can be calculated from the following equation:

$C_A = (100/O) \times V_L \times C_L \times D_N$		
C_A	Annual cost per room	EUR/yr/room
O	Average annual occupancy rate	%
V_L	Laundry volume	kg
C_L	Laundry cost	EUR/kg
D_N	Number of days open per year	Days/yr

For a room with 75 % occupancy and 4 kg of laundry per room night open year around, and at a laundry service cost of EUR 0.50 per kg, annual laundry costs would equate to EUR 479. Thus laundry costs for a 100-room hotel could be EUR 47 900 per year, and a textile reuse rate of just 5 % could save almost EUR 2 400 per year.

A small 14-room hotel in the UK saved EUR 700 per year following the introduction of a simple linen reuse policy (Envirowise, 2008).

To encourage guest participation in reuse programmes, savings may be invested in environmental programmes (e.g. Accor 'Plant for the Planet' funding), or in onsite environmental initiatives.

Energy management

Simple measures to reduce energy use during housekeeping can save significant amounts of money, especially in relation to temperature regulation. In the absence of a building management system, reducing thermostat temperature by just 1 ºC can reduce heating energy consumption by up to 10 %, whilst closing shutters and curtains in summer can significantly reduce the demand on air conditioning systems (see section 7.3).

Efficient cleaning

Efficient cleaning techniques reduce chemical and water costs. For example, one less toilet flush every time a room is cleaned in a 100-room hotel could save EUR 330 per year, at a water price of EUR 2.00 per litre.

Despite significantly higher upfront costs for microfibre compared with conventional mops (EUR 2.72 compared with EUR 0.33 per 100 rooms cleaned), and higher washing costs (EUR 23.52 compared with EUR 3.92 per 100 rooms cleaned), the lifecycle cost of cleaning using microfibre mops is 5 % lower than conventional mops owing to 95 % chemical and water savings and 10 % labour savings (Espinozal et al., 2010).

Through substitution of cleaning chemicals in laundry and housekeeping operations, a small 14-room hotel in the UK was able to save EUR 1 700 per year (Envirowise, 2008).

Driving force for implementation

Efficient housekeeping measures, such as staff training in efficient and chemical-free cleaning and energy management, can achieve significant cost reductions with small investment costs.

Similarly, towel and bedclothes reuse programmes can be driven by economic factors, although where savings are reinvested into other environmental programmes CSR and image may be more important.

Green procurement of durable bedclothes with lower lifecycle servicing costs is driven by economic factors, but green procurement of organic or ecolabelled textiles is driven by CSR and marketing – ecolabelled products are a highly visible indication of environmental responsibility that can add value to the service offer.

Reference organisations

Accor, Gavarni Hotel Paris, Strattons Hotel UK, EU Flower and Nordic Swan ecolabelled hotels (e.g. Best Western and Scandic hotels).

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5.4 Optimised small-scale laundry operations

Description

Water consumption

Accommodation providers generate a considerable amount of laundry (section 5.3), comprising bed sheets, pillow cases, duvet covers, towels, tablecloths and napkins, and staff uniforms. The latter items are also common to eateries. The provision of clean, crease-free bedclothes is a particularly important quality control point for accommodation establishments: unclean or creased bedclothes can give guests an instant bad impression. Effective and professional laundry operations are therefore a priority, and may be performed on site or off site by subcontracted commercial laundries. It is common for hotels to launder towels and smaller items on site, whilst outsourcing the laundering of sheets to commercial laundries that have the large-scale specialist equipment (e.g. continuous batch washers and roller irons) to deal with such items efficiently whilst guaranteeing a high-quality, crease-free finish (section 5.5). This technique refers to laundry operations located on accommodation premises, whilst the next technique (section 5.5) deals with large-scale (processing over 250 kg textiles per hour) on-site and commercial laundry operations using highly automated systems and continuous batch washers.

Within the accommodation subsector, daily laundering of bed linen and towels weighing in the region of 2.5 kg to 6 kg per room[9] can consume up to 100 litres of water – considerably more than half the total water consumption of a best practice hotel (see Figure 5.3 in section 5). Laundry operations represent the second greatest potential for water saving within a hotel, and also represent considerable potential for savings in energy and chemical consumption. High-temperature washing, tumble drying, multi-roll ironing and garment tunnel finishing are energy-intensive laundry processes. For the washing phase, water efficiency is closely related to energy efficiency: lower water consumption means lower water heating requirements.

Table 5.17 provides an overview of best practice measures to minimise water (and energy) use in laundries. In the first instance, laundry volumes should be minimised through efficient housekeeping (section 5.3). Then, accommodation managers must decide whether to outsource laundry services or perform laundry operations onsite (best practice for large-scale onsite and commercial laundry operations is described in section 5.5). Efficient washing processes are based on optimisation of the following four factors in relation to the washing requirements of specific wash loads, through equipment selection and programming:

- mechanical action
- chemical action
- temperature
- time.

Equipment selection

Accommodation SME, such as B&Bs, may use domestic machines, while small laundries use washer extractors of similar design to domestic machines but more robust and sometimes containing programmable micro-processor controls. These machines comprise a rotating drum that generates mechanical action and applies a high gravitational spin to extract water and detergent from the laundry following washing and rinsing. Front-loading machines, with doors on the front rather than on top, apply a full rotation around a horizontal axis, generating a laundry free-fall motion that maximises efficient flow-through and compression whilst minimising abrasive rubbing (EC, 2007). Front-loading machines use up to 60 % less water than top-loading machines (Smith et al., 2009), but nonetheless can consume up three times more water and two times more energy than a continuous batch washer used in large laundries – hence large laundries are described in a separate technique (section 5.5).

[9] Accor (2007) refer to 4 kg per room per night, O'Neill et al. (2002) refer to median laundry of 5.4 kg per room per night from a US study, ranging from 2.4 to 5.8 kg per room per night

The selection of efficient equipment is one of the most important measures to save water and energy in laundry operations. Average specific water consumption in domestic washing machines decreased from 13.9 L per kg of laundry in 1997 to 9.6 L per kg in 2005, and average energy consumption now stands at 0.17 kWh/kg laundry (AEA, 2009). However, there is considerable variation in water efficiency across models. A UK survey of new domestic washing machines found that optimum-rated water consumption varied from 6.2 to 11.8 litres of water per kg cotton laundry across models with 5 kg capacity (Which, 2011). For domestic machines, the EU Energy label provides a useful indication of energy- and water-efficiency.

<u>Efficient batch management</u>

Washing machines are more efficient at full capacity than partial capacity, even when a half-load programme is used. Washing can be optimised by:

- separating laundry into batches depending on washing and drying requirements;
- fully loading washing machines with these batches;
- storing rinse water and reusing to prewash the next load;
- selecting the appropriate programme settings (especially timing and temperature) to minimise water and energy consumption;
- appropriate dosing of a detergent that enables effective cleaning at low washing temperatures.

<u>Drying and finishing</u>

Forced thermal drying of laundry is a particularly energy-intensive process that uses up to 1.4 kWh/kg textiles in large laundries (see Figure 5.24 in section 5.5). Small laundries dry products in tumble-dryers that use considerable amounts of gas or electricity to evaporate water. Combined washer-dryers also use a continuous flow of water to condense moisture, which can increase total water use to over 170 L per 5 kg load (UK Environment Agency, 2007). In small laundries, large flatwork such as sheets are typically finished on a single roll ironer that passes tensioned flatwork under a rotating roller heated by electricity or gas. Roller ironers simultaneously dry damp flatwork that has undergone mechanical extraction (e.g. a high speed spin in a washer extractor). A range of hand finishing equipment may also be used, including free steam-ironing tables, and automatic finisher for shaped garments.

Small accommodation premises may be able to naturally dry clothes, at least for some of the year, saving a considerable amount of energy. However, for most accommodation establishments, this is not practical, and best practice involves minimisation of energy required for forced thermal drying. As indicated in Table 5.17, energy required for laundry drying can be minimised by: (i) maximising mechanical drying by, for example, selecting washing machines able to generate high a g-force spin (350 g for domestic machines, over 1 000 g for commercial machines); (ii) selecting and correctly maintaining an efficient dryer; (iii) optimising the drying-ironing process to prevent excessive drying.

Finally, there are a number of opportunities for water reuse, and heat recovery from wastewater and dryers, that may be exploited to improve the efficiency of laundry operations.

Table 5.17: Portfolio of best practice measures for small-scale laundry operations

Stage	Measure	Description
Housekeep-ing	Reduce volume of laundry generated	– Encourage guests to reuse towels and bed linen (section 5.3). Minimise use of tablecloths and napkins in restaurants.
Washing	Purchase efficient washing machines	– Purchase the most efficient front-loading washing machines (e.g. 'A+++' EU energy rating for domestic machines, or efficient microprocessor-controlled, variable motor speed commercial machines).
	Load optimisation	– Install stepped capacity machines to cope with different loads. Separate laundry into batches based on washing requirements (e.g. textile type and degree of soiling), and wash batches at full machine capacity. Optimise temperature and detergent dosing.
	Wash programme optimisation	– Match wash programme to textile type and degree of soiling. Use low temperature wash and efficient detergents. Use single-step wash with two rinses, and calibrate micro-processor water-level control where necessary.
	Water recycling	– Recover and store rinse water, and possibly wash water following microfiltration, and use for wash or prewash step.
	Heat recovery	– Recover heat from wastewater, and if possible also from tumble dryer exhaust, to heat incoming fresh water.
	Green procurement of detergent and efficient dosing	– Avoid hypochlorite and use ecolabelled detergents. Match detergent dosing to recommendations and laundry batch requirements. Optimise with machine cycle. Soften hard water.
Drying	Purchase efficient equipment	– Purchased washing machines can achieve high g-force spin cycles (350 – 1 000 g depending on size) to minimise thermal drying requirements. Avoid flow-through water-condensing dryers. – Purchase heat-pump or gas-fired dryers.
	Optimise laundry cycle	– Optimise drying time in relation to target moisture content – use moisture sensors.
Ironing and finishing	Minimise ironing energy use	– Use an efficient roller ironer. Where relevant, use condensate from HVAC systems in steam irons. Aim for final textile moisture content in equilibrium with atmospheric conditions.
	Minimise chemical use for finishing	– Avoid or minimise use of water and dirt repellent chemicals.
Entire process	Optimisation through water and heat recovery, and maintenance	– Optimise the entire laundry process. Recover heat from dryer and wastewater to heat incoming freshwater. Send staff on specialist training courses and seek expert advice.

Achieved environmental benefit

Washing process

Careful control of water levels in washer extractors (damped dip tube connected to a micro-processor control unit) can reduce water and energy consumption by 30 % (Carbon Trust, 2009). Reusing rinse water in washer-extractor machines can reduce water consumption by between 30 % and 40 %, heating energy consumption by up to 45 %, and detergent consumption by up to 30 % (EC, 2007; Smith et al., 2009).

The use of lower temperature washing, in combination with effective low-temperature detergents, can reduce washing energy consumption considerably. For example, reducing the temperature of the main wash from 60 °C to 40 °C can reduce electricity consumption by 0.7 kWh per wash for a 10 kg load, equivalent to 40 % of average specific energy consumption (assuming 3 L of water per kg textiles in the main wash).

Figure 5.18 presents the magnitude of water and energy savings achievable for the washing process. For a small 10-room hotel, the purchase of an efficient washing machine using 7 L water per kg laundry instead of the European average of 9.6 L/kg, and washing predominantly at 40 ºC instead of 60 ºC, could reduce water consumption by 14 m^3 and energy consumption by 383 kWh per annum. For a large hotel of 100 rooms, installation of rinse water recirculation alongside efficient machines and a default wash temperature of 40 ºC could save 252 m^3 of water and 5 475 kWh of energy per annum.

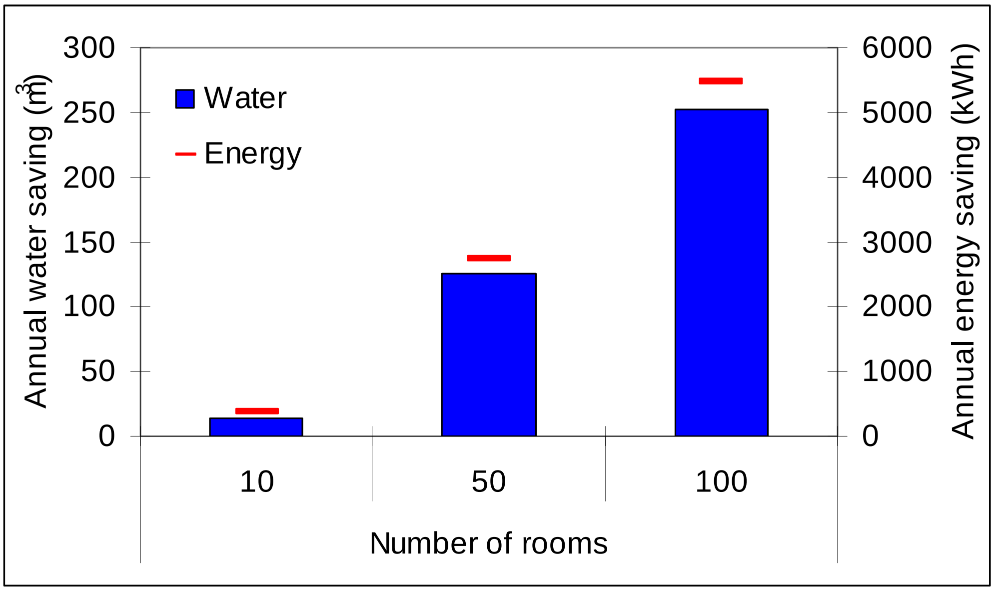

Figure 5.18: Annual water and energy savings achievable for the washing process in different sizes of establishment (assuming 75 % occupancy and on average 2 kg laundry per occupied room per night)

Drying and finishing processes

Heat-pump driers and gas-fired driers can each reduce primary energy consumption for tumble drying by around 45 %, compared with standard electric tumble driers (Bosch, 2011; Miele, 2010; Miele Professional, 2011). Optimal use of efficient roller ironers can reduce ironing energy consumption by a similar percentage. Figure 5.19 indicates the magnitude of energy savings achievable through implementation of best practice for different sizes of establishment, based on the same assumptions as those applied in Figure 5.18, and that half of the laundry is dried in driers, whilst the other half (sheets) is dried in flat bed ironers.

On a laundry weight basis, drying and ironing are associated with energy savings twice as high as for washing. However, given that drying is divided between tumble drying and ironing for different laundry groups, the magnitude of energy savings achievable for each of the three laundry processes is similar – e.g. for a 100-room hotel, energy consumption for washing, tumble-drying and ironing can typically be reduced by 5 475, 5 475 and 6 023 kWh/yr, respectively, leading to a total laundry energy saving of 16 973 kWh/yr.

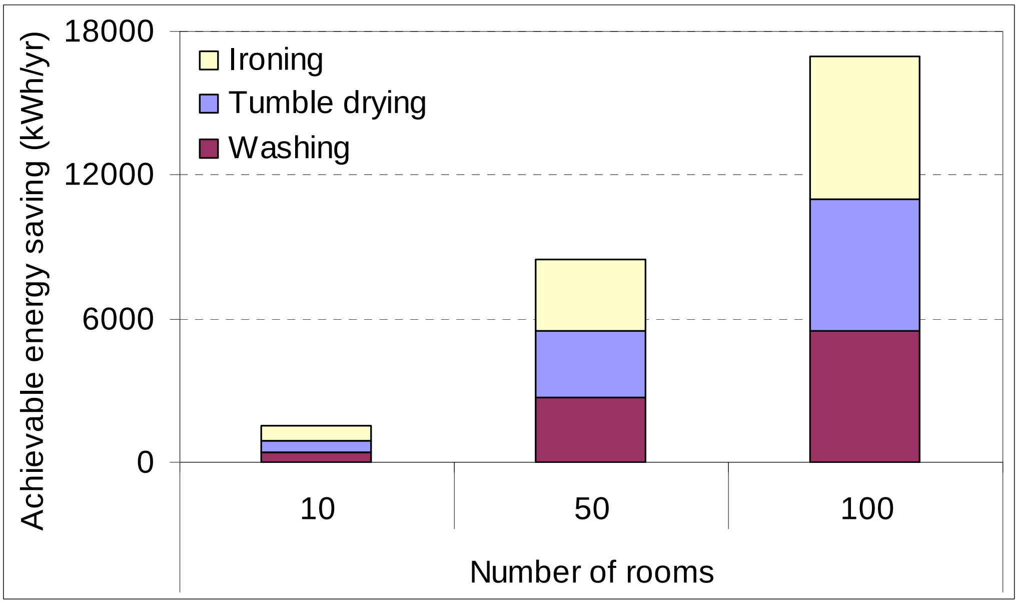

Figure 5.19: Energy savings achievable from the implementation of best practice washing, drying and ironing for different sizes of establishment

Appropriate environmental indicator

Appropriate indicators

The European energy label (EC, 2010) requires manufacturers of domestic washing machines to display on clear labels total annual machine energy and water consumption based on the following use pattern:

- 220 washes per year
- 3/7 of which are at full load and 60 °C cotton programme
- 2/4 of which are at half-load and 60 °C cotton programme
- 2/4 of which are at half-load and 40 °C cotton programme.

Power consumption during 'standby' and 'on' modes is included in calculations, and lower percentage loading rates are assumed for larger machines. Based on these data, machines are awarded energy ratings of A^{+++} (most efficient) to G (least efficient). For example, one A^{+++} rated machine[10] with a load capacity of 8 kg uses 11 880 L of water and 182 kWh of electricity per year over 220 wash cycles according to EU energy label calculations, approximating to specific consumption of 9.4 L and 0.145 kWh per kg washing. EU energy ratings are strongly related, but not directly proportionate, to specific energy and water consumption across different domestic machine sizes. Specific energy and water consumption figures approximated from EU energy labelling are higher than what is achievable under optimum operating conditions – tourism enterprises may be expected to operate washing machines more efficiently under higher average load rates compared with an average domestic situation.

In addition, the Energy label grades machines according to their spin drying efficiency, with classes A-G based on the weighted average percentage moisture remaining following the above ratios of wash cycles. An 'A' rating represents ≤45 % moisture, a 'G' rating ≥90 % moisture. Table 5.18 lists appropriate indicators and possible benchmarks of best practice for on-site laundry processes.

[10] Miele W5000 WPS Supertronic Washing Machine: http://www.miele.co.uk/washing-machines/w5000/w5000wpssupertronic-393/

Table 5.18: Indicators and benchmarks (BM) of best practice for water, energy and chemical use efficiency in laundry processes

Aspect	Indicators and benchmarks
Water	– EU energy rating for domestic machines (BM: 'A^{+++}') – Optimisation of water level and programming in commercial machines – Installation of rinse-water recycling system – Water consumption (L) per kg laundry washed for commercial machines (BM: ≤7 L per kg textile)
Energy	– EU energy label rating for domestic washing machines (BM: 'A^{+++}') – EU energy label spin dry rating for domestic washing machines (BM: 'A') – Moisture content of textiles following spinning (BM: ≤45 %) – Energy consumption (kWh) for: (i) washing; (ii) drying; (iii) the entire process (BM: 2.0 kWh per kg textile) – Implementation of natural drying of laundry where possible – Installation of heat-pump or gas-fired tumble-dryers – Implementation of heat recovery
Chemical use	– Average weight (grams) of **active ingredient** used per kg laundry – Average critical dilution volume of chemicals used per kg laundry – Implementation of automatic dosing – Percentage of chemicals used that are ecolabelled (BM: ≥80 %)

Benchmarks of excellence

Water and energy efficiency are closely related for washing machines. Hohenstein Institute (2010) report that state-of-the-art water efficiency for washer-extractors has improved considerably since 1995, and over the five years from 2005 to 2010 stood at 8 L per kg textiles. This could be further reduced through collection and recycling of rinse water. Carbon Trust (2009) report that small commercial laundries and on-premises laundries processing fewer than 100 000 pieces per week consume 2.0 to 2.9 kWh per kg textiles (total consumption, including for non-laundry processes such as lighting). The following benchmarks of excellence are proposed for small-scale laundry processes.

BM: laundry is outsourced to efficient commercial laundry service providers complying with benchmarks specified in section 5.5.

BM: all new domestic washing machines have an EU energy label rating of 'A^{+++}', or average annual laundry water consumption ≤7 L per kg laundry washed in laundries with commercial machines.

BM: total laundry process energy consumption ≤2.0 kWh per kg textile, for dried and finished laundry products.

BM: at least 80 % by active-ingredient-weight of laundry detergent shall have been awarded an ISO Type I ecolabel (e.g. Nordic Swan, EU Flower).

Cross-media effects

Optimising laundry operations reduces water and energy use, and can also reduce chemical use. The higher resource consumption required to manufacture detergents containing enzymes is small compared with energy savings that can be realised by the use of such detergents through effective cleaning at lower temperatures (Henkel, 2009).

In terms of replacing older machines, approximately 90 % of the lifecycle impact of white goods is due to operation compared with 10 % due to manufacture and disposal, and it can be more environmentally responsible to replace an older machine with a more efficient one rather than have it repaired (Environment Agency, 2007).

There may be some trade-off between hygiene and environmental objectives in relation to temperature settings. The minimum temperature compatible with hygiene requirements should also be sought.

Operational data

Washing machine selection

When installing new washing machines, the first factor to establish is the required total capacity. The maximum total required washing machine capacity can be calculated from the following equation:

$C = (\sum(M_{1-n} / R_{1-n}) \times T_{w1-n}) / T_L$	
C	Maximum total machine capacity in L
M_{1-n}	Maximum mass of laundry expressed as kg per day
R	Load ratio (see Table 5.19)
T_w	Wash cycle time for batches 1 to n expressed as hours
T_L	Time allocated for laundry washing expressed as hours per day

The mass of different items (towels, sheets, duvet covers) can be taken from known specifications or measured directly, and multiplied up to calculate total mass per batch according to room changing rates (see section 5.3). Note that T_L can also be expressed as the number of hours dedicated to laundry over a number of days where peak loads occur on particular days (e.g. weekend changes) and can be worked through during subsequent days.

Once the maximum total machine capacity requirement has been calculated, the machine combination to achieve this volume can be defined. Where workloads are variable, for example across seasons, a modular approach enables a higher frequency of optimised loading. For example, Picafort Pallace in Mallorca has a maximum laundry volume of 700 kg per day that varies considerably over the year. Mab Hoestelero (2004) reported the following optimised solution capable of 650 kg washing per day with two operators working seven hours:

- one 55 kg washer-extractor
- one 22 kg washer-extractor
- one 12 kg washer-extractor.

The above 'stepped' capacities create a range of combined wash capacities depending on the combination of machines in operation, i.e. 12, 22, 34, 55, 67, 77 or 89 kg. This maximises the opportunity for optimised loading of the machines in operation. It is worth noting that large drums offer greater mechanical cleaning owing to a higher drop height and consequent compression effect (EC, 2007).

Once the required machine capacities have been decided, specific models may be selected. Durability and reliability are important factors for hospitality use. Once these criteria have been met (e.g. through testimonials of other hospitality users), energy and water efficiency are key criteria for both environmental and lifecycle economic performance. As mentioned under 'Appropriate environmental indicators', the EU energy label provides a useful guide for the energy and water efficiency of domestic machines. For commercial machines, the optimum efficiency may be calculated from technical specifications, though these will not be directly comparable with EU energy ratings that assume sub-optimal average use characteristics. The incorporation of micro-processor controls, variable speed drives, damped dip tubes (to measure water level), and integral load weighting system are important features that can be specified on new commercial machines or retrofitted to enable accurate adjustment of water levels, chemical dosing and wash programmes.

Another important factor to consider when selecting washer-extractors is the maximum gravitational (g-) force generated during the spin cycle, as this determines the mechanical drying capacity of the machine. Many washing machine manufacturers quote spin speed in revolutions per minute (rpm). G-force is a function of both drum diameter and spin speed:

$g = 0.56 \times D\ (n/1000)^2$	
D	Diameter of the wash drum in mm
n	rpm for the spin cycle

Therefore, at a given spin speed, the g-force is proportional to drum diameter. Modern large washer-extractors are able to generate up to 1 000 g (Hohenstein Institute, 2010). The option of different spin speeds is also important so that a lower spin speed can be selected for delicate fabrics.

Laundry installation

Figure 5.20 provides an example of an optimised laundry configuration. Water from the final rinse may be reused either in the prewash, the main wash, or the first rinse of the subsequent load. Rinse water from earlier rinses may be used in the prewash or the main wash of the subsequent load, in which case detergents will be carried over and dosing can be reduced accordingly (by up to 30 %: EC, 2007). Water tanks are easily retofittable and may be installed on top of washer-extractors, or anywhere nearby. The installation of pipework from the machine to the water tank, and modification of machine wash programmes to manage water recycling (operation of correct input and output valves depending on the cycle position) are straightforward. Meanwhile, the installation of a simple heat exchanger can recover heat from prewash and main wash wastewater. Microfiltration of wastewater can be introduced at the heat recovery point as shown in Figure 5.20, enabling further water recovery and up to an 80 % reduction in freshwater consumption (EC, 2007). For heat recovery, the EC (2007) recommend corrugated pipe heat exchangers owing to their efficiency, robustness and tolerance of soiled water. The following check criteria are important to optimise heat exchange performance:

- the flow directions are connected in countercurrent direction
- there are turbulences in the liquids
- there is a large heat transfer surface
- the mass flow and the temperature differences in both directions are the same
- as much time as possible is provided for the heat exchange.

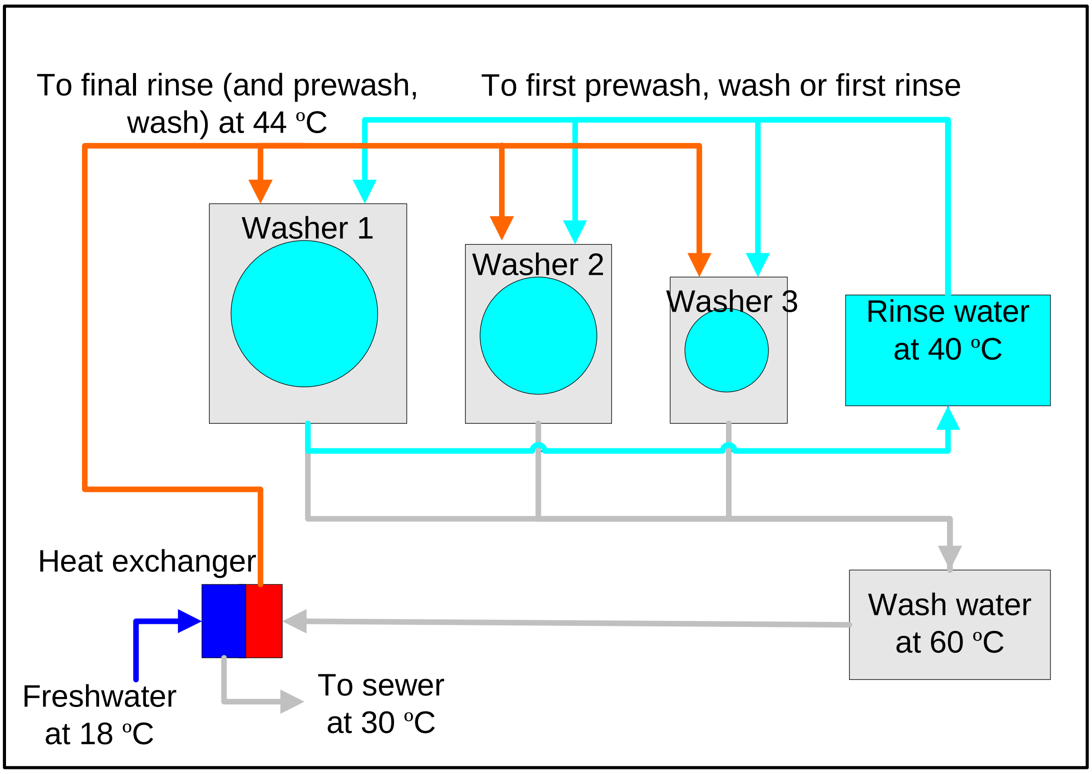

Figure 5.20: Schematic example of an optimised small-scale laundry washing process, with rinse water reuse and heat recovery from wastewater (based on information in EC, 2007)

Batch management

In a typical accommodation establishment, laundry comprises: (i) towels and bath mats; (ii) sheets and other bedclothes; (iii) tablecloths and napkins; (v) garments. Incoming laundry should be separated into batches according to washing and drying requirements. Towels and bath mats should be separated from bed linen, and these batches further divided depending on the degree of soiling (Table 5.20) and thus required cleaning intensity. For example, tableclothes and napkins are likely to require more intensive washing to remove fats, oils and greases. It may be more efficient for housekeeping to sort laundry at source, and send to the laundry room in separated batches. It is common for accommodation providers to outsource the laundering of bedclothes to commercial laundries that have the equipment to efficiently provide a high-quality, crease-free finish to sheets, duvet covers and pillow cases.

The rated load capacity of most washer-extractors is based on a standard material weight to drum volume ratio of 1:10. However, to ensure proper washing, load factors and consequently load volumes should be adjusted according to the type of textile and degree of soiling (Table 5.19). Reducing the rotational speed of the wash cycle in variable speed extractors for polyester cotton can reduce creasing and enable higher load rates (Carbon Trust, 2009). In order to load machines correctly, it is necessary to define various types of full load in terms of number of towels or sheets, etc, based on sampling of laundry item weights (Table 5.19). Underloading reduces efficiency in proportion to load, because the same quantity of water, energy and detergent is used, and half-load programmes are less efficient. Overloading also reduces efficiency because mechanical and chemical action is impeded by textiles being bundled closely together, and items may require re-washing.

Table 5.19: Load ratios for different textiles with light and heavy soiling, and example number of items that can be washed in a 100 L (10 kg rated capacity) machine

Material	Soiling	Load ratio	kgs full load (examples)
Cotton	Light	1:12	8.3 (16 towels)
	Heavy	1:12.5	8.0 (16 towels)
Polyester-cotton (linen)	Light	1:15	6.7 (8 sheets)
	Heavy	1:17	5.9 (7 sheets)
Duvet quilts (internal)	Light	1:20	5.0 (3 duvets)
	Heavy	1:22	4.5 (2 duvets)
Mops		1:9.5	10.5 (35 mop heads)
NB: Assumes 0.5 kg per cotton towel, 0.8 kg per polyester-cotton sheet, 1.6 kg per duvet (2 m x 2 m), 0.3 kg per mop head. *Source:* Laundry and Dishwasher Info. (2011).			

Chemical dosing

Chemical dosing should be matched to the size and cleaning requirements (Table 5.20) of different loads. Excessive dosing not only wastes detergent, but can increase rinse requirements. Heavily soiled laundry can be pre-dosed or 'spotted' with strong detergents, for example containing hydrogen peroxide, and/or sent to more intensive wash cycles. For the main wash, the use of low-temperature detergents, especially biological detergents containing enzymes, is associated with a number of advantages:

- reduced energy costs
- possible reduced rinsing requirements
- reduced risk of colour run
- increased fabric longevity (lower fade rate).

Where low temperatures are used, chemical disinfection is recommended, using hydrogen peroxide or peracetic acid (Hohenstein Institute, 2010). Large commercial washing machines have built-in programmable chemical dosing. Automatic chemical dosing units can be easily retrofitted to smaller wash-extractor machines, and enable more accurate control of detergent and conditioner quantity and timing. Automatic dosing pumps can be programmed for different settings according to different wash load requirements: for example, low, medium and high soiling. It is important to periodically check the calibration of the auto dosing pumps.

Table 5.20: Typical degree of soiling for hospitality laundry

Light soiling	Medium soiling	Heavy soiling
– Bed sheets, bedclothes, towels – Cloth hand towels	– Service staff clothes – Tableclothes, napkins – Mops and mats	– Kitchen and technical staff clothes – Clothes, dish towels, etc.
Source: Nordic Swan (2009).		

Programme setting

Table 5.21 summarises the main processes performed by washer-extractor machines. Washing machines are programmed to vary the intensity of the mechanical action, the time and the temperature of the wash cycle. For example, programmes for delicate fabrics apply: (i) a higher water fill-level in order to reduce the drop-height and associated mechanical action of front-loader extractors; (ii) a shorter wash time (e.g. 5 – 10 minutes at wash temperature) and fewer rotations per minute to reduce mechanical action; (iii) lower temperature; (iv) lower detergent concentrations (Laundry and dishwasher info, 2011). Such programmes use more water and energy, and should only be used for genuinely delicate fabrics – they can usually be avoided for hospitality laundry.

For lightly soiled hospitality laundry, a single-stepped wash with two rinses and inter-extracts (spins) is sufficient, saving up to 30 % water and energy compared with a standard two wash and three rinse process (DTC LTC, 2011).

Table 5.21: Main stages of the washing and drying process performed by washer-extractors

Stage	Functions	Conditions	Time	Chemicals
Prewash	Rapid wetting Swelling of soil Removal of heavy soil Dissolving and swelling of spots	20 – 25 ºC (blood) 50 – 60 ºC (fat, oil)	8 – 12 minutes	50 – 70 % detergent dose
Main wash	Removal of soil Dissolving and swelling of spots	30 – 90 ºC	10 – 15 minutes	30 – 50 % detergent dose
Rinse	Removal of soil residues Removal of detergent residues (surfactants, alkali and bleaching agents)	25 – 60 ºC	8 – 12 minutes	
Neutralisation	Reduction of textile pH to 6.0-6.5, in order to prevent discolouring during ironing	20 – 25 ºC	2 – 4 minutes	Formic or acetic acid
Spinning	Mechanical dewatering	Up to 600 g	5 – 10 minutes	
Source: EC (2007).				

Modern washer-extractors are controlled by micro-processors connected to sensors that control the water level (the 'dip') in the drum at all stages of the washing cycle. Carbon Trust (2009) recommend that water levels be adjusted (by trial and error if necessary) to the following:

- prewash dip of 125 mm
- wash dip of 75 mm
- rinse dip as low as possible without leading to yellowing of textile following drying.

Some detergents contain brighteners that only become activated above 60 ºC. Constant low temperature washing can lead to blockages in machines and pipes from the accumulation of unused detergent agents. Periodic high temperature washes, and the avoidance of detergents with brighteners, can prevent this problem. Thermal washing at 60 ºC for two minutes disinfects laundry, which is recommended but not essential for hospitality laundry (Carbon Trust, 2009) – chemical disinfection may be used instead. If low temperatures are used for the main wash cycles, laundry may be periodically disinfected by washing at high temperatures. Some machines offer sluice programs that introduce a short, high temperature cycle to the wash. However, it has been demonstrated that washing at 40 ºC with standard domestic detergents is sufficient to destroy viruses (Heinzel et al., 2010). Alternatively, chemicals may be used to achieve low temperature disinfection, as specified in the European standard for control of bio-contamination in laundries, EN 14065.

The maximum spin speed should be selected within the constraints of the fabric. At temperatures above 40 ºC, mixed polyester cotton fabrics can become creased at high spin speeds or long durations (EC, 2006). For commercial machines with micro-processors, the final spin speed and time should be adjusted for different fabrics. For cotton fabrics, the spin speed should be set to the maximum possible and the spin time adjusted in one minute increments until no further water is extracted. For polyester-cotton garments, the spin time and spin speed should be adjusted by trial and error to obtain the minimum moisture content with no pressure creases.

Programme optimisation should be performed by laundry technicians and consultants. Once programmes have been pre-set, they should not be changed by laundry operatives, and it is imperative that operatives use the correct preset programmes, and this should be clearly guided by charts visible at the point of use.

Quality control and wash optimisation

A quality control inspection should be performed to identify items that require re-washing. The rate of re-washing is a useful guide to optimisation, with an optimum rate of 3 – 5 % proposed (Business Link, 2011). A rate of less than 3 % indicates that laundry is being over-washed (time, temperature and/or dosing should be reduced), whilst a rate of more than 5 % indicates inadequate washing (time, temperature and/or dosing should be increased).

Washer-extractors should be checked for leaking drain and water inlet valves, and correct operation of thermostats.

The hygienic quality of laundered textiles may be checked by independent testing. For example, many commercial laundries in Germany are awarded with the RAL-GZ standard (Hohenstein Institute, 2011).

Drying

Thermal drying is a highly energy-intensive process and should be minimised through the maximisation of mechanical water extraction (high g-force spinning in washing machines) and, wherever practical, natural line drying – see, e.g. from Travel Foundation under 'Economics'. However, in large accommodation establishments, thermal drying is unavoidable. In small-scale laundries, thermal drying is performed in dedicated tumble-dryers and during ironing. Where a commercial flatwork ironer is used, bedclothes do not require a separate thermal drying stage. Mab Hoestelero (2004) refer to Picafort Pallace in Mallorca where only towels require drying.

In the first instance, it is important to select efficient tumble-dryers. Most new tumble-dryers are of the condenser type, in which a heat exchanger removes heat from hot moist air from the drum to the surrounding atmosphere, resulting in moisture condensation within the machine, before the air is recirculated into the drum via a heating element. Compared with dryers that vent hot moist air from the drum directly outside, condenser driers retain more heat energy (heat of condensation), but require good ventilation (and sometimes active cooling) of the room in which they are located. Recently, heat-pump dryers have become commercially available. These dryers use a heat-pump to extract heat from the cooling (condensation) phase and release it to the heating phase, resulting in up to 50 % less energy consumption than a conventional condensing dryer, and less heat transfer to the surrounding atmosphere. Domestic-sized heat-pump driers use less than 0.5 kWh per litre moisture removed from textiles, resulting in specific energy consumption of approximately 0.25 kWh per kg, to dry laundry at 45 % moisture content (Bosch, 2011; Miele, 2010). Meanwhile, tumble-dryers can be purchased that use gas instead of electricity to heat the drum air. These can reduce primary energy consumption and associated environmental impacts such as GHG emissions by over 50 % (Miele Professional, 2011), and result in environmental benefits where electricity is supplied primarily from fossil-fuel sources. However, where electricity is sourced from largely renewable sources (e.g. where an establishment has a genuine green electricity supply contract: see section 7.6), electric tumble driers are more environmentally friendly. Tumble-dryers can be selected with moisture sensors that halt the drying process when a pre-programmed moisture content is reached (e.g. 'cupboard dry' or 'ironing' settings).

Laundry rooms often require high ventilation rates to avoid overheating. In buildings with centralised controlled ventilation and heat recovery, this heat will be distributed throughout the building and will reduce heating demand in winter. In buildings without such systems, it may be possible to install a heat-recovery system that uses waste heat from dryers to heat ventilation air in winter (Figure 5.21).

Figure 5.21: A heat recovery system installed in a hostel laundry

The most important management action to minimise energy consumption in the drying process is to ensure correct drying times, and avoid over-drying that wastes energy and damages textile fibres, leading to higher replacement rates (Figure 5.31 in the next section shows the significant contribution of textile wear towards washing costs). The purpose of drying is to remove excess water from textile products, relative to their moisture content under normal atmospheric conditions (e.g. 6 – 8 % for cotton: EC, 2007). This should be the target moisture content after ironing. Thus, the equilibrium moisture content and the drying potential of the ironing should be subtracted from laundry moisture content after the washing stage when calculating dryer times, or when programming dryers containing moisture sensors. Sheets and other bedclothes may not require tumble drying where commercial ironers are used. Further points to reduce energy consumption during laundry drying are to fill machines to their rated capacity, to clean the lint trap at least once per day, and to check for correct operation of end-point moisture sensors, fans, and to clear ducting.

Ironing

It is common for accommodation providers to outsource the laundering of bedclothes to commercial laundries. Where bedclothes are laundered onsite, it is financially worthwhile to invest in a commercial flatbed ironer that can save a lot of labour and negate the need for the separate thermal drying of sheets.

In the first instance, it is important to select an efficient flatwork ironer. EC (2007) report that specific direct energy consumption of 0.9 kWh per litre of moisture removed for new steam-powered roller ironers, compared with 1.4 kWh per litre of moisture removed for older steam-powered ironers. These values correspond to energy consumption of 0.35 and 0.55 kWh per kg textiles at 45 % moisture content, respectively, indicating a machine efficiency differential of at least 0.2 kWh per kg textiles. Smaller scale ironers may be heated using either electricity or gas. As for driers, gas heating results in environmental benefits where electricity is supplied from primarily fossil-fuel sources, whilst electric heating is environmentally superior where 'green electricity' (section 7.6) is sourced.

Energy consumption during drying can be minimised by operating flatwork driers as close to the rated capacity as possible, and in large batches to reduce the number of machine heat-ups required. The roller speed should be adjusted to ensure that flatwork leaving the ironer is dried to equilibrium moisture content in one pass, and as much of the ironer surface as possible is covered with flatwork at all times of operation (batch preparation and purchasing the correct width of ironer is important). Condensation water from the tumble driers or air-conditioning units can be used for steam irons, avoiding the need to purchase distilled water.

Laundry optimisation

The following points provide guidance on optimisation of the entire laundry process (also refer to washing optimisation, above).

1	Firstly, ensure that batch management is optimised to maximise machine loading rates.
2	Based on typical batch characteristics, assess the potential to reduce wash temperature. The potential for this may be high for typically lightly soiled accommodation laundry – it is worthwhile to experiment with different temperature and chemical dosing settings. Aim for a rewash rate of 3 – 5 %. Additional chemical costs will be compensated by reduced energy consumption and textile wear.
3	For commercial-sized machines, install tanks and modify wash programmes to reuse rinse water in earlier rinse or prewash cycles. In areas of water stress, assess the economic viability of installing a microfiltration system to reuse prewash water in the prewash or wash cycle. Account for water, energy and chemical savings.
4	Ensure all economically viable heat recovery opportunities are being exploited. Install a basic heat exchanger (e.g. corrugated pipe system) to transfer wastewater heat to incoming freshwater. Identify any opportunities to use waste heat from the drying process to heat incoming wash water.
5	Minimise use of tumble-dryers by extracting as much moisture as possible during washer extractor spin cycles, transferring flatwork directly to roller ironers, and ensuring laundry is not over-dried (should aim for equilibrium moisture content at end of finishing process).
6	Adjust the speed of roller ironers to ensure adequate drying in one pass, and utilise at as high a capacity as possible (correct sizing important).
7	Calculate when it would make financial sense to invest in new equipment based on annual energy and water savings (see Table 5.22).

Realisation and maintenance of optimum efficiency requires monitoring and reporting of key performance indicators for energy and water use efficiency. These should be expressed as kWh energy and L water consumed per kg laundry processed, and reported weekly or monthly in charts that enable easy tracking of progress over time. These data require sub-metering of all energy (electricity, gas, oil, steam) and water consumed in the laundry, and information on the number of pieces laundered. The average piece weight of mixed laundry items is around 0.5 kg (Carbon Trust, 2009), but this may vary for hospitality laundry and can be established for individual laundries through weighing a sample of laundry items.

Economics

Consumable costs

Figure 5.22 presents the difference in consumable cost of laundry operations per kg textile for an average laundry, consuming 12 L of water, 1.5 kWh energy and 15 grams of detergent per kg textile, and a best practice laundry consuming 6 L water, 1.0 kWh energy and 10 grams of detergent per kg textiles. Consumable costs are dominated by chemical use, and can typically be reduced by one third, from EUR 0.40 to EUR 0.26 per kg textiles, through the implementation of best environmental management practice. Where electricity is used for all process heating, energy costs can be considerably higher than indicated in Figure 5.22. For example, in Germany the energy costs for laundries using electricity for process heating would be twice as high as indicated in Figure 5.22.

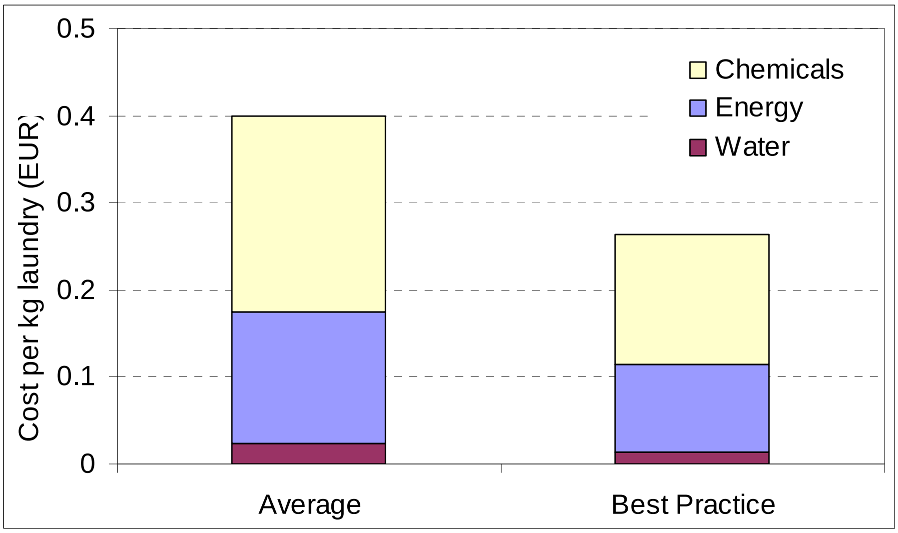

Figure 5.22: Consumable costs per kg of fully processed laundry under average and best practice conditions, at an energy cost of EUR 0.10/kWh, water cost of EUR 2/kWh and chemical cost of EUR 15/kg

Efficient management, such as batch sorting and full machine loading, results in economic savings at little or no additional cost. For example, the Travel Foundation (2011) refer to a Moroccan hotel where linen is line dried on sunny days. Over nine months between January and September 2010, air drying 12 465 kg of linen saved EUR 700 of electricity and EUR 800 of gas.

Given the large contribution of chemicals towards consumable costs, increased efficiency of chemical use can represent a significant driving force for wash processes optimisation that also reduces water consumption. This may offset any increase in chemical costs associated with the avoidance of environmentally harmful chemicals and green procurement of ecolabelled detergents.

Equipment selection and installation

The installation of efficient equipment associated with best practice may increase capital costs. Energy and water savings achievable through the use of more efficient equipment are presented in Table 5.22, assuming efficient management of the laundry process. The average lifetime of white goods is eight years. Efficient washing machines are not necessarily more expensive than less efficient ones (Environment Agency, 2007), but the annual energy and water savings of such machines (Table 5.22) would justify an additional investment of several hundred euro during procurement selection in a small establishment. In a larger establishment with 100 rooms, the energy and water savings of efficient machines combined with rinse water reuse justify a total additional investment of several thousand euro for these features – based on a two to three year payback time and a low electricity price of EUR 0.10 per kWh. The payback times for installation of water recycling tanks and basic heat recovery systems such as corrugated pipe heat exchangers are short (EC, 2007).

The cost of tumble-dryers, and the price premium demanded for efficient heat pump or steam compression dryers, is highly variable. Some domestic-sized tumble-dryers use a continuous flow of freshwater to condense water out of hot moist air from the drum, using approximately 3 L of water per kg laundry. Therefore, selection of an efficient dryer can reduce both energy and water consumption in a small accommodation establishment (Table 5.22), justifying an additional procurement cost of several hundred euro for an efficient machine. In a 100-room hotel, annual energy savings for efficient driers would justify an additional investment ranging between approximately EUR 800 and EUR 2 400 depending on energy prices (Table 5.22).

The magnitude of energy savings from efficient ironers, and thus the justified price premium for efficient new machines, are similar to those from efficient tumbler driers (Table 5.22).

Gas is a cheaper energy source than electricity, and some laundries are switching to gas-fired tumble-driers and ironers for this reason.

Table 5.22: Examples of savings achievable from implementation of best practice under different situations

Situation		Annual saving (EUR)				
		Water	**Energy**			**Total**
	Prices	EUR 2 / m^3	EUR 0.05 / kWh (gas)	EUR 0.10 / kWh	EUR 0.15 / kWh	**EUR**
10-room hotel	Efficient washing machine, 40 °C wash	27	-	38	58	**65 – 85**
	Efficient heat-pump dryer	32	-	55	82	**87 – 114**
	Efficient ironer		-	60	90	**60 – 90**
100-room hotel,	Efficient washing machine, 40 °C wash, rinse water reuse	504	-	548	821	**1 052 – 1 325**
	Efficient heat-pump or mechanical steam compression dryer		238	548	821	**238 – 821**
	Efficient flatwork ironer		301	642	903	**301 – 903**

Driving forces for implementation

Efficient laundry operations can reduce energy and water costs. In some Member States, governments provide financial incentives for the installation of efficient laundry equipment. In the UK, efficient laundry equipment is covered by the Enhanced Capital Allowance scheme that deducts the costs of efficient new equipment from tax liability in the year of purchase.

Many tourist destinations, especially around the Mediterranean, suffer water stress during peak season, and there is pressure to reduce water use associated with tourism. Economic driving forces may be stronger in such destinations if authorities impose higher water charges.

Emerging techniques

At the larger commercial scale, mechanical steam compression driers may soon become commercially available, and can achieve similar energy savings to heat-pump driers (Palendre and Clodic, 2003).

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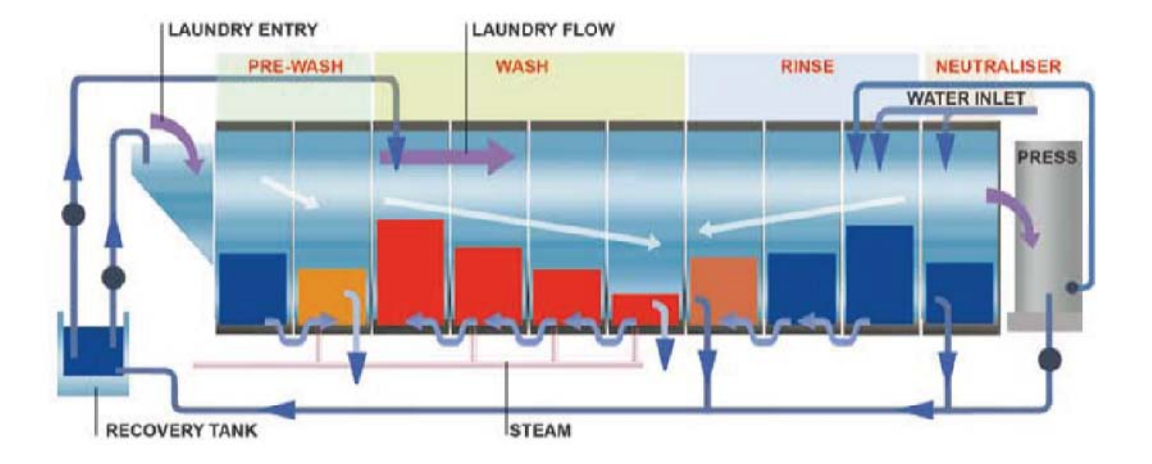
5.5 Optimised large-scale laundry operations

Description

Large-scale professional laundry operators can provide a more efficient alternative to on-site laundry operations. Efficient large-scale and commercial laundry operations with a capacity of hundreds to thousands of tonnes of laundry textiles per year typically achieve water use efficiencies of 5 to 6 litres of water per kg of linen, compared with in excess of 20 litres per kg for non-optimised small-scale laundry operations (Bobák et al., 2010; ITP, 2008). Specific water consumption as low as 2 litres per kg has been demonstrated following process optimisation and water recycling (EC, 2007). It is common for hotels and other tourism service providers, including restaurants, to outsource laundry operations. This technique applies directly to all tourism service providers who control large-scale on-site laundry operations (typically large hotels with over 500 rooms), and also to outsourced providers of laundry operations. Tourism service providers can reduce their indirect environmental impact by ensuring that their laundry providers implement best practice according to this technique.

Best practice for large hotels (over 500 rooms) and outsourced laundry providers is to operate continuous batch washers (CBW) with counter-flow current, such as shown in Figure 5.23. Such washers are efficient at laundry loads of over 250 kg per hour (Carbon Trust, 2009). Discrete batches of 25 – 100 kg are introduced into one end of the machine and moved through a long 1 – 2 m diameter drum 'tunnel' divided into water compartments with different quantities of water, and varying temperatures and chemistry, by the motion of a water-permeable Archimedes screw. Such systems are highly water efficient because clean water is only injected at the final neutralisation and rinse phases of the cycle, and moves counter to the laundry movement, towards the wash and prewash phases, where detergents are added, thus effectively recycling water through phases of progressively more dirty laundry. In addition, water extracted from washed laundry during pressing and from the rinse phase may be re-injected at the prewash and wash phases, and water from the wash phase may be filtered and re-injected at the prewash phase, enabling water use efficiencies of better than 5 litres per kg textiles.



Source: Girbau (2009).

Figure 5.23: An example of a 10 module continuous batch washer with counter-flow water current and steam heating

The choice and dosing of laundry detergents has important implications for the quality of wastewater arising from laundry operations in terms of toxicity and eutrophication potential. There may be a trade-off between wastewater quality and process efficiency, as strong chemical action may reduce the need for heating. In the US there is a move towards the use of ozone generators that inject ozone, a powerful oxidising agent, directly into the rinse water as a highly effective disinfectant (US EPA, 1999). Benefits claimed for ozone injection include lower detergent dosing, lower temperature washes and the avoidance of chemical additives for disinfection such as hydrogen peroxide (Cardis et al., 2007). However, it is difficult to control ozone concentrations in order to guarantee disinfection and realise these potential benefits (DTC LTC, 2011). Best practice is therefore to minimise chemical dosing through process optimisation (e.g. water use minimisation and rinse water reuse), accurate dosing, the avoidance of environmentally harmful chemicals such as hypochlorite and the selection of more environmentally benign chemicals.

CBWs do not spin dry laundry as per washer-extractors. Following washing, drying is a two-stage process based on:

- mechanical dewatering – a quick process applied to all laundry exiting the CBW, usually using a mechanical 'hydro-extraction' or 'membrane' press to remove most of the excess water, with an energy demand in the region of 0.05 kWh per kg textiles;
- thermal drying – a slower and energy-intensive process using heat to evaporate residual water, with an energy demand of up to 1.4 kWh per kg textiles. Textiles are dried in tumble driers, roller-ironers (flatwork), and finishers (garments).

Laundries are large consumers of energy, although this consumption represents a smaller fraction of a typical guest 'footprint' compared with laundry water consumption (Figure 5.3 in section 5). In large laundries, steam is often used as a convenient energy carrier to heat all major processes, from the prewash phase of the CBW process, through drying, to ironing or finishing. Bobák et al. (2011) compare an 'average' steam-heated laundry with poor energy management with an optimised steam-heated laundry (Figure 5.24). Typically, steam is generated in gas boilers, and heat losses occur at this stage, and during distribution via the walls of transfer pipes, and through leaks. This can offset some of the efficiency advantages, such as use of efficient CBWs, of large-scale laundries.

In a large laundry, the first phase of thermal drying is performed by gas- or steam-heated tumble driers, and can require approximately 0.4 kWh per kg textiles – a similar amount of energy to that consumed in the CBW (Figure 5.24). The second phase of thermal drying is performed by roller ironers for damp flatwork (e.g. bedclothes) or a tunnel finisher for damp garments. In finishing tunnels, garments are first subjected to a steam spray to de-wrinkle them, a hot damp downward blast of air to straighten them, and a hot dry blast of air to remove moisture.

Table 5.23: Portfolio of best practice measures for large-scale laundry operations

Stage	Measure	Description
House-keeping	Reduce volume of laundry generated	– Encourage guests to reuse towels and bed linen (section 5.3). – Minimise use of tablecloths and napkins in restaurants.
Washing	Optimisation of continuous batch washers	– Match water input to batch washing requirements and optimise water cycling through the process to achieve correct water levels and liquor ratios. – Monitor and adjust machinery and dosing to minimise textile wear (Hohenstein Institute, 2010).
	Water recycling	– In addition to recovery of rinse and press water, wash water may be recycled through a micro-filter system to re-inject into the prewash.
	Heat recovery	– Recover heat from steam used in the drying process and wastewater to heat incoming fresh water.
	Green procurement of detergent and efficient dosing	– Use laundry detergents compliant with Nordic Swan criteria for laundry detergents for professional use (Nordic Ecolabelling, 2009). – Match detergent dosing to recommendations and laundry batch requirements. – Optimise with water level and temperature, and mechanical washing effectiveness. Soften hard water.
Drying	Optimal use	– Maximise mechanical drying according to textile type, fully load dryers, and control drying times to terminate at equilibrium moisture content (~ 8 %).
	Maintenance	– Ensure adequate dryer insulation, check for leaks, moisture sensor operation, duct blockages, and clean lint from filters every hour (or install automated lint cleaner).
Finishing	Ironer type	– Replace old ironers with efficient new ironers (e.g. heating band design) of appropriate width for bedclothes, and ensure adequate insulation and maintenance to avoid steam leaks.
	Optimal loading	– Install semi-automatic loader, adjust roller timing to achieve final textile moisture content in equilibrium with atmospheric conditions after single pass.
	Minimise energy use in tunnel finishers	– Minimise heating time for textiles to reach maximum drying temperature, and decrease temperatures in subsequent zones to maintain this temperature. Recirculate hot air and ensure adequate insulation of tunnel. Aim for final textile moisture content in equilibrium with atmospheric conditions.
	Minimise chemical use for finishing	– Avoid, or if not possible, minimise, the use of water- and dirt-repellent chemicals.
Entire process	Optimisation through water and heat recovery, and maintenance	– Optimise the entire laundry process. Recover heat from flue-gas to heat steam feeder water, recover heat from dryer/ironer steam and wastewater to heat CBW inflow. Ensure entire distribution network is insulated, inspected and maintained to prevent leaks (install automatic leak detection system).

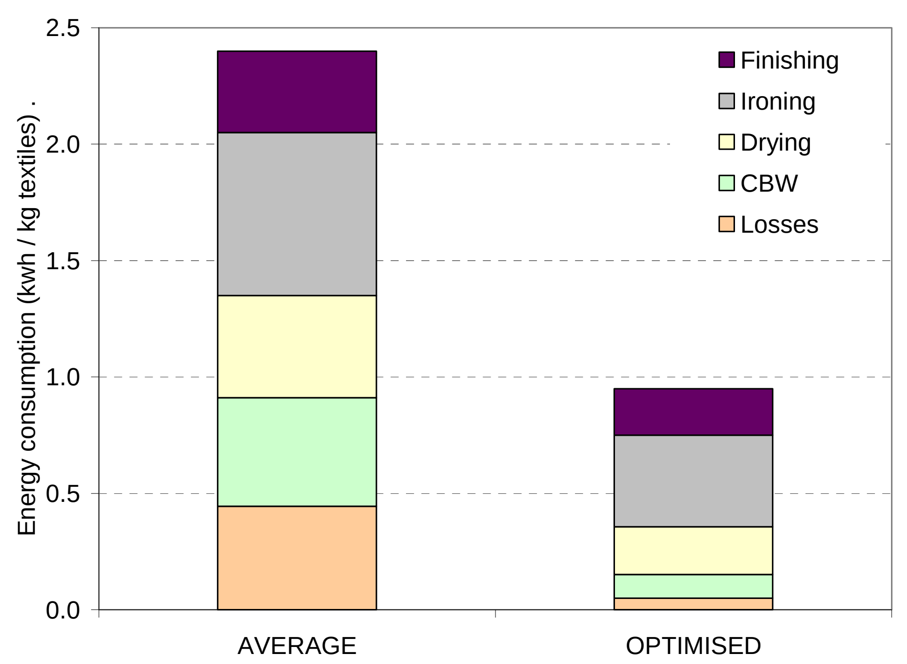
Achieved environmental benefit

Table 5.24 summarises energy and water savings that can be achieved in washing drying processes. Ensuring correct water levels in each CBW compartment alone can reduce water consumption by 30 % (Carbon Trust, 2009). Optimisation of an older CBW can reduce water consumption by 50 % and energy consumption by 70 % according to P&G (2011). Bobák et al. (2011) estimate that optimisation of a steam laundry system can reduce total energy use by 60 %, or 1.45 kWh per kg textiles (Figure 5.24), after implementation of various water reuse and heat recovery steps.

Table 5.24: Energy and water savings achievable from various measures to improve laundry efficiency

Measure	Saving
Replace washer-extractors with a CBW	50 % reduction in energy and water consumption (Carbon Trust, 2009)
Fine-tune CBW	30 % reduction in water consumption (Carbon Trust, 2009)
Reduce wash temperature from 80 ºC to 60 ºC	25 % reduction in CBW energy consumption
Reuse of dewatering press and rinse water in prewash compartment	2 – 3 L per kg textile (EC, 2007)
Wastewater heat recovery	5 – 10 % heating energy (Carbon Trust, 2009)
Microfiltration and reuse of process wash water	Up to 75 % reduction in water consumption and 25 % reduction in energy (Wientjens B.V., 2010). 2 L per kg textiles (EC, 2007).
Use of low pressure steam from condensate to heat rinse water	10 % reduction in total energy consumption (Carbon Trust, 2009)
Maximise mechanical dewatering	5 % reduction in total energy consumption(*)
Recycle tumble-dryer heat with heat exchanger	Up to 35 % reduction in drying energy (Jensen, 2011)
Optimise drying	0.23 kWh per kg textiles, 9 % total energy use (Bobák et al., 2011)
Optimise ironing	0.31 kWh per kg textiles, 13 % total energy use (Bobák et al., 2011)
Optimise entire system	60 % reduction in energy consumption (Bobák et al., 2011)
(*)Achieve 50 % instead of 58 % residual moisture content.	

Microfiltration of CBW process water and reinjection into the prewash phase can reduce net specific water consumption by 2 L per kg textiles (EC, 2007). Maximum water savings of 75 % and maximum energy savings of 25 % are claimed for CBW water recycling systems incorporating microfiltration (Wientjens B.V., 2010).



Source: Based on data in Bobák et al. (2011).

Figure 5.24: Energy use for an average and an optimised continuous batch washer system based on use of steam generated by natural gas

Appropriate selection and dosing of detergent and conditioning chemicals reduces COD loading to the sewer (and, depending on the final wastewater treatment effectiveness, to the environment), and reduces water toxicity. In particular, avoidance of hypochlorite avoids emissions of toxic and bio-accumulating absorbable organic halide (AOX) compounds.

Appropriate environmental indicator

Benchmarks of excellence

Nordic Ecolabelling (2010) present criteria for awarding points to textile service providers, according to environmental performance for the laundering of different textile categories. To date, 31 laundry sites in Norway, 16 in Sweden, and one in Finland have been awarded the Nordic Swan ecolabel. Accordingly, the following overarching benchmark of excellence is proposed.

BM: all laundry is outsourced to a provider who has been awarded an ISO type-1 ecolabel (e.g. Nordic Ecolabelling, 2010), and all in-house large-scale laundry operations, or laundry operations outsourced to service providers not certified with an ISO Type-1 ecolabel, shall comply with the specific benchmarks for large-scale laundries described in this document.

Water

Nordic Ecolabelling energy and water efficiency criteria for the award of maximum points for the textile categories 'hotels' and 'restaurants' are proposed as the basis of benchmarks of excellence. These benchmarks correspond with state-of-the-art performance identified by the Hohenstein Institute (2010) from data relating to over 1.7 million washes in commercial laundries.

The appropriate environmental indicator for laundry water efficiency is litres of water per kg laundry and the proposed benchmark of excellence for large hotels, and outsourced laundry providers for accommodation and restaurants, is:

BM: total water consumption over the complete wash cycle ≤5 L per kg textile for accommodation laundry and ≤9 L per kg textile for restaurant laundry.

Energy

The appropriate environmental indicator for laundry energy efficiency is kWh per kg dried, finished laundry, and the proposed benchmark of excellence for large hotels and outsourced laundry providers is:

BM: total process energy consumption for dried and finished laundry products ≤0.90 kWh per kg textile for accommodation laundry and ≤1.45 kWh per kg textile for restaurant laundry.

Chemicals

Proposed benchmarks of excellence for chemical use are:

BM: exclusive use of laundry detergents compliant with Nordic Swan ecolabel criteria for professional use (Nordic Ecolabelling, 2009), applied in appropriate doses.

BM: wastewater is treated in a biological wastewater treatment plant having a feed-to-microorganism ratio of <0.15 kg BOD_5 per kg dry matter per day.

Cross-media effects

Optimised CBW processes enables highly efficient use of water, energy and washing detergents, with no major cross-media effects.

Where accommodation or food and drink providers outsource laundry, the improved efficiency of laundry operations in terms of water, energy, and chemical consumption achievable in an optimised large-scale laundry outweigh the energy consumption and air emissions associated with laundry transport. Transporting 500 kg of laundry a total distance of 30 km (return trip) in a small commercial van would consume approximately 0.042 kWh of diesel per kg laundry[11], compared with possible energy savings in the region of 0.5 – 1.0 kWh per kg laundry arising from processing in an optimised large-scale laundry.

The energy requirements for microfiltration of process water, at approximately 0.75 kWh energy per m^3 recycled (Wientjens B.V., 2010), are small compared with heat recovered in recycled water (1.16 kWh per m^3 per degree centigrade of heat recovered).

Operational data

Transport

Transport of outsourced laundry should be optimised by the laundry service providers based on the distribution of clients, timing of collection and deliveries in relation to traffic, backhauling (combining delivery and collection), and the size, efficiency and EURO rating of delivery vehicles.

[11] Assuming diesel consumption of 7 L/100 km

CBW design
Table 5.25 presents some important features of CBW systems that contribute towards optimum wash performance. Newer designs of CBW have rotating perforated drums with smooth walls in place of the original basic Archimedes screw design, resulting in improved mechanical wash action and reduced abrasion and blockages. New designs enable full rotation and free-fall of laundry, maximising laundry flow-through and compression whilst minimising abrasive rubbing (EC, 2007).

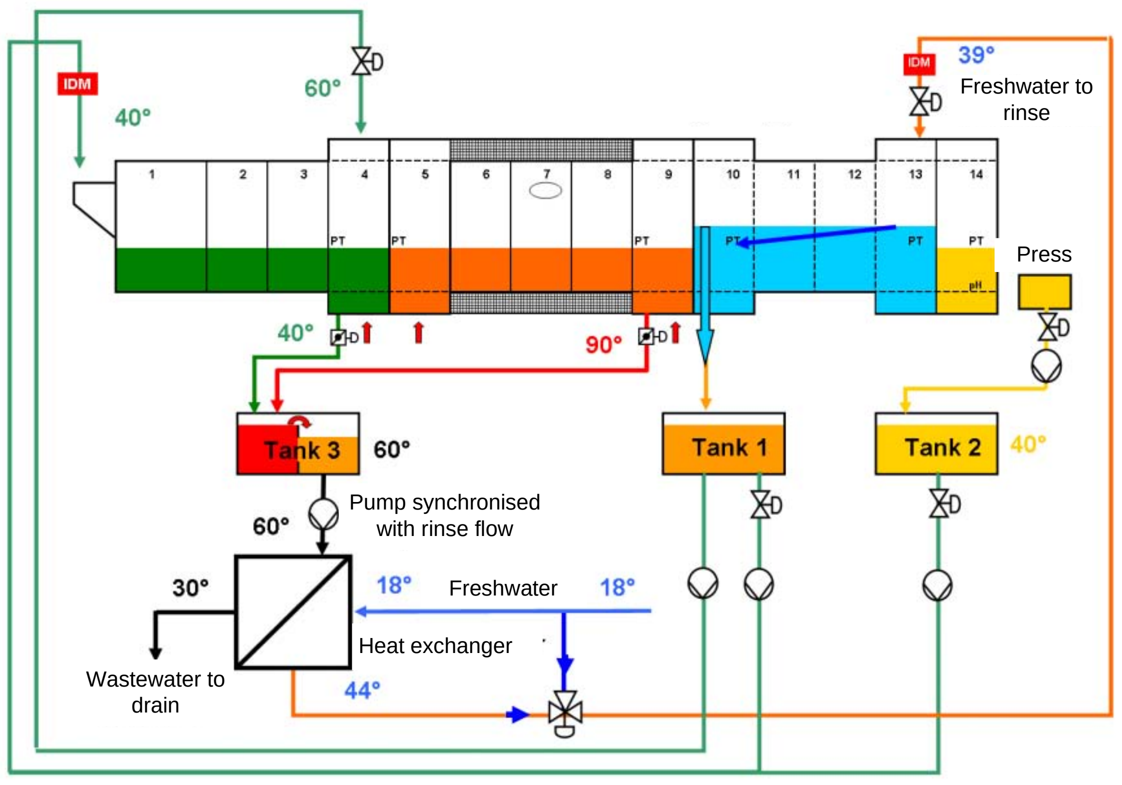
Table 5.25: Features of CBW systems to optimise performance across the four main factors affecting wash effectiveness

Mechanical action	Chemical action	Temperature	Time
Straight drum walls Large drum diameter Programmable g-force factor	Weight dependent doings Water level and rinse water	No drum core 60mm foamed drum insulation Temperature control for disinfection Wastewater heat exchange	Quick drain Quick heating Optimised cycle time
Source: Derived from EC (2007).			

Batch organisation and loading
Loading rates of CBWs are strongly and inversely related to the specific efficiency, even though some new machines adjust programme water consumption and chemical dosing according to load weight. Where loads are deposited into the CBW via a monorail system, classification bags in the sorting area may be attached via weighing devices that automatically send the bag forward once the correct load weight is achieved. The accuracy of this process should be checked by operatives, facilitated by clearly marking the correct load position on the weighing scales (Carbon Trust, 2009).

For hotel laundries with CBW machines, it is important to sort batches according to textile type and degree of soiling (see Table 5.19 and Table 5.20 in section 5.4). For commercial laundries, it can be more efficient to spread laundry from different customers across batches to maximise CBW loading rates, and separate afterwards. Some commercial laundries rent textiles to clients, such as hotels and hostels, in which case laundry may not need to be separated by the customer.

Water and energy optimisation in CBW
Water and energy use efficiency in the CBW are strongly related, and optimisation is bound within laundry washing effectiveness and hygiene parameters. As a general rule for CBW, the conductivity difference between clean water and final rinse water at the end of the rinsing zone should be less than 0.3 mS/cm (above 0.5 mS represents a potential threat to human health) (Proctor and Gamble, 2011). Full drainage of wash water before laundry is transferred to the rinse compartment reduces soiling of rinse water, and thus the quantity of water required in rinse compartments. There are numerous opportunities for water recycling to optimise water use efficiency in a CBW, as indicated in Figure 5.25. Final rinse water extracted by mechanical pressing can be reused directly for the prewash, along with water reclaimed from the start of the rinse phase, to save a total of 2 – 3 litres per kg textile (EC, 2007).



Source: EC (2007).

Figure 5.25: Optimised water reuse and heat recovery for a 14-compartament CBW

In addition, microfiltration of used wash water through ceramic filters or similar (Figure 5.26) can enable up to 75 % of effluent water and 25 % of energy (in warm water) to be reused (Wientjens B.V., 2010). As an example, the AquaMiser system is compact, weighing 175 kg and fitting within 2m^2, has a max output capacity of 6m^3/hr filtrate, operating at 4.5 kW using 500 litres (N) compressed air per hour at 6 – 8 bars pressure, and has a backwash filter control to minimise maintenance requirements (Wientjens B.V., 2010). The achievable water recycling rate is lower for optimised CBW systems already operating with efficient water cycling. Water use as low as 2 L / kg textiles is reported (EC, 2007).

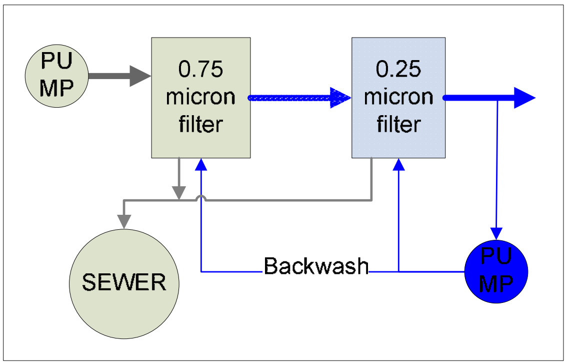


Figure 5.26: Water recycling using micro-filtration

Using heat recovery to heat incoming freshwater at the final rinse phase has the advantage of increasing the final temperature of the textiles and thus reducing drying energy requirements. However, rinse water that is recycled to the prewash compartment should not be above 40 ºC otherwise it could fix stains such as blood into textiles. There is some scope to reduce wash temperatures for hospitality laundry that is typically lightly soiled (see Table 5.20 in section 5.4). Laundry disinfection requirements vary across EU Member States. In the UK, high temperature disinfection is not required (but is recommended) for hospitality laundry (Carbon Trust, 2009). Certification standards based on hygiene testing, such as the German RAL-GZ 992/1 standard, may be used to verify hygiene performance.

CBW optimisation should be performed by qualified laundry technicians or consultants. Once programmes have been pre-set, they should not be changed by laundry operatives, and it is imperative that operatives use the correct preset programmes – this should be clearly guided by charts visible at the point of use.

Chemical use

Following dirt removal, hydrogen peroxide is an effective oxidising agent to kill bacteria and viruses. For hospitality laundry that does not require sterilisation, hypochlorite is not necessary (Bundesanzeiger Verlagsgesellschaft, 2002). If stubborn stains remain after washing, hypochlorite may be added selectively at the rinse stage. Hydrogen peroxide may be substituted with ozone generators that directly inject ozone into cool rinse water, to attain a concentration of 1.5 to 3.0 mg/l O_3 that kills bacteria and viruses at low temperature (US EPA, 1999). However, it is difficult to verify O_3 concentrations in the rinse water, and this technique is rarely applied in Europe.

Typically, approximately 10 g of detergent is used per kg laundry in a CBW (EC, 2007), with auxiliary chemicals such as peracetic acid (PAA), hydrogen peroxide, chlorine, acid and fungicide.

EC (2007) refer to Sanoxy detergent that reduces water and total energy consumption… The chemical and energy cost implications of lower wash temperatures are described under 'Economics', below.

Mechanical dewatering

Depending on the type of textile, the mass of water contained in the saturated fabric immediately after washing can be two to three times the mass of the dry fabric. Thermal drying is an energy-intensive and relatively time-consuming process that can use over 1 kWh per kg textiles. Considerable energy savings can be achieved by maximising the use of quick and efficient mechanical dewatering (Figure 5.27), using either a dewatering press or a centrifuge. Theoretical energy consumption for a commercial water extraction press with a load capacity of 50 kg is 0.035 kWh/kg textile (dry). Maximising mechanical dewatering can also reduce water consumption by providing more water that can be recycled into the wash process (see Figure 5.23). The effectiveness of mechanical dewatering depends on: (i) pressing time; (ii) temperature of the rinse water; (iii) pressure; (iv) textile type.

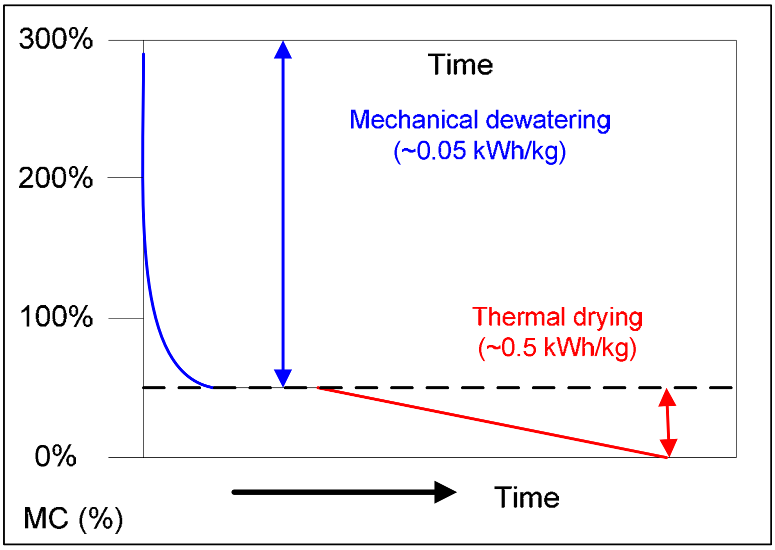


Figure 5.27: The relative time and energy consumption required for mechanical dewatering and thermal drying of textiles

Table 5.26 shows the sensitivity of residual moisture content to key parameters. Optimisation of the drying process depends on the type of textile (e.g. maximum pressure constraints) and integration with the wash process. Increasing the final rinse temperature from 25°C to 55°C can reduce residual moisture content after pressing by 8 %, reducing drying energy requirements. This is an important consideration when calculating the payback of waste heat recovery in incoming rinse water. Timing should be set to achieve maximum drying within the time available between CBW batch deliveries.

Table 5.26: Residual moisture contents after press dewatering under varying conditions

Key variable	Conditions	Moisture content
Time (cotton @ 51 bar)	90 seconds 180 seconds	53 % 43 %
Temperature (cotton @ 51 bar and 90 seconds)	25 ºC 55 ºC	58 % 50 %
Pressure (cotton @ 50 ºC, 90 seconds)	28 bar 51 bar	64 % 53 %
Textile (@ 25 ºC, 51 bar)	Cotton Polyester/cotton (65/35)	58 % 41 %
Source: EC (2007).		

Moisture contents following dewatering should not exceed 50 % for sheets and 52 % for towels to ensure efficient drying in ironers and tumble-dryers, respectively (Carbon Trust, 2009). High moisture contents may indicate a hydraulic leak or faulty pump in the press system that requires maintenance or replacement, and can be identified through periodic weighing of laundry items.

<u>Thermal drying</u>
Following mechanical dewatering, towels and bath mats are dried in tumble driers, sheets, tablecloths and napkins can be transferred directly to dewatering ironers, and garments are dried in finishers. According to EC (2007), thermal drying options in large-scale laundries can be ordered according to energy efficiency accordingly (kg steam required to remove one litre of water from textiles in brackets):

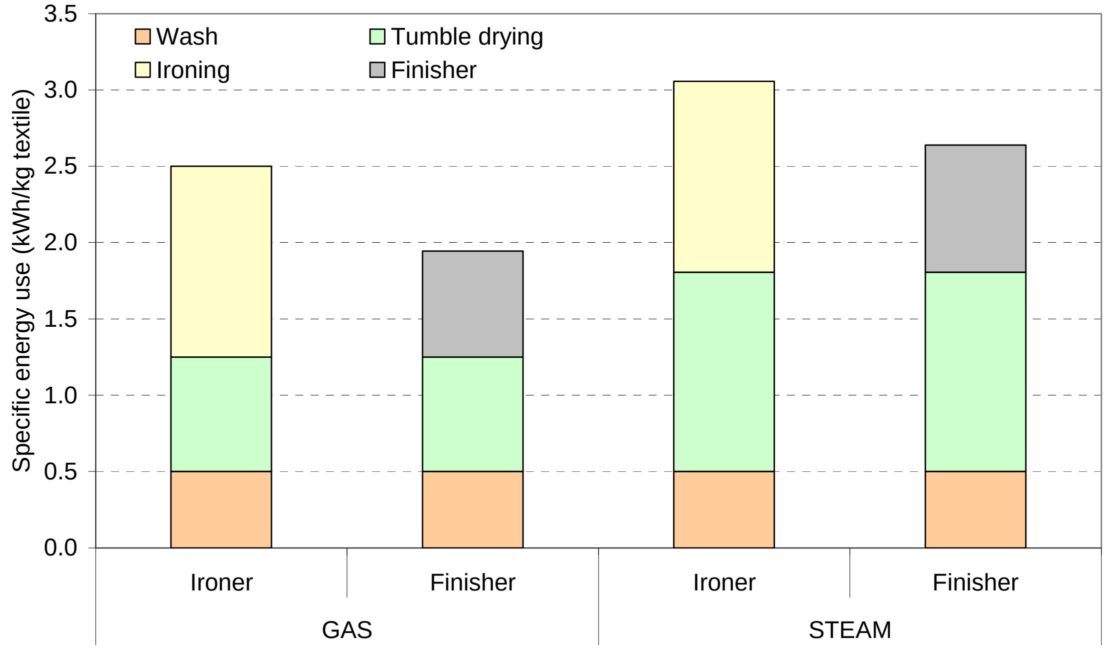
- old, poorly insulated ironer (2.5)
- steam tumble-dryer (2.0)
- new ironer (1.6)
- garment finisher (1.0).

Optimisation of the thermal drying process should be based on maximisation of the lowest energy processes available and applicable to the fabrics being laundered. Old ironers should be replaced by efficient ones as soon as is economic (see Table 5.28), and use of tumble-dryersshould be minimised. Over drying should be avoided by calculating drying times to ensure that the final moisture content after the last drying process is as close as possible to the equilibrium moisture content of the textile under standard atmospheric conditions (e.g. 6 – 8 % moisture for cotton).

Large steam tumble driers require approximately 0.5 kWh per kg textiles (Figure 5.24). Measures to reduce energy consumption during drying are to recycle hot process air, rapid initial heating of the air to minimise textile heat-up time, optimum drum loading to ensure textile movement and good heat transfer, regular filter cleaning (once per hour), and optimisation of end-point textile moisture content in relation to any further drying in the ironing or finishing phase and according to a target textile moisture content in equilibrium with atmospheric conditions. End-of-cycle terminators based on infrared detectors that leave 8 % moisture in towels are optimum and can be easily retrofitted. Tumble driers with axial, rather than radial, flow have been demonstrated to use significantly less energy (Carbon Trust, 2009).

Monthly inspections should be performed to check that heated air is not bypassing the rotating cage, that the door seal is sound, that there are not any air leaks, and that melted plastic or other contamination is cleared from the cage. Automatic lint screen cleaning systems can be installed to maintain optimum operating efficiency.

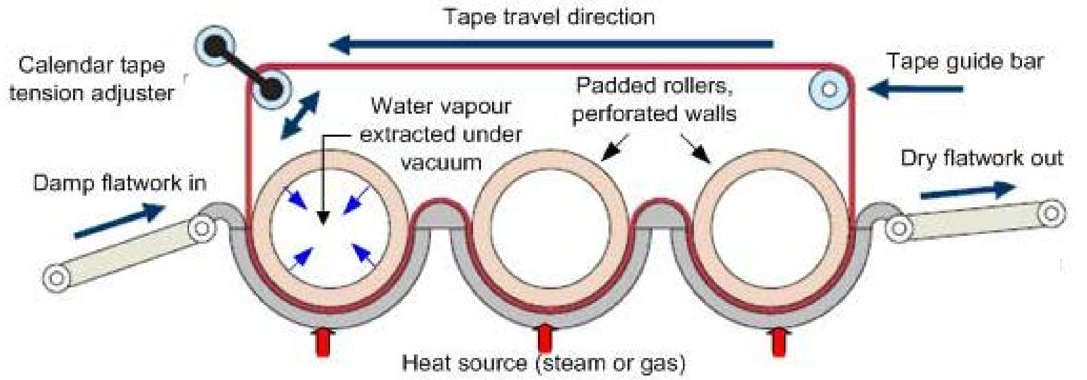
For dryers and finishers, direct gas heating is more efficient than indirect heating via steam owing to the energy losses through heat exchange and distribution for high-energy-state steam (Figure 5.28). The ratio of useful heat energy output to energy input is typically 0.85 for direct gas-fired systems compared with 0.7 for steam systems. Gas-fired tumble driers may be up to 30 % more efficient than steam-heated driers (Carbon Trust, 2009). Nonetheless, steam provides a convenient centralised source of heating for large laundries processing more than 500 kg textiles per day (EC, 2007). Steam leakage can be minimised by installation of automated steam trap leakage detection systems, and systems can also be optimised with respect to the entire laundry process (Figure 5.30), which can reduce losses associated with steam generation and distribution by 90 %, to just 0.05 kWh/kg textiles (Bobák et al., 2011).



Source: EC (2007).

Figure 5.28: Energy consumption for sheet fabric (ironer) and garments (finisher) based on direct gas heating and indirect heating using steam

The majority of laundry from the hospitality sector is flatwork that will require ironing rather than finishing (for garments). Where mechanical water extraction brings moisture content down to 50 % or less, flatwork may be transferred directly to roller ironers, by-passing tumble driers. Large-scale laundry dewatering irons apply pressure and heat to reduce residual moisture content in flatwork textiles (e.g. bed linen and tablecloths), and are usually based on a two or three-roller design (Figure 5.29). The efficiency of large-scale dewatering ironers has improved considerably in recent years, from consumption of 2.5 kg of steam per litre of water removed to 1.6 kg steam per litre of water removed from the textiles (EC, 2007) – these values translate to specific drying energy requirements of 0.6 and 0.4 kWh per kg textiles at 50 % moisture content, respectively. One feature of more efficient ironers is heat-retaining hoods. The efficiency of roller ironers should be monitored, and the machinery frequently inspected, to indentify maintenance actions. For example, roller padding can become worn, reducing contact pressure with the textiles and thus drying efficiency. Carbon Trust (2009) recommend replacing the three layers of thin material traditionally used as roll padding with two layers of stronger polyester needle-felt to improve ironing performance by up to 30 %, and reduce energy consumption.



Source: Elaborated from carbon Trust (2009).

Figure 5.29: Schematic representation of rigid-chest three-roll ironer operation

A derivative of the traditional rigid chest roller ironer shown in Figure 5.29 is now being commercially marketed as a more energy-efficient alternative. Heating band ironers use a heated sheet of high quality stainless steel to maintain pressure against the rollers, enabling a higher pressure of up to 16 bars to be applied evenly across textiles (Kannegiesser, 2004). It is claimed that heating bands also offer continuous heating over their entire surface, including the 'bridge' between rollers, and suffer less from the wear-induced contact area reduction that occurs when the padding on conventional roller systems is worn (Kannegiesser, 2004; EC, 2007). Table 5.27 presents operational data for a modern heating-band ironer compared with a traditional rigid chest ironer. For the heating-band ironer, a 90 % decrease in heated mass reduces start-up heating by 189 kWh per day, and the reduced radiation losses from the smaller heated-surface area reduces heating by 120 kWh per day.

Table 5.27: An example of typical daily energy losses for a rigid-chest ironer and a heating-band ironer of the same capacity, both heated by steam

	Rigid chest ironer	**Heating band ironer**
Specifications	1200 mm diameter, 3500 mm width, 3 rolls, 6 tonnes heated steel	1200 mm diameter, 3500 mm width, 2 rolls, 0.62 tonnes heated steel
Steel heating-up (daily)	211 kWh / day	22 kWh / day
Radiation	192 kWh / day	72 kWh / day
Escaping vapour	88 kWh / day	18 kWh / day
Total	491 kWh / day	112 kWh / day
Energy saving		379 kWh / day
NB Assumes one 8 hour per day shift and 1.83 kg steam = 1 kWh energy. *Source:* EC (2007).		

Energy consumption during ironing can be minimised by operating driers as close to rated capacity as possible – this can be achieved by having a buffer stock of flatwork ready for ironing in case of any interruptions in the line from previous processes. The most efficient loading systems are semi-automated, comprising monorails to which the corners of textile sheets are clipped and that deposit sheets onto the flatwork ironing surface automatically in response to a signal from a remote operative. Automatic feeders should be adjusted to give edge to edge feeding in order to cover the width of the iron, and roll-to-roll speed differentials set to give 50 mm stretch in 10 turns of an 800 mm diameter roll (Carbon Trust, 2009). The roller speed should be adjusted to ensure that flatwork leaving the ironer is dried to equilibrium moisture content in one pass, and that as much of the ironer surface as possible is covered with flatwork at all times of operation.

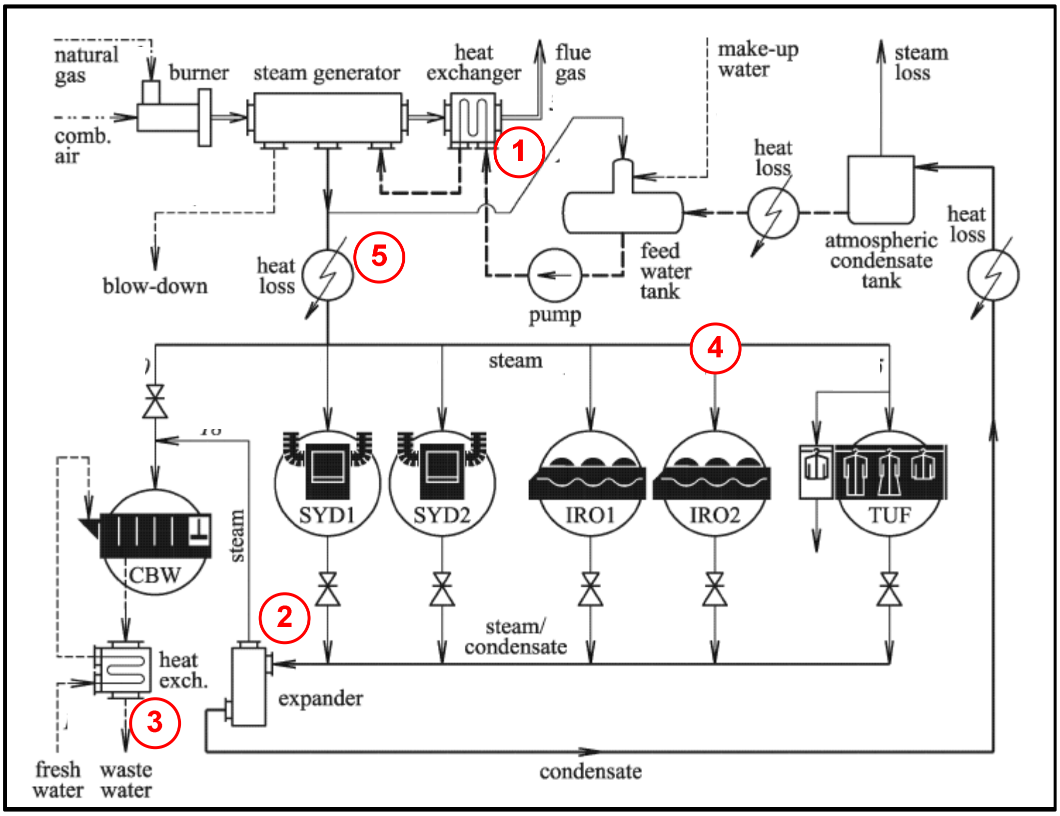
In garment finishers, approximately one kg steam (0.55 kWh heat) is required per litre of water evaporated from the textiles. The energy requirement of garment finishing is minimised by the recirculation of 90 % of the air and optimisation of temperature distribution in the heating, finishing and drying zones according to the textile density. The temperature of succeeding zones should decrease to ensure rapid textile heat-up and maintain a constant textile temperature (EC, 2007).

Following ironing, textiles may be treated with chemicals to repel water and dirt. This is unnecessary, especially for accommodation textiles that are frequently laundered, and should be avoided where possible.

<u>System optimisation</u>
In relation to overall laundry system optimisation shown in Figure 5.30, the most important measures to reduce heat losses from the steam system are given below.

- Recovery of heat from the flue-gas to heat steam feeder water (point 1 in Figure 5.30).

- Recovery of steam from the drying cycle, in an expander, to heat process water in the CBW (point 2 in Figure 5.30). This can save around 10 % of entire laundry energy demand (Carbon Trust, 2009).
- Recovery of heat from wastewater (ideally combined with water recovery) to heat incoming process water to the CBW (point 3 in Figure 5.30). This can save 5 – 10 % of laundry heat demand.
- Regular inspection and maintenance of the distribution system to prevent leaks (point 4 in Figure 5.30).
- Appropriate insulation of pipes, CBW, dryers, finishers and irons to minimise heat losses (point 5 in Figure 5.30).



SYD = Steam dryer; IRO = Ironers; TUF = Tunnel finisher

Source: Derived from Bobák et al. (2011).

Figure 5.30: Steam-heated laundry with optimised energy management

EC (2007) recommend corrugated pipe heat exchangers for their efficiency, robustness and tolerance of soiled water, and specify the following check criteria to optimise the heat exchange process: (i) the flow directions are connected in counter-current direction; (ii) there are turbulences in the liquids; (iii) there is a large heat transfer surface; (iv) the mass flow and the temperature differences in both directions are the same; (v) as much time as possible is provided for the heat exchange (i.e. for a tunnel washer, throttle the rinse flow to almost the total cycle time).

The following sequence of checks may be useful to consider for optimisation of the entire laundry process:

1	Firstly, ensure that batch management is optimised to maximise CBW loading rates and that the CBW is performing according to correctly specified programme parameters.
2	Based on typical batch characteristics, assess the potential to reduce wash temperature, water use and chemical dosing. The potential for this may be high for typically lightly soiled hotel laundry – it is worthwhile to experiment with different temperature and chemical dosing settings. Aim for a rewash rate of 3 – 5 % (lower indicates over-washing, higher indicates under-washing). Balance chemical costs against savings from reduced energy consumption and textile wear (see 'Economics').
3	Minimise thermal drying requirements by maximising mechanical dewatering press times, and optimise the efficiency of thermal drying by ensuring maximum loading rates in tumble-dryers and flatwork ironers. Avoid over drying: control timing to achieve final moisture contents of 8 %, in equilibrium with atmospheric conditions (install moisture sensors in tumble driers).
4	Ensure that all economically viable water reuse opportunities are being exploited, especially reuse of rinse water in earlier rinse of prewash compartments. Assess the economic viability of installing a microfiltration system to reuse prewash water in the prewash or wash cycle. Balance system modification costs against water, energy and chemical savings.
5	Ensure all economically viable heat recovery opportunities are being exploited. Heating incoming final rinse water with wastewater from the main wash is simple and cost effective, but requires careful control: a higher rinse temperature reduces drying requirements, but should not cause prewash temperature to exceed 40 ºC when reused (in order to avoid the fixing of stains).
6	Inspect and test all equipment frequently, and perform regular maintenance, especially to tumble driers (check filters, fans, ducts, moisture sensors) and roller-ironers (adjust speed settings and check for padding wear).
7	Calculate when it would make financial sense to invest in new equipment, such as a new CBW or heated-band ironer. More efficient drying equipment can pay back relatively quickly: in particular mechanical dewaters and high-efficiency ironers. Assess the possibility to use direct gas heating instead of steam heating.

Regular system maintenance is crucial to maintain optimal operating efficiency (Carbon Trust, 2009). Equipment should be checked weekly, and in some cases daily, for problems. Regular maintenance tasks include: (i) clearing wax from vacuum fans and ducts on the ironers; (ii) repairing holes in grilles above the tumble dryer heater batteries to prevent lint blockage; (iii) adjusting hanger delivery mechanisms at the tunnel finisher to give one garment per peg. Equipment tuning should be performed every three months, including:

- adjustment of 'wait' times in the hydro-extraction press programme to maximise press times;
- adjustment of the roll-to-roll stretch on ironers to improve the heat transfer over the gap pieces between the rolls;
- adjustment of end-of-cycle terminators on tumble-dryers so that they leave 8 % moisture in towels.

Realisation and maintenance of optimum efficiency requires monitoring and reporting of key performance indicators for energy and water use efficiency: kWh energy and L water consumed per kg laundry processed. These should be reported weekly or monthly in charts that enable easy tracking of progress over time, and can be calculated from: (i) energy (electricity, gas, oil, steam) and water bills; (ii) the number of pieces laundered. The average piece weight of mixed laundry items is around 0.5 kg (Carbon Trust, 2009), but this may vary for hospitality laundry and can be established for individual laundries through weighing a sample of laundry items.

Applicability

Optimised CBW laundry processes incorporating heat recovery and water recycling following microfiltration are applicable to large hotels with over 500 rooms, and commercial laundries serving the entire hospitality sector (accommodation, restaurants, bars, etc.).

Laundry from food preparation in restaurants and accommodation establishments is typically more heavily soiled than laundry from rooms in accommodation, and requires more energy and water-intensive laundering (see 'Environmental indicators' section above).

Economics

Most best environmental management practice measures for large-scale laundries are based on water, energy or chemical resource efficiency, and therefore have relatively short payback times when implemented in new systems or following retrofitting. Table 5.28 summarises some important economic factors for the referenced best practice measures.

Replacing older drying equipment such as irons with more efficient new models typically results in large annual energy savings of tens of thousands of euro (Table 5.28). Thus, it can be financially worthwhile to bring forward replacement of older equipment (e.g. after a major breakdown).

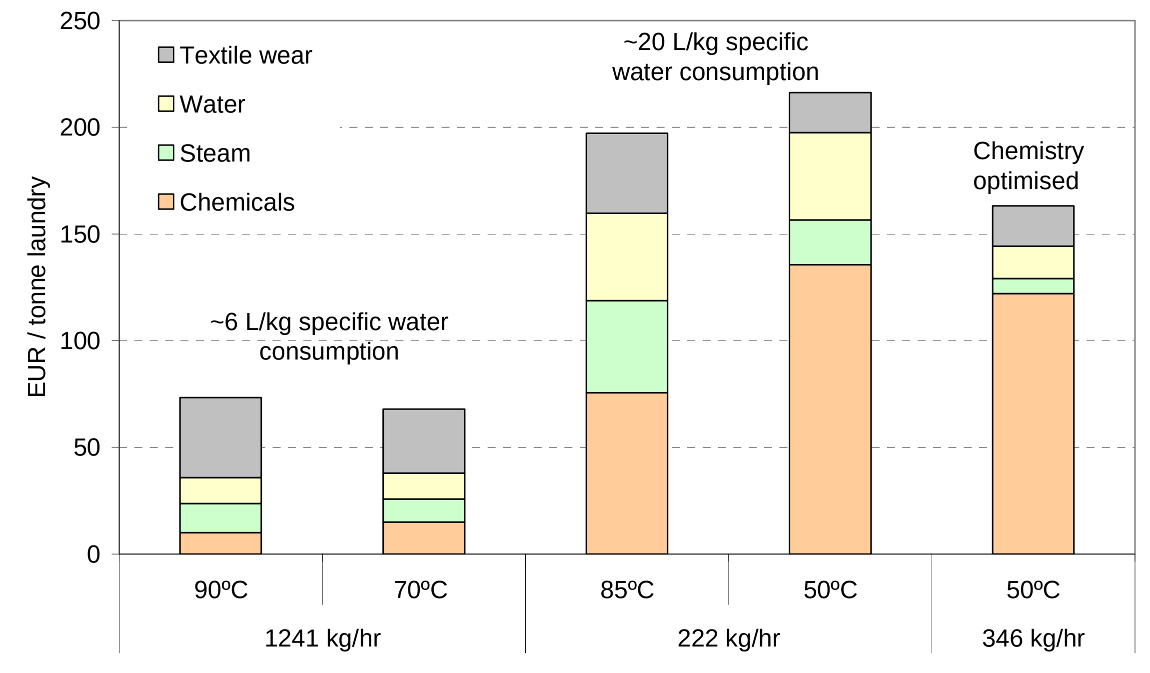
The installation of microfiltration equipment to filter prewash water for reuse offers an acceptable payback time, in the region of two years, where water supply and disposal costs are at or above EUR 2.00/m^3.

Table 5.28: Important economic considerations associated with laundry best practice measures

Measure	Economic considerations
CBW water and energy optimisation	At a water service (provision and treatment after disposal) price of EUR 2/m^3 and a gas price of EUR 14/GJ (EUR 3.89/MWh), optimisation of an older CBW system processing 7 t/day of laundry can achieve annual cost savings of EUR 25 000 for water and EUR 40 000 for energy (P&G, 2011). These water and energy savings equate to EUR 14 and EUR 24 per tonne of laundry processed, respectively. This water saving cost would increase to EUR 21 per tonne of laundry at a water service cost of EUR 3/m^3. One company offers a CBW optimisation service with payback periods as short as 12 months (P&G, 2011).
Laundry energy optimisation	According Bobák et al. (2011), energy optimisation of the entire laundry process can yield energy cost savings of EUR 73 per tonne laundry, of which EUR 35 per tonne are attributable directly to the optimisation of drying processes. Replacing an older ironer using 2.5 kg steam per litre of water removed with a new ironer using 1.6 kg steam per litre of water removed will reduce annual energy costs by EUR 27 000 for a laundry operating at 10 tonnes per day, five days per week.
Water filtration:	At a water service (provision and treatment after disposal) price of EUR 3/m^3, recycling of prewash water from a 12 t/day laundry CBW process through a microfiltration system can save EUR 27 000 per year (EUR 9 per tonne laundry). This compares with a capital and installation investment of EUR 40 000, thus leading to a payback period of 17 months (EC, 2007). The payback time increases to 21 months and 27 months at a water service price of EUR 2.50 and EUR 2.00 per m^3, respectively.

Measure	Economic considerations
Chemical selection and dosing	Chemical selection and dosing should be optimised with water, energy and textile wear costs for different batch characteristics. Efficient dosing based on laundry type and degree of soiling reduces costs. Avoidance of more environmentally harmful chemicals can reduce costs, but substitution with more environmentally friendly chemicals can increase costs. Selection of ecolabelled detergents may increase detergent costs.

Textile wear represents a significant component of washing costs, and can account for half of washing costs for relatively efficient operations using 6 L/kg laundry (left bars on Figure 5.31). Reducing maximum wash temperature from 90 ºC to 50 ºC reduces textile wear by up to 50 %. Figure 5.31 highlights how the cost benefits of lower temperature washes are offset by chemical costs that can increase by a factor of 1.8. The cost effect of temperature reduction is laundry-specific, and can be positive or negative. For efficient laundries, a decisive factor is whether or not the laundry operators bear the cost of textile wear. For in-house laundries on accommodation premises, reduced textile wear costs can justify temperature reductions, whilst for outsourced laundries temperature reductions may not be justified by cost savings that exclude textile wear.



NB: Water price 2 EUR/m3, steam price EUR 23.5/tonne (gas heating), chemical price ranging from EUR 1 000 to EUR 1 800 per tonne, and textile price EUR 7 500 per tonne.

Source: Based on modified values from EC (2007).

Figure 5.31: Specific washing costs and textile wear for a 13-compartment CBW under high load rates and 8-compartment CBW under low load rates, for higher and lower temperature washes

It is important to implement heat recovery after water optimisation, as the latter process can reduce water consumption, and thus required heat-exchanger size, by approximately 30 %, reducing heat exchanger installation cost by 15 % (Carbon Trust, 2009).

Driving force for implementation

The main driving force for implementing optimised CBW processes is economics, as described above. For large hotels, implementation of efficient laundry systems may also be driven by environmental award schemes, or simply public relations benefits.

For commercial laundries, improved environmental performance, especially if recognised by third-party certification, can improve business opportunities, especially with hospitality enterprises operating green procurement policies.

Many tourist destinations, especially around the Mediterranean, suffer water stress during peak season, and there is pressure to reduce water use associated with tourism. Economic driving forces may be stronger in such destinations if authorities impose higher water charges.

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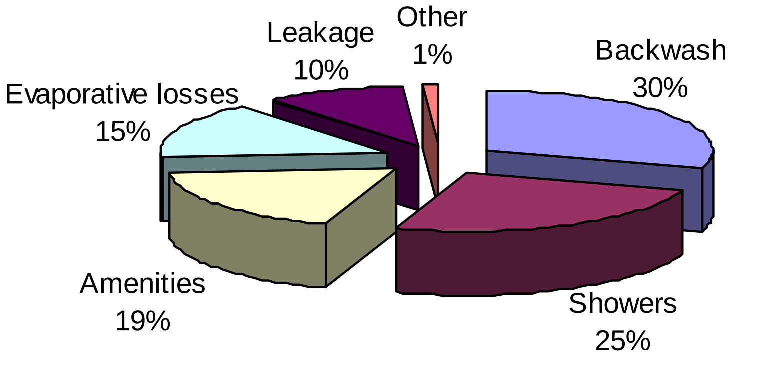
5.6 Optimised pool management

Description

Swimming pools give rise to a number of environmental impacts, especially where poorly managed, through demand for water, energy and disinfectant chemicals. An indoor heated 25 m pool (300 m^2) can lose 21 000 litres of water per week in evaporation (water temperature of 28 ºC, air temp of 29 ºC and relative humidity of 60 %) (Business Link, 2011). This would equate to 30 litres per guest-night for a hotel with 100 guests. Although this example is for a relatively large pool, it excludes water consumption for backwashing, that can be of a similar magnitude, or greater (Figure 5.32). Ecotrans (2006) suggest that swimming pools increase water consumption by an average of 60 litres per guest-night across hotels and camping sites. Meanwhile, sub-meter data from a German hotel indicate water consumption of 52 litres per guest-night for the pool area, including showers (Hotel Colosseo, 2011).

Figure 5.32 displays the breakdown of water consumption in a typical community swimming pool. The main processes are backwashing, showers, and evaporative losses and leaks. Water use for amenities (e.g. onsite cafes) may not apply to accommodation pool areas.



Source: Hazell et al. (2006).

Figure 5.32: Breakdown of water consumption across processes and areas in a typical community pool

Sanitisation of swimming pools is usually performed using chlorine, via dosing with compounds such as calcium or sodium hypochlorite. Chlorine compounds react with organic matter to form chloramines, disinfection byproducts that irritate eyes, and, when added in high doses, can form carcinogenic trihalomethanes. A fraction of the chlorine compounds volatilise to the atmosphere, and filter backwash water containing chlorine is toxic to freshwater ecosystems, and must be released to a sewer unless specially treated and/or recycled. Some alternatives to the addition of hypochlorite such as the addition of copper salts are also associated with ecotoxicity problems.

Finally, operation of swimming pools requires energy, to power filter and backwashing pumps, lights, and in some cases water heating and indoor heating and ventilation. ÅF-Energikonsult AB (2001) estimated that hotel swimming pool systems can consume 45 000 kWh to 75 000 kWh per season. Specifically for pool heating, Ochsner (2008) estimate typical energy demand of 50 – 150 W/m^2 for indoor pools, 50 – 200 W/m^2 for a pool in a sheltered location, 100 – 300 W/m^2 for a pool in a partially protected location, and 200 – 500 W/m^2 for a pool in an unprotected location. Carbon Trust (2005) estimate that a typical public leisure centre containing a 25 m pool consumes over 1 500 kWh/m^{2}yr, of which 65 % is for pool heating and ventilation. Ventilation of indoor pools often leads to high heat loss via the exhaust of moist, warm air to the atmosphere: swimming pool areas may experience air change rates of 4 – 10 changes per hour (Carbon Trust, 2005). In addition, water heating for showers can consume considerable amounts of energy (sections 5.1 and 5.2). Carbon Trust (2009) estimate that building services account for 35 – 50 % of the operating cost of a modern indoor swimming pool.

Best practice measures

Table 5.29 summarises the main best practice measures to reduce water, energy and chemical consumption in swimming pool areas. In the first instance, the decision to build a pool and the selected design are critical, though these decisions are likely to be guided by marketing considerations. It may not be necessary to have a pool onsite – there may be options to organise a pool share or guest-use scheme with neighbouring establishment(s) or local leisure facility providers. In terms of pool design, outdoor, unheated and natural pools are the options with the lowest environmental impact. Where applicable, particularly for outdoor pools with a relatively short season, installation of a natural pool is best practice (see section 9.6). If the pool is integrated into the building design, the necessary infrastructure can be put in place to recycle pool overflow and filter backwash water for toilet flushing. A good building envelope (section 7.2) will reduce heating costs – high quality double- or triple- glazed windows with blinds where necessary to reflect direct sunlight, with a good quality seal and carefully located entrance areas to minimise drafts.

The most efficient pool disinfection and heating systems should be specified during the design phase, but may also be retrofitted. Outdoor pools can converted to natural pools relatively easily (section 9.6). Drainage barriers can be installed around the pool to collect and recirculate overflow and splash water. Ozone generators or ultra-violet (UV) systems may be installed to reduce chlorine requirements. Simple solar heating tubes or a heat-pump system may be installed to heat (or pre-heat) pool water, and a heat recovery system with controlled ventilation installed to recover heat from exhaust ventilation air. Motion sensors can be installed to switch off features such as fountains when no users are present.

Finally but importantly, many optimisation measures can be taken for all existing pools by applying good management techniques and minor retrofitting. Installation of a water sub-meter to record inflow to the pool is an important measure to enable performance tracking and the identification of problems. Hazell et al. (2006) found that the majority of public swimming pool managers surveyed could not provide annual water consumption data. Monitoring and benchmarking of water, energy and chemical consumption is therefore a key best practice measure for pool/accommodation managers.

Use of pool covers, careful regulation of temperature and chemical dosing, maintaining water at the correct level below the pool sides and careful control of filter backwashing can all significantly reduce water and energy consumption. Backwash water can be filtered and used for irrigation. Careful (automated) control of HVAC systems for indoor pools can reduce heating energy consumption, and careful control of water circulation through filters (manually, based on usage rate, or automatically, based on water quality monitoring) can reduce energy, especially if combined with variable speed pumps. Regular sweeping of the pool area and requiring users to pass through a foot bath can reduce disinfection and backwashing requirements arising from contamination.

Table 5.29: Best practice measures to reduce water, energy and chemical consumption in swimming pool areas

<table>
<tr><th>Aspect</th><th>Best practice measures</th><th>Applicability</th></tr>
<tr><td>Management</td><td>Monitor energy, water and chemicals consumption (see sections 5.1 and 7.1)</td><td>All pools</td></tr>
<tr><td rowspan="5">Disinfection</td><td>Natural pools (see section 9.6)</td><td>Lower usage pools</td></tr>
<tr><td>Require users to pass through foot bath</td><td rowspan="2">All pools</td></tr>
<tr><td>Sweep debris from surrounding area</td></tr>
<tr><td>Optimised chlorine dosing</td><td>All chlorine pools</td></tr>
<tr><td>Electrolysis, ozonation or UV</td><td rowspan="4">All pools</td></tr>
<tr><td rowspan="5">Water efficiency</td><td>Monitor water consumption</td></tr>
<tr><td>Optimised backwashing frequency and timing</td></tr>
<tr><td>Backwash water recycling</td></tr>
<tr><td>Backwash water reuse</td><td>Where water scarce</td></tr>
<tr><td>Timer-controlled low-flow showers (section 5.2)</td><td>Shower areas</td></tr>
<tr><td rowspan="7">Energy efficiency</td><td>Ensure good building envelope (section 7.2)</td><td>Indoor pools</td></tr>
<tr><td>Position in sunny and sheltered area</td><td>Outdoor pools</td></tr>
<tr><td>Avoid excessive water temperature</td><td>Heated pools</td></tr>
<tr><td>Correct use of pool cover</td><td rowspan="2">All pools</td></tr>
<tr><td>Demand-control of water circulation</td></tr>
<tr><td>Solar or heat-pump water heating</td><td>Heated pools</td></tr>
<tr><td>Controlled ventilation with heat recovery</td><td>Indoor pools</td></tr>
</table>

Achieved environmental benefit

Water

Figure 5.33 displays potential water savings from different processes for a 25 m swimming pool (a large accommodation pool).

Smith et al. (2009) claim that pool covers can reduce outdoor pool evaporative losses by 200 litres per day in warm climates. This figure may be close to 1 000 litres per day for heated indoor pools. Covers also reduce energy consumed for pool heating and ventilation by 10 – 30 % (Carbon Trust, 2005).

Optimisation of backwashing frequency based on filter pressure rather than fixed intervals can reduce water consumption for backwashing by over 50 %. For example, backwashing a sand filter once every three days for five minutes, instead of once every day for five minutes, could reduce water consumption by 1 500 litres per day, or 550 m^3 per year.

Reverse osmosis can enable the reuse of up to 65 % of backwash water, potentially saving around 500 m^3 per year (Hazell et al., 2006).

Installing low-flow and timed showers could result in a similar magnituide of savings, in the region of 500 m^3 per year.

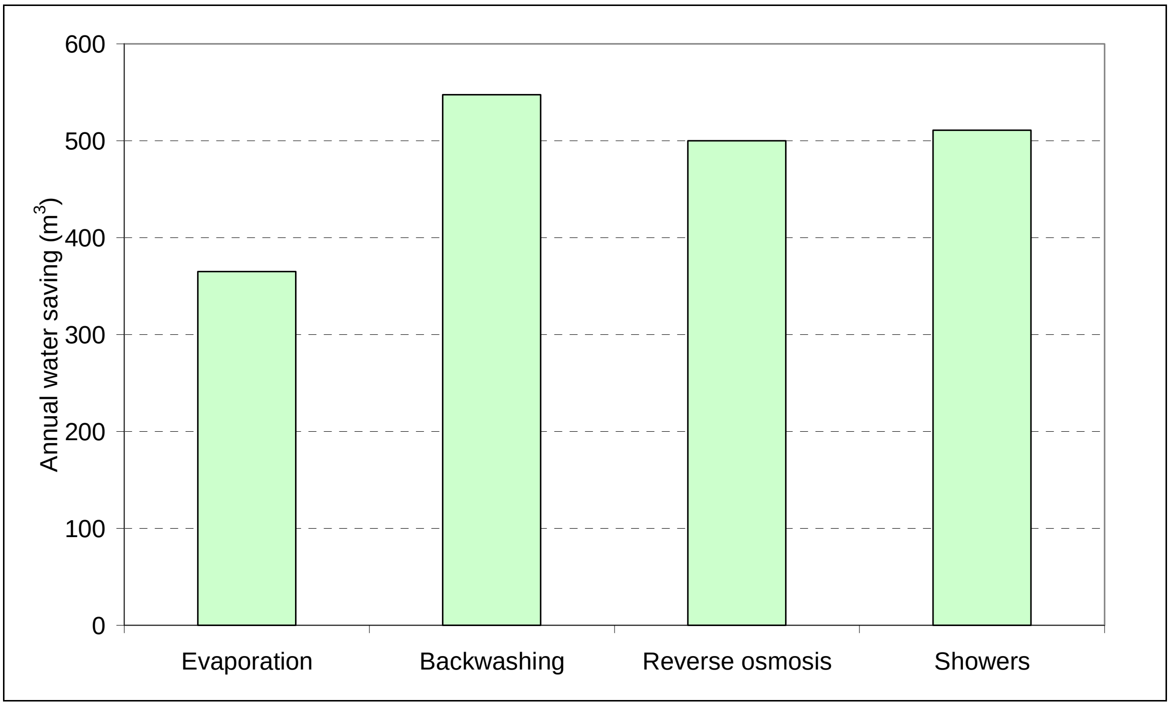


Figure 5.33: Estimated potential annual water savings across different processes for a 25 m pool

<u>Chemicals</u>

Proper control of pool filtration and disinfection can significantly reduce chlorine (e.g. sodium hypochlorite) inputs. UV-disinfection of pool water can reduce chlorine inputs by up to 30 %, and may also reduce the need for top-up water to dilute chlorine by-products (Leisure-design, 2012). Reduced chemical use leads to upstream environmental benefits in terms of reduced resource consumption and air emissions, and downstream environmental benefits in terms of reduced ecotoxicity impacts in receiving waters.

<u>Energy</u>

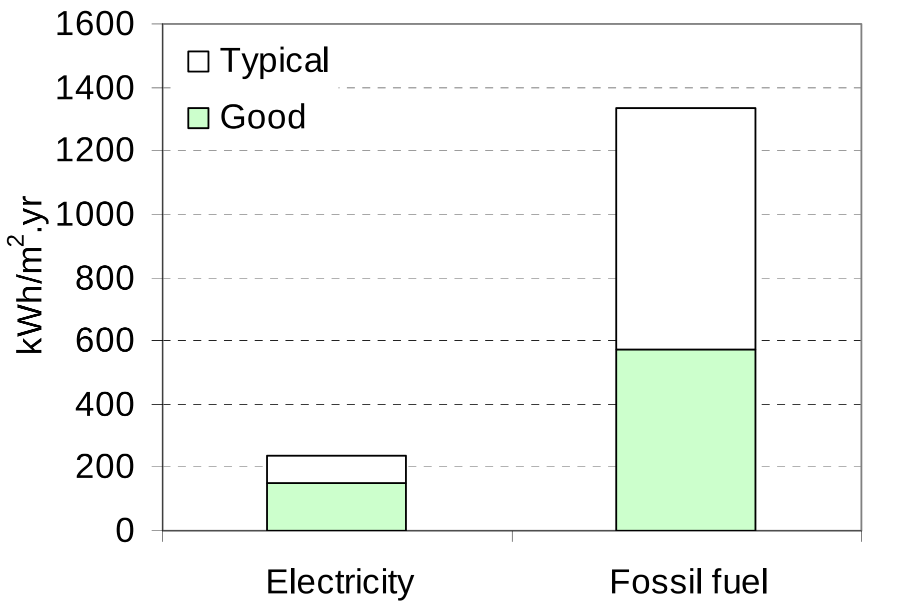
Installation of a real-time (continuous, automated) energy monitoring system alongside provision of staff training and awareness raising on energy issues by Knowsley Metropolitan Borough Council in the UK led to electricity savings of 24 % and gas savings of 30 % in leisure centre sites (Carbon Trust, 2005).

HVAC heat recovery and heat-pump heating and dehumidification can reduce HVAC energy consumption by 50 – 80 % compared with simple open extraction systems.

Variable speed drive pumps may reduce pump electricity demand by up to 80 % (Leisure-design, 2012).

Balantia (2012) refer to a potential energy saving of 146 kWh per m^2 pool surface per year from installation of a pool cover on a small indoor pool in a luxury Spanish hotel.

Carbon Trust (2005) indicate that good practice can reduce energy consumption by 848 kWh/m^2yr for a typical public lesisure facility containing a 25 m swimming pool, primarily through a reduction in heating fuel consumption (Table 5.35). Best practice, including use of heat-pump heating, could potentially reduce the residual 725 kWh/m^2yr by a further 50 %.



Source: Carbon Trust (2005).

Figure 5.34: Annual fossil fuel and electricity consumption per m^2 for a 'typical' and a 'good' leisure centre containing a 25 m pool

Appropriate environmental indicator

<u>Water consumption</u>

Water consumption for swimming pools in tourism establishments is poorly documented. The ideal indicator for water use efficiency is water consumption per user, although this indicator is not regularly reported, perhaps in part because the number of users are not necessarily recorded in accommodation premises (though estimates based on surveys may be made). An alternative indicator is water consumption per m^2 of pool area, also not frequently reported.

As referred to in the description, above, there are some data relating to water consumption for hotel swimming pools averaged per guest-night. This is a relevant indicator based on data that should be readily available (if sub-metering of pool area water consumption is in place). It is important to define what is included in this measure – specifically, whether it represents just pool water consumption, or also water consumption for the entire pool and spa area (i.e. including showers and toilets, etc.).

<u>Energy consumption</u>

As with water consumption, energy consumption for swimming pool areas is not well reported. Ideal indicators are kWh/m^{2}yr or kWh/user. However, it is sufficient to report on the simple indicator kWh per guest-night, enabling easy comparison with total energy consumption indicators (section 7.1).

<u>Chemical consumption</u>

The type and quantity of chemicals consumed per m^2, per user or per guest-night is the relevant indicator here. For example, grams sodium hypochlorite per guest-night.

<u>Benchmark of excellence</u>

Owing to the lack of data on water, energy and chemical consumption in swimming pools, it is not possible to propose a performance benchmarks for swimming pools. Instead, the following management benchmark is proposed:

BM: implementation of an efficiency plan for swimming pool and spa areas that includes: (i) benchmarking specific water, energy and chemical consumption in swimming pool and spa areas, expressed per m^2 pool surface area and per guest-night; (ii) minimisation of chlorine consumption through optimised dosing and use of supplementary disinfection methods such as ozonation and UV treatment.

Cross-media effects

The main cross-media effects associated with measures in this section are:

- energy requirements for UV treatment to reduce chlorine requirements (small compared with avoided upstream chlorine production and potential downstream ecotoxicity effects);
- energy requirements for reverse osmosis to reduce water consumption (this is also expensive, and therefore only justified in areas of intense water scarcity);
- water consumption by bathers taking showers before entering the pool, to reduce chlorine requirements (as with previous effect, depends on water scarcity of the area).

Operational data

<u>Monitoring and benchmarking</u>

In the first instance, all water, energy and chemicals used for operation of the pool area should be monitored and used to benchmark performance over time (monthly and annual basis). Sub-metering should be in place to enable monitoring of water consumption for:

- the swimming pool
- changing (shower and toilet) areas.

Following initial data collation and normalisation relative to pool area and number of users (e.g. $L/m^2.yr$ or L per user water consumption), a consultation with swimming pool specialists may be used to inform on the level of efficiency represented by these data, and scope for improvement.

Frequent assessment (ideally daily checks) of consumption data can provide a useful indication of systems problems and maintenance requirements. For this purpose, the installation of automated recording systems is useful (see sections 5.1 and 7.1).

Showers and toilets in changing areas can be a major source of water consumption. Operational data on installing low-flow fittings (showers and taps), shower timers (percussion valves or sensors) and efficient dual-flush toilets in changing areas can be found in section 5.2.

<u>Filtering and backwash optimisation</u>

Filter circulation pumps are often over-sized owing to limited available size options, leading to excessive filter pressure with associated energy wastage and less effective filtration. Variable speed drives (inverters) may be fitted to pumps to enable precise control of pump speed according to demand.

Backwashing sand filters is a water-intensive process, requiring in the region of 225 to 450 litres per minute for a standard pool. Many hotel pool filters are backwashed as a matter of routine once or twice a day, compared with typical requirements of once every two or three days. Backwashing should be based on filter pressure rather a fixed schedule – for example, when the filter pressure required is over 0.5 bar more than the pressure required for a clean filter.

The backwash process should not take more than three to five minutes, and the subsequent pipe rinsing process just 15 to 30 seconds (Travel Foundation, 2011). It is important that all pool maintenance procedures, including backwashing, are clearly displayed in the pool room, and staff properly trained.

It has been claimed that recycled glass may be a more efficient filtration medium than sand, and that installing pre-filters can reduce the need for backwashing by up to 50 % (Leisure-design, 2012). This latter reference refers to the design of a 'Passive Pool'.

Backwash water recycling

Filter backwash water may be recycled back into the pool following appropriate treatment to achieve required water quality standards – usually locally applicable drinking water quality standards as pool water may be swallowed (NSW Gov, 2012). Controls should be put in place to protect against system failures and ensure health protection.

Reverse osmosis is considered to be the best available technology for the treatment of backwash water for recycling, and has been shown to remove over 99.5 % of dissolved salts, up to 97 % of most dissolved organics and 99.99 % of micro-organisms (NSW Gov, 2012). It is important to consult with a qualified expert on the design of a backwash water recycling plant as such plants work most effectively when combined with other treatments. For example, pre-treatment using ultra-filtration and granular activated carbon may be necessary to prolong the life of the reverse osmosis membrane.

Disinfection

Disinfection of pool water involves destruction of 99 % of exposed pathogens using a disinfection agent such as hypochlorite, and removal of particulate matter using a flocculating agents and filtration (ITP, 2008). The residual disinfection agent (e.g. free chlorine from hypochlorite) must be present in a sufficient concentration to kill new bacteria. Over 90 % of free chlorine is consumed through organic matter oxidation, emphasising the importance of measures to minimise organic matter loading (cleaning pool area, installing a foot cleaning bath for users).

Careful management of dosing and pool pH (Table 5.30) is critical to minimise hypochlorite consumption, irritation problems, and water consumption through dilution compensation for over-dosing. Automatic dosing is the best solution, based on monitoring of residual chlorine concentrations at least every two hours. Target chlorine concentrations should be adjusted according to microbiological parameters, tested at least every month (ITP, 2008). It is important to note that chlorine requirements increase with water temperature.

Table 5.30: Acceptable ranges for chemical parameters of pool water

Parameter	Acceptable range
pH	7.2 – 7.6
Total alkalinity	80 – 200 ppm
Total chlorine (gas plus hypochlorites)	0.5 – 1.0 ppm
Combined chlorine (chloramines)	<half total chlorine
Source: ITP (2008).	

It is relatively straight forward to install a UV filter through which filtered water can be passed to kill bacteria, thus reducing the residual chlorine requirements. Ozone generators can also be added (ozone produced by passing an electric current through air), to bubble ozone through water after filtration, also reducing residual chlorine requirements and improving water quality by oxidising organic compounds. Water must then be passed through a carbon filter to remove any remaining ozone. However, ozone generation and use requires careful regulation, as ozone leaks can be extremely hazardous to health. Additionally, ozone is highly reactive and unstable, making it difficult to control ozone concentrations in the ozone chamber and thus to regulate disinfection.

Pool heating and circulation

Pool heating requirements can be minimised by:

- ensuring that water temperature does not exceed recommended values (Table 5.31)
- minimising air-flow over the pool surface
- using a pool cover when the pool is not in use
- minimising water losses through back-washing and dilution to control pool chemistry.

Table 5.31: Recommended pool water temperatures for different pool types

Pool type	Recommended water temperature
Conventinal pool	28 ºC
Leisure pool	29 ºC
Hydrotherapy pool	32 – 40 ºC
Spa pool	40 ºC
Source: Carbon Trust (2008).	

Ideally, pool water heating may be achieved in combination with ventilation air dehumidification (see below). Air-water or water-water heat pumps are well suited to the low temperature heating requirements for pool water (section 7.4). Alternative sources of water heating particularly well suited to swimming pools include unglazed and glazed solar thermal collectors and heat pumps. The former are simple black pipes that absorb solar radiation to heat water flowing through them and are relatively cheap to install (ITP, 2008). Typically, an area equivalent to at least half the pool area is required.

HVAC

For indoor pools, operational data on improving the building envelope to minimise heat loss can be found in section 7.2. Specifically for swimming pools, it is important that the walls and base of the pool structure are well insulated where these are built down into the ground. Also, care should be taken to exclude drafts, by installing draught exclusion insulation, self-closing doors and foyer areas.

Best practice in HVAC system configuration, as described in section 7.3, applies here. HVAC within pool areas may be integrated into the accommodation building HVAC system, possibly via an automated building management system (section 7.1). The main objective of a pool-hall ventilation system is to distribute air in order to:

– provide comfortable temperatures for occupants

– avoid uncomfortable draughts

– remove smells produced by water treatment

– minimise evaporation and condensation.

To achieve this, pool ventilation systems may be zoned into three main areas, with specific requirements and recommendations (Table 5.32).

Table 5.32: Requirements and guidance for ventilation in three main zones of pool centres

Zone	Requirements	Comments
Pool surface	– Remove contaminants (although odours caused by water treatment process are not usually dangerous) – Evaporation control (minimise air movement at the pool surface)	– Control the water treatment process to minimise odours – Air requirements for bather respiration are met by diffusion and do not require additional ventilation – Direct ventilation air onto the building envelope to minimise evaporation from pool surface and to reduce the risk of condensation and mould problems on the building fabric
Pool side	– Comfort of the bather (before entering and after leaving the pool) – Comfort of the poolside staff	– Redirect any grilles and jets near the pool side to avoid direct air flow from the ventilation system – Staff should be discouraged from opening doors or windows, which creates draughts (instead, localised cooling can be provided by increased air movement such as through simple overhead fans).
Other areas	– Protecting the pool hall structure from condensation – Providing comfort to non-swimmers	– Provide separate air flows for the pool and other areas to minimise mixing between areas – In a new pool building, the air flow could be directed upwards from a slot at the foot of the walls in 'laminar flow' – For existing pool buildings, inlet grilles and jets can be repositioned so that drier air entering the pool hall can be pointed towards the sides of the building rather than down on to the pool – Comfort for spectators can be improved by having a similar arrangement to direct drier incoming air over them. – It may be necessary to blow drier air into ceiling voids to ensure that condensation does not occur on hidden parts of the structure

Source: Carbon Trust (2008).

For stand-alone HVAC control in an indoor hotel swimming pool, Carbon Trust (2009) recommend an air handling unit employing heat recovery and/or a heat pump, controlled by a thermostat and humidistat, to maintain an air temperature of 29 ˚C and relative humidity of 60 %. Note that air temperature should not be more than 1 ºC above pool water temperature in order to avoid excessive evaporation. Two main options are available.

- Plate heat exchangers may recover 75 – 80 % of sensible heat from outgoing air, but only recover latent heat (from moisture) when the outdoor air inflow temperature is low enough to cause condensation within the heat exchanger.

- An alternative, more expensive, option is to install a heat pump dehumidification, in which a heat pump is used to: (i) cool a condensing surface over which moist air from the pool building is circulated; (ii) heat re-circulating and incoming air; (iii) possibly also heat pool water. Such systems can reduce HVAC energy consumption by up to 50 – 80 % compared with open-air extraction systems.

Ventilation rates should be adjusted to account for factors such as the number of bathers, evaporation rate and water quality. Carbon Trust (2008) suggest a guideline figure of 10 litres of ventilation air per second, per square metre of total pool hall area (equating to approximately 4–6 air changes per hour depending on the height of the pool hall). However, best practice is to employ modulating dampers in combination with variable speed fans, humidity and CO sensors, so that pool air can be mixed with fresh air and re-circulated, in order to match the air exchange rate with humidity and air quality requirements. This is dependent on good air quality being maintained in relation to disinfection agents and by-products.

Application of a pool cover overnight not only reduces heat and water loss from the pool water body, but reduces over-night HVAC requirements. It may be possible for HVAC system to be shut down overnight, although to avoid condensation damage it may be preferable to leave the system on standby and activated by humidistat (if relative humidity increases above 70 %).

Applicability

Table 5.29, above, refers to the applicability of specific best practice measures within this BEMP section.

Economics

Best practice measures referred to above realise economic benefits in the form of:

- reduced energy demand
- reduced water demand
- reduced chemical demand
- lower maintenace costs for filters, pumps, and the building fabric (less condensation damage).

Record keeping and good management practices do not involve significant capital costs but can realise substantial savings in relation to the above costs (Carbon Trust, 2005). Installing an automated building management system can lead to a further 10 % energy cost savings, and can realise relatively short payback for larger leisure centres (Carbon Trust, 2006).

Energy savings

For a 25 m pool situated within a 1000 m^2 complex, energy savings from good management practices and basic retrofits such as as variable speed pumps and heat exchangers (see Figure 5.34) could range from EUR 50 000 to EUR 85 000 per year at energy prices of EUR 0.06 to 0.10 per kWh.

Installing a recirculation system with a heat pump would require an investment of approximately 30 % more than for a full fresh air system controlled via a humidistat, but a 20 % reduction in energy costs should lead to a payback of approximately two years for a 100 m2 pool (Carbon Trust, 2009).

Installing automatic variable speed control of swimming pool pump motors at Hutton Moor Pool saved approximately EUR 8 000 per year (Carbon Trust, 2005) – these savings are likely to be considerably higher at current energy prices. The lifetime savings of high-efficiency variable speed motors can be many multiples of capital costs. Carbon Trust (2005) note that lifetime operating costs for a EUR 350 motor for a pool circulation pump can exceed EUR 35 000.

Water savings

Economic benefits associated with water savings are smaller than benefits arising from energy savings. At a water price of EUR 2.50 per m^3, annual water savings of almost 2 000 m^3 for a 25 m pool (Figure 5.33) would translate into annual cost savings of almost EUR 5 000.

As referred to in section 5.2, installation of low-flow shower, tap and toilet fittings or retrofit options is associated with short payback periods, often less than one year.

Pool covers have a payback period of 1 – 3 years, dominated by the energy rather than water saving (Carbon Trust, 2005).

Reverse osmosis backwash water recycling requires high capital, operational and maintenance costs, and may only be worthwhile in areas of extreme water shortage.

Driving force for implementation

As referred to above, optimised pool management can lead to significant economic savings through reduced energy, water and chemical consumption, and reduced maintenance requirements.

Careful control of pool water quality and chemical dosing, in particular avoiding excessive chlorination, can increase user enjoyment.

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5.7 Rainwater and greywater recycling

Description

Some water applications in buildings, such as toilet flushing and irrigation, do not require the use of potable water. These applications can be responsible for a large share of total water use. Landscaped grounds were found to be the most important determinant of water use efficiency across Hilton hotels. Across Scandic hotels each m^2 of landscaped ground was statistically associated with an additional 88 L per year of water consumption (Bohdanowicz and Martinac, 2007). Thus, the use of water recycled from on-site rainwater or grey water collection systems can considerably reduce demand for potable water from the mains supply.

Rainwater collection systems divert rainfall water into storage tanks. Run-off systems can be installed on roofs and other impervious surfaces. The harvested water can be used for non-potable demand such as toilet flushing, washing machines, irrigation, cooling towers or general cleaning purposes. Thirty-five percent of new buildings built in Germany in 2005 were equipped with rainwater harvesting systems (EC, 2012), and about 100 Accor hotels have been installed with rainwater recovery tanks to supply irrigation or car washing applications.

Grey water is the term used to describe wastewater from activities such as bathing, showering, laundry, dishwashers, and excludes 'black water' from toilet flushing. Grey water may be collected and reused for non-potable water applications such as toilet flushing and irrigation by the installation of separate wastewater drainage systems for toilets and grey water sources.

Although usually too expensive and impractical to retrofit, water recycling systems can be installed at relatively low cost during construction, and at reasonable cost during major renovations. Smith et al. (2009) estimate water recycling systems can add 15 % to plumbing system costs during major renovation. The decision to install rainwater collection systems and greywater recycling should be based on a cost-benefit assessment that considers economic and environmental criteria, including the source and scarcity of water supply now and in the future. Water recycling is highly visible to guests, and may thus be a useful way to convey corporate environmental responsibility. One potential alternative for enterprises with a high irrigation water demand that can avoid the need for installation of a separate wastewater collection system is the use of all treated wastewater for irrigation (section 6.3).

Rainwater collection for irrigation is regarded as a basic good practice measure. Best practice is considered to be:

- installation of a rainwater collection and distribution system for use inside the building
- installation of a greywater collection, treatment and distribution system for use either inside or outside the building.

Achieved environmental benefit

EC (2009) estimate that water recycling can reduce water consumption by an additional 10 %, after a 40 % reduction in water consumption achievable from implementation of water efficiency measures.

A rainwater recycling system installed in the 250-room ETAP city-centre hotel in Birmingham, UK, saves up to 780 m^3 of potable water per year (5 % to 10 % of consumption). This saving equates to about 6 % of best practice water consumption for this size of hotel (after implementation of all other water efficiency measures).

NH Campo de Gibraltar hotel substitutes 20 % potable water with filtered and treated greywater from showers, used to flush toilets.

There are some cross-media effects associated with rainwater collection and greywater recycling (see below). The overall environmental benefit will be highest where local (perhaps seasonal) water shortages exist, and where water is imported from other areas or desalinated. In such areas, modest reductions in water consumption may lead to significant reductions in water stress (with associated benefits, including for biodiversity), and/or energy requirements for deslination.

Appropriate environmental indicator

Indicators

The most relevant indicators of water recycling implementation are:

- installation of a rainwater recycling system that supplies internal water demand
- installation of a greywater recycling system that supplies internal or external water demand
- quantity of rainwater and grey used, m^3/yr
- percentage of annual potable water consumption substituted with recycled rain- or grey-water

In areas where seasonal water scarcity is a problem, particularly as a consequence of tourism demand, seasonal indicators may be relevant – e.g. water consumption per guest-night during peak season, or percentage reduction in consumption achieved over the peak season.

Benchmarks of excellence

So far, there is little information on specific water savings achievable through the implementation of this BEMP, which may vary considerably depending on factors such as climate. Therefore, the following benchmark of excellence represents best practice for this technique.

BM: installation of a rainwater recycling system that supplies internal water demand, or a greywater recycling system that supplies internal or external water demand.

Best practice in this technique may also be reflected in conformance with the benchmark for potable water consumption in section 5.1 (i.e. ≤140 L per guest-night for fully serviced hotels and ≤100 L per guest-night for other types of accommodation).

Cross-media effects

Reused rain water can have a higher energy and carbon footprint than mains supply water owing to infrastructure and pumping requirements. The carbon footprint of a domestic sized rainwater harvesting system over **30 years** has been estimated at approximately 800 kg CO_2 eq. However, this is minor compared with total household carbon emissions from energy use, which can be 100 times higher.

Rainwater reuse systems essentially bypass the natural water cycle. Where drainage water would otherwise soak into the ground, and where groundwater levels are locally declining, and where water is supplied from a (nearby) area with greater water availability, widespread rainwater harvesting could exacerbate **local** water stress. Such situations are unlikely, however. On the contrary, widespread rainwater harvesting could reduce flooding risk during high rainfall events.

Operational data

Run-off water quality

Contaminants in roof run-off water include organic matter, inert solids, faecal deposits from animals and birds, trace amounts of metals and complex organic compounds. Concentrations vary depending on roof material, antecedent dry period and surrounding environmental conditions (e.g. proximity motorways or industrial areas). Leaching of heavy metals such as copper, zinc and lead can present a problem where these materials are extensively used in roof construction. However, a study of roof run-off quality in Hamburg, Germany, found that copper, lead and zinc concentrations were well within World Health Organization drinking standards (Villarreal and Dixon, 2005). The quality of roof run-off (Table 5.33) is acceptable for domestic uses, especially following basic filtration. It is possible but usually not necessary to fit a device to rainwater collection systems that diverts the first flush of run-off water during rain events, containing the highest concentrations of contaminants, to normal drainage.

Table 5.33: Water quality parameters for 'fresh' and stored roof run-off water

	pH	BOD	COD	TOC	TS	SS	Turbidity
		mg/l					NTU
Roof run-off	5.2 – 7.9	7 – 24	44 – 120	6 – 13	10 – 56	60 – 379	3 – 281
Stored run-off	6 – 8.2	3	6 – 151	–	33 – 421	0 – 19	1 – 23
Source: Villarreal and Dixon (2005).							

Run-off water from some surfaces such as car parks can contain relatively high levels of contaminants such as hydrocarbons and heavy metals from vehicles, and will not be suitable for use indoors. Run-off water should be tested before deciding to install a recovery system. Where water is not suitable for indoor use, it may be suitable for irrigation following installation of a first-flush diverter and appropriate filtration.

Run-off collection system design

Rainwater collection and reuse is a simple process. The necessary components can be easily installed in a new building at relatively little expense, but are more difficult to retrofit in an existing building. Extensive plumbing modifications are required to separate the water supply network into two systems supplying: (i) kitchen taps, bathroom taps and showers supplied by 100 % potable water from the mains supply; (ii) toilet cisterns, urinals and laundry facilities supplied with rainwater or potable water depending on availability. Where rainwater is available in sufficient quality and quantity, it may also be used in showers.

A typical rainwater reuse system comprises the following components.

- A standard roof or surface run-off water collection system operating under gravity and diverted into a storage tank, fitted with a debris screen and filter.
- A storage tank with water-level detector, ideally situated underground, into which rainwater is diverted from standard rainwater collection pipes.
- A control unit that sends either mains water or stored rainwater either directly to the distribution system under pressure, or to a header tank.
- A separate pipe distribution system feeding relevant fittings (urinals, cisterns, etc.) with water supplied either directly under mains/tank-pump pressure or from a header tank.
- (Possibly) A header tank with float-operated inlet valves from pumped rainwater and from the mains water supply, and an outlet valve into the building water supply system.

There are various methods of tank sizing, some of which may be area specific. One guideline is that the tank should be large enough to hold 18 days of average demand, or five per cent of annual yield, whichever is lower (Peacock irrigation, 2011). Another guideline is that the tank should be able to store sufficient water to supply average demand over the longest dry periods (statistically defined from 30-year climatic data). The yield can be calculated by the following simple equation:

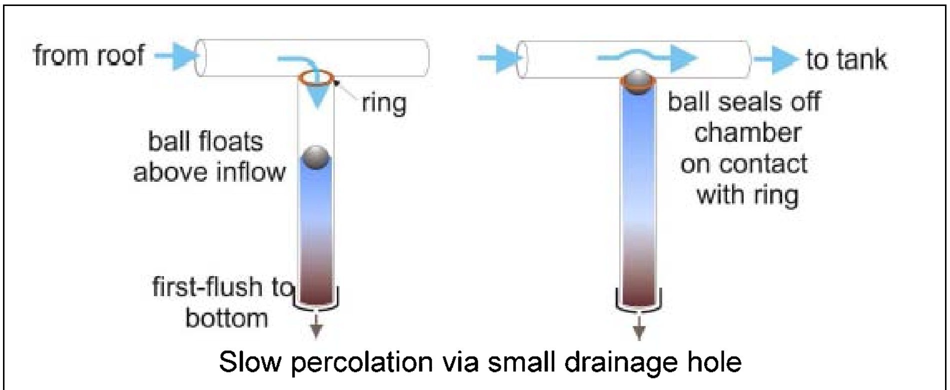
$S = (R/1000) \times A \times RC$		
S	Annual supply	m^3
R	Annual rainfall	mm
A	Plan area draining into collection pipes	m^2
RC	Run-off coefficient	0 – 1

Annual rainfall varies considerably across and within countries and across years. Climatic average annual rainfall data should be obtained from the nearest weather station. Area refers to the **plan** area, which will differ from the roof area for sloping roofs. UNEP (2009) suggest run-off coefficients of 0.8 – 0.9 for tile roofs, 0.6 – 0.8 for concrete and 0.7 – 0.9 for metal sheets.

Thus, for a concrete roof with a 500 m^2 plan area in a region exposed to 1 000 mm annual rainfall, annual run-off water supply would be 1 x 500 x 0.7 = 350 m^3. Applying the 5 % rule, the total recommended tank capacity would be 17.5 m^3. However, strong seasonality in rainfall, in particular the occurrence of long dry periods, may require larger capacity. The seasonality of rainfall patterns should be assessed, and tanks may be sized according to the aforementioned dry-period supply rule. The British Standard code of practice for rainwater harvesting systems (BSI, 2009) recommends a modelling approach to tank sizing that considers temporal variations in demand and yield, using at least three years of data, for commercial applications such as tourism establishments. Occasional overflows are a useful way to clean debris from the tank and maintain water quality. Tanks may also be sized for stormwater control to reduce the risk of flooding, in which case statistical data on storm events should be used to specify 'oversized' tanks.

Rainwater system installation

Rainwater collectors such as guttering should be regularly inspected and kept clean of debris, including leaves. Wire mesh screens may be fitted to gutters to debris entering the system, and it is recommended to fit a filter to the inflow of the rainwater collection tank. These typically contain a fine wire mesh of e.g. 0.35 mm, may contain additional micro-filtration layers, and can be self-cleaning (by periodically applying high-pressure water over the mesh surface to a separate outlet for debris). A first-flush diverter may be fitted to reduce the concentration of pollutants in the collected rainwater (Figure 5.35).

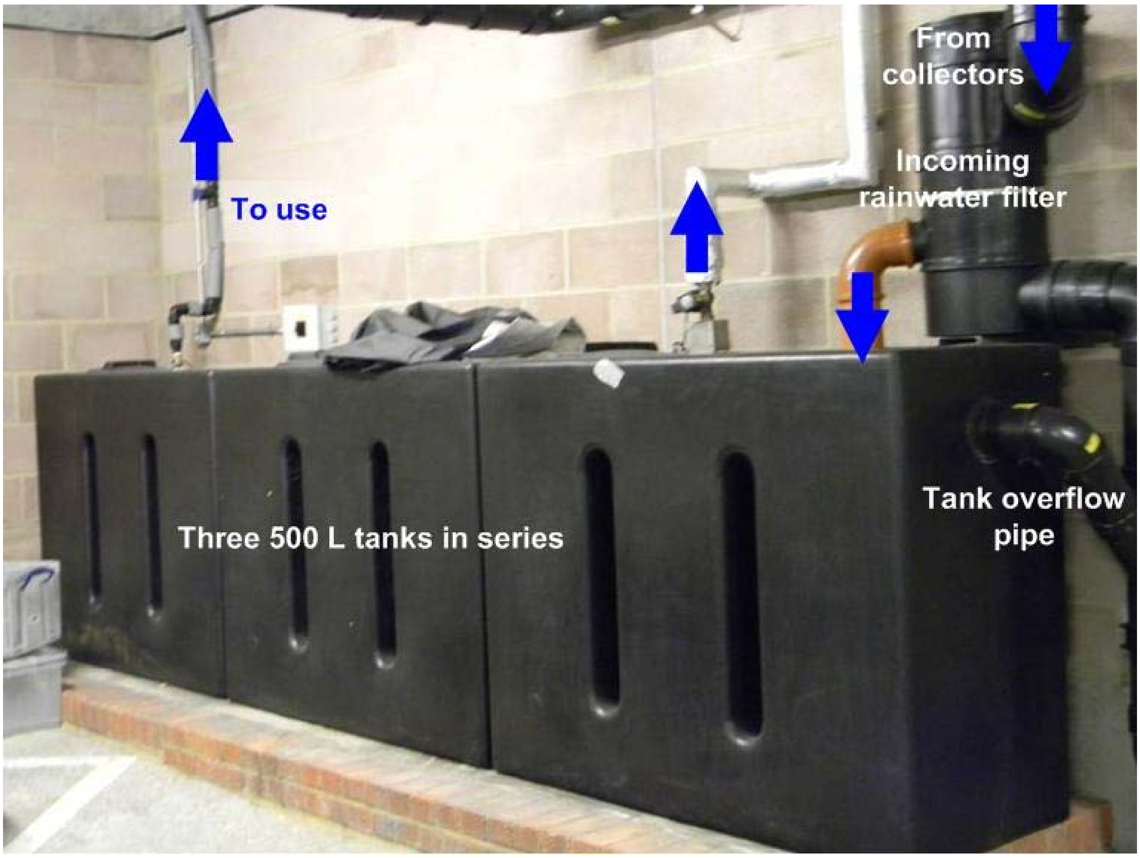


Source: UNEP (2003).

Figure 5.35: Float-ball mechanism to divert first flush run-off water

Prefabricated rainwater storage tanks are commercially available in sizes of up to 7 m^3 for underground types and 10 m^3 for above-ground types (Bicknell, 2009). It is possible to buy tanks built in two pieces that are joined together during installation – these can be particularly useful where space onsite is restricted for installation. Where large storage capacity is specified at the building design phase, purpose-built concrete tanks may be constructed. Alternatively, multiple pre-fabricated tanks may be installed in series (see Table 5.34).

Table 5.34: An example of a small rainfall collection (above) and storage (below) system, from the Rafayel Hotel in London



Tanks should be installed underground or in unheated basement areas where the temperature remains stable and relatively low throughout the year. Buried tanks with an ambient temperature not exceeding 12 ºC are ideal because they restrict biological activity that can otherwise be associated with water discolouration, and potential health risks (Bicknell, 2009). BSI (2009) recommend a floating extraction point at 100 mm to 150 mm below the water surface, or alternatively a fixed extraction point at 150 mm above the base of the tank. Overflow pipes should be at least equal in capacity to inflow pipes, protected from backflow and vermin, and, where possible, connected to a soak-away drain.

It is highly recommended to install a meter to measure rainwater use. This will facilitate the identification of problems, and enable calculation of potable water savings. This system will usually be incorporated into the control system that controls pumps and regulates the backup (potable) water supply. The system may also be integrated into a centralised building management system.

Pipework should be clearly identifiable as supplying rainwater, and differentiated from pipework supplying only potable water. Pipework may be identified by markings inserted during manufacture, or attached labels. It is recommended that labels be attached at 0.5 m intervals along the pipe, and on the outside of insulation where this is present (BSI, 2009). Similarly, labels and signs should be visible at all points of use stating 'non-potable water'.

Frequent inspection of the system and tank water can identify water quality problems, combined with occasional dip testing of water in the storage tank or cistern, for example in accordance with BS 7592. Sampling of water quality at the point of use is only required if problems are detected from the periodic sampling (BSI, 2009). Guideline values for use of collected water to flush toilets in single site and communal domestic systems are provided by BSI (2009):

- escherichia coli number ≤250 per 100 ml
- intestinal enterococci number ≤100 per 100 ml
- total coliforms ≤1000 per 100 ml.

<u>Grey water recovery</u>

Greywater recovery requires the installation of separate wastewater collection systems for: (i) showers, basins, washing machines, kitchen appliances, swimming pools (greywater); and (ii) toilets (black water). In fact, separate greywater collection may be restricted to room showers and basisns, in order to avoid more heavily soiled water from kitchens and laundries.

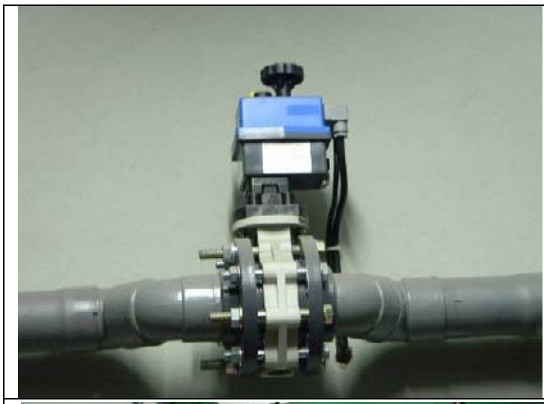
In its most basic form, greywater recycling requires:

- installation of a separate wastewater collection system for greywater and blackwater
- basic screening to remove debris
- installation of large greywater storage tanks (as described above for rainwater harvesting)
- connection to an irrigation system.

It is easy to incorporate a basic heat-exchange process into greywater collection systems, to heat fresh water entering the heating system. Such a system is described in section 9.3 for a campsite. Use for indoor activities such as toilet flushing requires installation of a separate supply system as described for rainwater recycling (above). An example of a system using pool overflow water for toilet flushing is provided for a campsite in section 9.3. Here, the example of NH Campo de Gilbralter is presented.

The 100-room NH Campo de Gibraltar hotel, in Algeciras, Spain, was opened in 2009 with a novel grey water recycling system shared with one other NH hotel (Hesperia hotel, in Cordoba). Wastewater is collected separately from basins and showers, treated, and recirculated for toilet flushing, reducing potable water consumption by 20 %. The sequence of steps is elaborated with reference to photos in Table 5.35.

Table 5.35: Sequence of steps in greywater recycling implemented at NH Campo de Gibraltar hotel

<table>
<tr><td></td><td>1. Greywater diversion

An electrovalve controls flow of separated greywater into the treatment tank depending on remaining capacity. If full, greywater is diverted to the sewer.</td></tr>
<tr><td>
</td><td>2. Greywater filtering

A flow sensor located after the electrovalve activates a dosing system to add hypochlorite to greywater entering the treatment room for recovery.

Following hypochlorite dosing, water is filtered through a mesh screen to remove debris such as hair. This screen is manually cleaned, requiring 15 minutes per day. Debris is collected in a standard waste bin and sent for disposal.

Filtered water is left to settle in a sedimentation tank. Sludge from the sedimentation tank is collected every 15 – 30 days by a tanker.</td></tr>
<tr><td></td><td>3. Storage

Filtered, settled greywater is directed to a series of three intermediate and two final storage tanks.</td></tr>
</table>

	**4. Distribution** Stored grey water is pumped to toilet cisterns throughout the hotel through a clearly labelled greywater pipe network.
	**5. Toilet flushing** All toilets in the hotel are flushed using treated greywater.

CRC (2002) make the following recommendations for the safe reuse of grey water that minimises potential human health risks (in Australian conditions):

- kitchen grey water should not be included as it is highly polluted, putrescible and contains many undesirable compounds;
- grey water should not include wastewater from kitchen sinks, dishwashers, garbage disposal units, laundry water from soiled nappies or wash water from the bathing of domestic animals;
- removal of hair, lint, etc. via strainer or filter is necessary to ensure systems do not clog;
- blockages and build-up of slime may be avoided by using pressurised systems;
- storage of grey water is undesirable due to the potential for the growth of pathogenic micro-organisms, mosquito breeding and odour generation;
- sub-surface reuse is the preferred method of irrigation as surface irrigation is prone to ponding, run-off and aerosols (see section 9.2);
- reuse for toilet flushing should not be considered as it requires a high degree of treatment to ensure no health risks, toilet staining or biodegradation in cistern.

<u>Health and safety regulations</u>
Safeguards must be in place to prevent the possibility of backflow of collected non-potable water into the main supply system. The most rigorous safeguard is an air-gap system. Rainwater harvesting and grey water systems must conform to the European Standard on backflow protection by an air gap (EN1717). National regulations usually specify backflow protection requirements applicable to rainwater or greywater recycling systems. For example, in the UK rainwater harvesting systems that involve mains supply top-up must comply with section 5 of The Water Supply (Water Fittings) Regulations 1999 dealing with backflow protection to protect mains water – this requires an air gap with an unrestricted discharge between the incoming mains water and the recycled water ('a non-mechanical backflow prevention

arrangement of water fittings where water is discharged through an air gap into a receptacle which has at all times an unrestricted spill-over to the atmosphere': UK Governemnt, 1999). A tundish (Figure 5.36) is an appropriate spill-over arrangement (Bicknell, 2010).

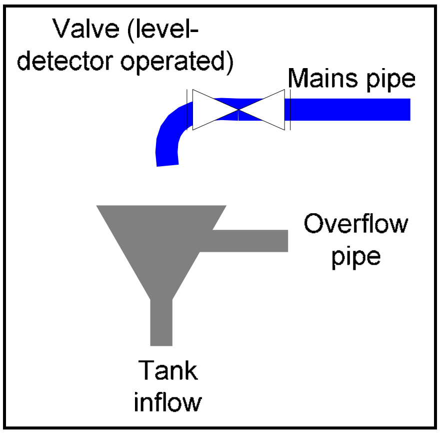


Figure 5.36: Basic tundish device

Applicability

The installation of rainwater and greywater recycling systems is applicable to all new buildings. Retrofitting such systems to existing buildings is expensive and impractical unless the building is undergoing extensive renovation.

Where wastewater is treated on site and there is a high demand for irrigation water, treatment and use of all wastewater for irrigation may be a more efficient option than separation and reuse of greywater.

Economics

The costs of equipment of water recycling facilities are high and the payback period is longer than for other water efficiency measures. A 14-year payback period was calculated for installation of rainwater recovery in the ETAP Birmingham city centre hotel (Accor, 2010). Therefore, this option should be applied after other more cost-efficient measures have been taken (see sections 6.2 6.6).

Greywater recovery systems require separate pipework and are therefore difficult to retrofit. Payback periods vary from 2 to 15 years depending on the type of system and the cost of potable water saved (ITP, 2008). Relatively high maintenance costs, of EUR 2 000 to EUR 3 000 per year, were also reported for the NH Campo de Gibraltar hotel, offsetting some of the 20 % reduction in the annual water bill.

Governments may provide financial incentives for the installation of water recycling systems, such as grants or tax rebates. In the UK, the Enhanced Capital Allowance scheme allows businesses to offset installation costs for water recycling systems against tax in the year of installation.

Driving force for implementation

The two primary objectives for implementing water recycling schemes are to: (i) reduce water consumption; (ii) reduce wastewater volume. The driving forces behind these include water and wastewater service charges (above) and CSR or green marketing (water recycling systems are highly visible indicators of environmental responsibility). Increasingly, national regulations are encouraging the installation of water recycling systems. In the UK, the following main regulatory drivers apply (Bicknell, 2010).

- The Code for Sustainable Homes encourages builders to install rainwater harvesting in new-builds.
- Part G of the Building Regulations (April 2010) sets a mains water consumption standard of 125 litres per head per day.
- Councils give expeditious and sympathetic handling of planning permission to applications which include rainwater harvesting.
- The Flood and Water Management Bill (April 2010) suspended the automatic right to connect to a sewer, encourages rainwater harvesting to help alleviate flood threats, and gives water boards greater powers to ban the use of hosepipes for outdoor water use during water shortages.

In addition, building standards such as BREEAM (BRE Environmental Assessment Method) contain requirements or award optional points for water conservation measures including water recycling, and governments may offer financial incentives (see above).

Reference organisations

- Over 100 hotels within the Accor group have rainwater recovery systems in use. The 250-room ETAP city-centre hotel in Birmingham, UK, installed a rain-water recovery system in 2007 that supplies toilet cisterns in 90 rooms and saves up to 780 m^3 of water per year. Potable water consumption is reduced by between 5 % and 10 % (Accor, 2010).
- The NH Campo de Gilbralater hotel recovers greywater from showers and basin for toilet flushing, as described in Table 5.35 above.
- The Uhlenköper Campsite in Germany uses water from the natural swimming pool to flush toilets in the adjacent washroom.
- Kühlungsborn camping park uses greywater from showers and basins in the washroom for irrigation, following heat recovery described in section 9.2.
- Basic practice is demonstrated by the 14-room Strattons hotel and restaurant in Norfolk, UK. Rainwater storage capacity of 15 900 L was installed, comprising one large 10 000 L tank, a smaller 1 100 L tank, and 12 x 400 L water butts (Envirowise, 2008). This water is used to irrigate the 0.4 hectare grounds that include a fruit and vegetable garden cultivated to supply the on-site restaurant. An additional 2 000 L of greywater per week are recovered from restaurant and kitchen operations and used in the garden.
- Another example of basic practice is the Rafayel Hotel in London, where rainwater is collected from the building roof and car-park-cover (Table 5.34, above) for irrigation of planted areas.

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6 MINIMISING WASTE FROM ACCOMMODATION

Tourism and waste generation

Tourism is responsible for a small share of waste generation within Europe, contributing towards the 6.7 % of total waste generation that arises from the wider services sector in the EU-27 (EEA, 2010). Nonetheless, the quantities of solid waste generated by tourism enterprises are large in absolute terms – 35 million tonnes of solid waste per year globally (Conservation International, 2003) – and the types of waste generated are associated with greater environmental impacts than bulky and often inert wastes from the construction and mining sectors that dominate waste generation statistics.

Tourists may generate up to twice as much solid waste per capita as local residents (IFC, 2007). Waste from accommodation has similar characteristics to mixed household waste, being composed of a diverse mix of materials, including organic and hazardous materials, that can give rise to significant environmental impacts upon disposal (especially through GHG emissions and leaching of toxic materials). Accommodation and restaurants are major contributors to packaging waste (Eurostat, 2010), including plastics and metals with high embodied energy that are responsible for significant resource depletion upon disposal. Furthermore, tourism waste often varies seasonally, and is generated in areas sensitive to littering, potentially putting pressure on waste management facilities during peak season and damaging high nature value resources. Plastic waste in the oceans poses a threat to whales, dolphins, sea turtles and birds.

Accommodation waste sorting

Waste generation and sorting varies considerably across hotels (Figure 6.1), and other types of accommodation. Waste sorting partly depends on the waste collection services available in different locations, and this may partly explain the large differences in unsorted waste generation across hotels within the same hotel chain but in different countries (Figure 6.1).

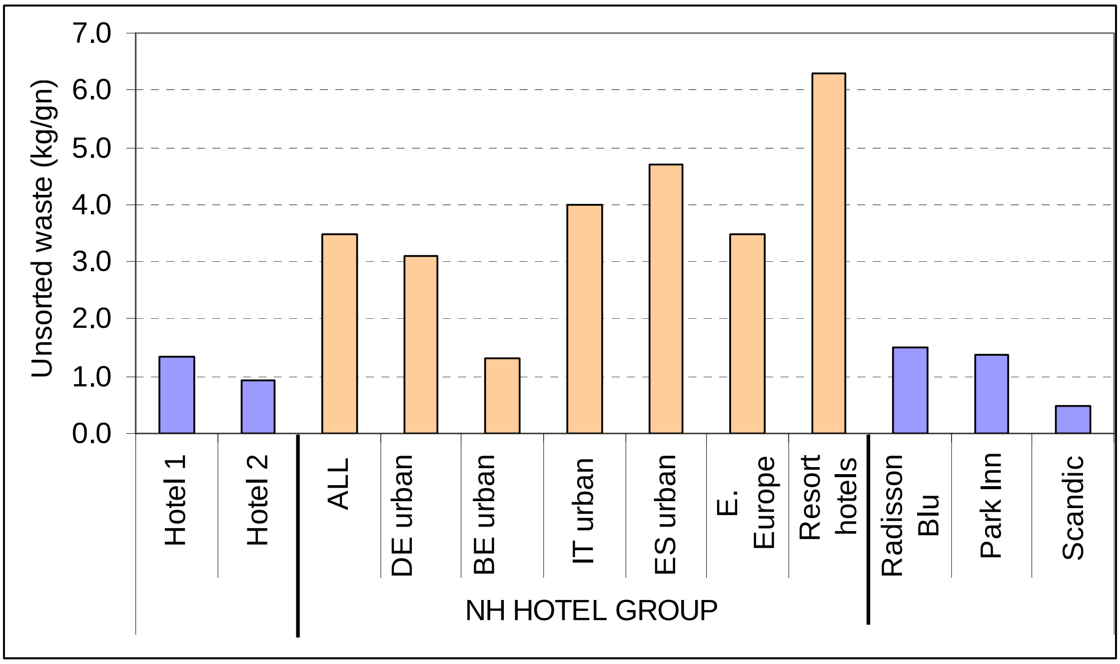
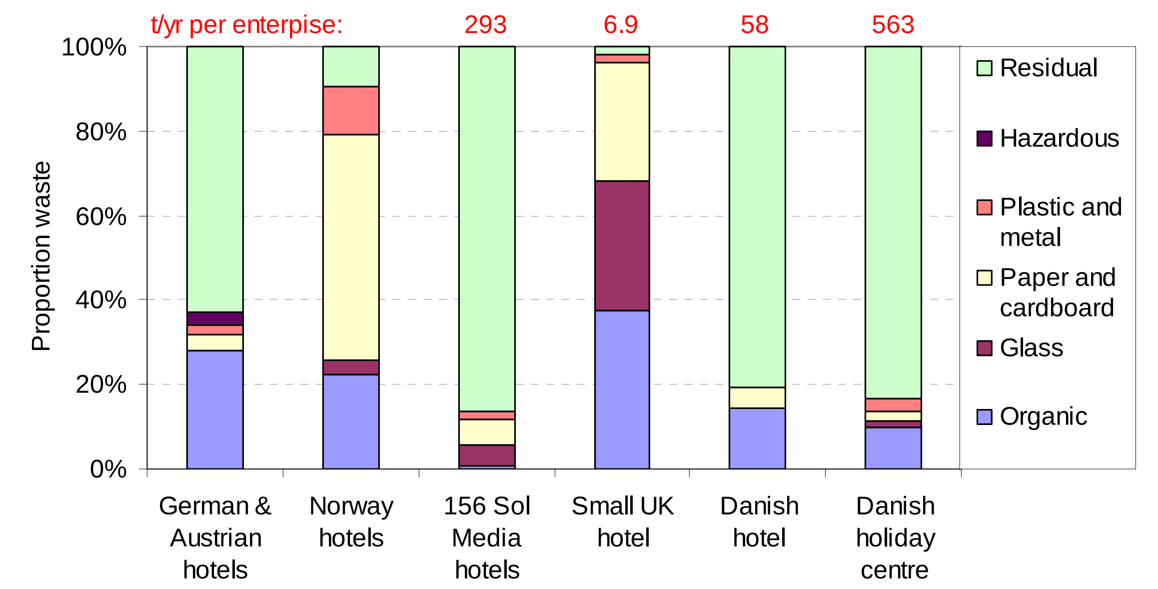


Figure 6.1: Unsorted waste generated per guest-night across different groups and types of hotel, from sustainability reports

The composition of waste from accommodation establishments is similar to household waste, but varies somewhat depending on the services offered. Hotels with restaurants have a higher share of organic waste. Classification of waste varies according to sorting, but organic, glass, paper and cardboard and plastic and metal are the main fractions (Figure 6.2). For many hotels with poor sorting, residual waste is the dominant fraction.



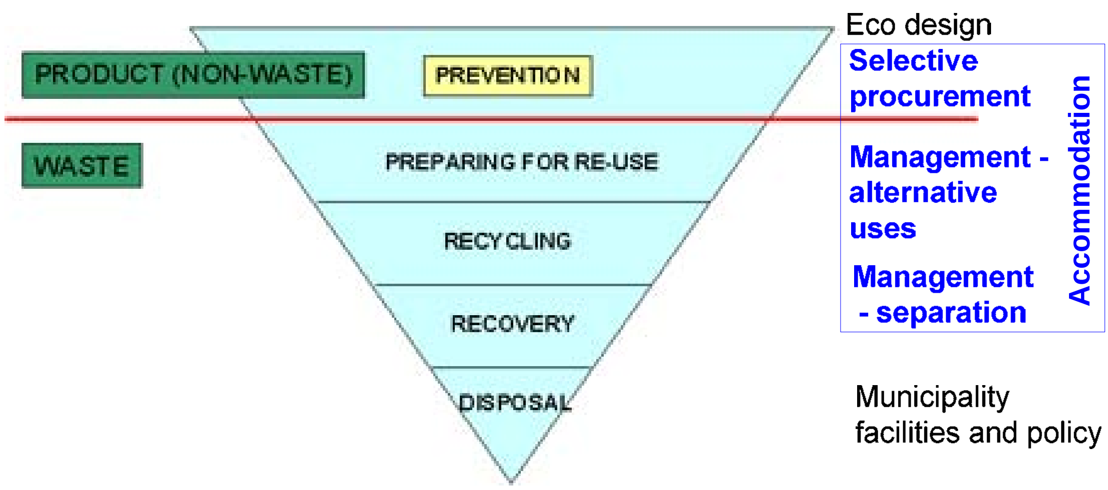
Sources: Ecotrans (2006); SFT (1998); Sol Media (2011); Envirowise (2008); Miljøstyrelsen (2000).

Figure 6.2: Composition of waste for accommodation enterprises reported by different sources

Waste management hierarchy

Figure 6.3 displays priority actions for resource efficiency and waste management, with actions relevant for accommodation managers highlighted. Priority actions relevant to accommodation managers are summarised below.

1. **Reduce:** Create as little waste as possible by not producing it to begin with – implement green procurement, do not over-order, select products with little packaging or returnable packaging.
2. **Reuse:** Consider where certain items can be reused, sold or donated to others that can use them.
3. **Sort:** Have a system in place for sorting everyday waste items such as bottles, cans, cardboard and paper for recycling. Consider what else might be recycled, taking into account local disposal possibilities.
4. **Recycle:** Send sorted waste for recycling.



Source: Derived from EC (2011).

Figure 6.3: The waste management hierarchy, with priority actions at the top

Driving forces for waste management

Various regulations are relevant for waste management in the tourism sector. Accommodation enterprises generate, store, and in some cases trade waste. European legislation relevant to accommodation providers with respect to waste management is listed below.

- Directive 2008/98/EC on waste and repealing certain directives.
- Decision 2000/532/EC establishing a list of hazardous wastes.
- Directive 2002/96/EC on waste electrical and electronic equipment.
- Regulation 1774/2002 laying down health rules concerning animal by-products not intended for human consumption.
- Directive 75/439/EEC regarding disposal of waste oils.
- Directive 94/62/EC on packaging and packaging waste and the amendment of Directive 2004/12/EC.
- Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators.

Other regulations are relevant for local authorities and waste management companies. These include Directive 99/31/EC on landfill of waste and Directive 2000/76/EC on waste incineration.

There are also strong economic incentives for minimising waste. For many types of waste, such as packaging, accommodation pays twice for it: at purchasing and at disposal.

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6.1 Waste prevention

Description

The first step in waste prevention and management in accommodation is to generate an inventory of the types and sources of on-site waste generation. Waste generated by accommodation is diverse, with a similar composition to domestic (municipal) waste, and comprises paper and cardboard items, glass and aluminium products, plastic items, organic waste, building materials and furniture, and used oils and fats (see Figure 6.2 in section 6). The Danish EPA conducted a waste survey of all service sector operations in Denmark in 2000, including accommodation facilities, and conference and course centres (Table 6.1). Hotels were generally found to sort into four main waste types: ordinary (residual) waste, bottles and other glass jars, organic waste and cardboard packaging.

Table 6.1: Typical waste constituents from different types of hotel, according to Danish waste classification

Hotels with restaurants	Holiday centres
– mixed waste for incineration – batteries – waste with household characteristics – bottles and glass – garden and park waste – iron and metal – organic waste – fluorescent tubes – cardboard waste – paper – plastic packaging – machines – equipment and furnishings – refrigerators – electric and electronic products	– mixed waste for incineration – batteries – waste with household characteristics – bottles and glass – garden and park waste – iron and metal – organic waste – fluorescent tubes – cardboard waste – paper – plastic packaging – machines – equipment and furnishings
Source: Miljøstyrelsen (2000).	

Table 6.2 presents the results from a more recent analysis of waste management in 36 hotels in the 2- to 4- star categories in Germany and Austria. Total waste generation averaged 1.98 kg (6 litres), per guest-night. Plastic and metal comprised a relatively small proportion of overall waste in this survey, but this may reflect low separation rates for these materials. The classification of waste in accommodation depends on the degree of sorting, and 'residual' classification is typically applied to a large proportion of waste where sorting rates are low. Waste types and quantities from accommodation depend on the services offered, especially in relation to food and beverage services.

Table 6.2: Waste percentages from Survey among German and Austrian hotels

	Residual	Paper	Glass	Plastic and metal	Organic
kg	49 %	12 %	6 %	2 %	31 %
Litre	55 %	23 %	5 %	8 %	9 %
Source: Ecotrans (2006).					

Hazardous wastes may include batteries, solvents, paints, antifouling agents, some packaging wastes, leftover insecticides and pesticides, leftover chlorine and hydrochloric acid from swimming pool operations, and de-icing chemicals. Generally the amount of hazardous waste resulting from hotel operations is small. Commission Decision 2000/532/EC lists how hazardous waste, including electronic equipment, shall be separated, collected and disposed of. Directives 2002/96/EC and 2002/95/EC of the European Parliament and the Council specify hazardous waste types affected.

A large portion of accommodation waste can be readily eliminated from the waste stream through prevention measures and recycling (section 6.2), informed by a site-specific waste inventory. An effective waste management programme can usually reduce the volume of waste sent to landfill or incineration by more than 50 % (Travel Foundation, 2011). Waste management programmes also save money by improving the use of materials and resources, and by lowering waste disposal costs. Senior management and procurement staff, housekeeping staff, catering staff and reception staff must be fully involved with waste management programmes to ensure effective implementation of prevention measures (Table 6.3).

Following the creation of a waste inventory, waste prevention and minimisation are the first priority steps in waste management and resource efficiency (see Figure 6.3 in section 6). There is considerable scope to prevent waste in the accommodation sector by taking a number of actions across different departments (Table 6.3).

Table 6.3: Best practice measures to prevent and avoid waste

Department	Measure	Description
All (management led)	Develop waste inventory	Survey all areas and processes to identify types and sources of on-site waste generation
Procurement	Efficient ordering and storage	Order perishable products frequently in quantities required. Store perishable products in appropriate conditions (e.g. correctly adjusted refrigeration units: section 8.4). Order non-perishable products in bulk
	Local sourcing and packaging return	Source food locally where appropriate, and return packaging for reuse (see also section 8.1)
	Select low packaging products	Select products with less packaging where possible and consistent with other green procurement criteria (section 2.2) – e.g. purchase chemicals in concentrate form
Housekeeping	Efficient bathroom toiletries	Replace individually wrapped soaps and shampoos with soap and shampoo dispensers. Provide additional toiletry items only on request
	Efficient housekeeping	Avoid use of bags in bins, or where used, replace only when soiled
Catering	Provision of low impact drinking water	Avoid bought-in bottled water where possible. Provide guests with tap water in rooms and dining area (may be filtered and bottled), and provide reusable glasses for drinking
	Efficient breakfast provision	Avoid single-portion servings as far as possible within hygiene constraints, and cook to order (see also section 8.1). Avoid single-use plates, cutlery, etc.
Reception	Efficient document management	Print documents only when absolutely necessary, double-sided in small font. Use electronic billing.

Packaging alone can account for up to 40 % of a hotel's waste stream (Travel Foundation, 2011), and avoiding single-use and individually wrapped items can prevent a considerable quantity of waste. The quantity of packaging is a relevant criteria for green procurement decisions, and it may be possible to return packaging to local suppliers for reuse – such practices may be negotiated with suppliers where they are not already offered. Procurement of concentrated products (e.g. chemicals) can also reduce packaging requirements, as can buying in bulk where appropriate, and avoiding over-ordering of perishable products. Accor (2007) estimated that just 30 % of individual hygiene products provided to guests are used, leading to considerable product waste in addition to packaging waste. Installation of soap and shampoo dispensers is one effective and economic measure to reduce waste. Similarly, there is often scope to reduce individually wrapped portions provided for breakfast, and to install tap-water dispensers (with filtration and bottling systems where necessary) to reduce the purchase of bottled water. Provision of information electronically, including electronic invoices and newspapers, instead of hard copies, can significantly reduce paper waste.

Achieved environmental benefit

Environmental benefit by waste type

Preventing waste is associated with multiple environmental benefits arising from avoided production and transport of products, and reduced handling and land-filling or incineration of waste. Preventing waste reduces the following environmental pressures:

- resource depletion
- land occupation
- soil contamination
- water pollution
- air pollution
- GHG emissions.

Table 6.4 indicates the magnitude of GHG emissions prevented by avoiding different types of waste.

Table 6.4: GHG emissions avoided per kg of different types of waste avoided

Material	Glass	Board	Wrapping paper	Dense plastic	Plastic film
kg CO_2	0.92	1.60	1.51	3.32	2.63
Source: WRAP (2011).					

Accommodation premises savings

Figure 6.4 demonstrates the magnitude of waste avoidance achieved by a single average-performing 189-room hotel. A 30 % reduction in total (sorted plus unsorted) waste generated per guest-night over a period of five years translated into a reduction of 35.7 tonnes per year of waste sent for disposal.

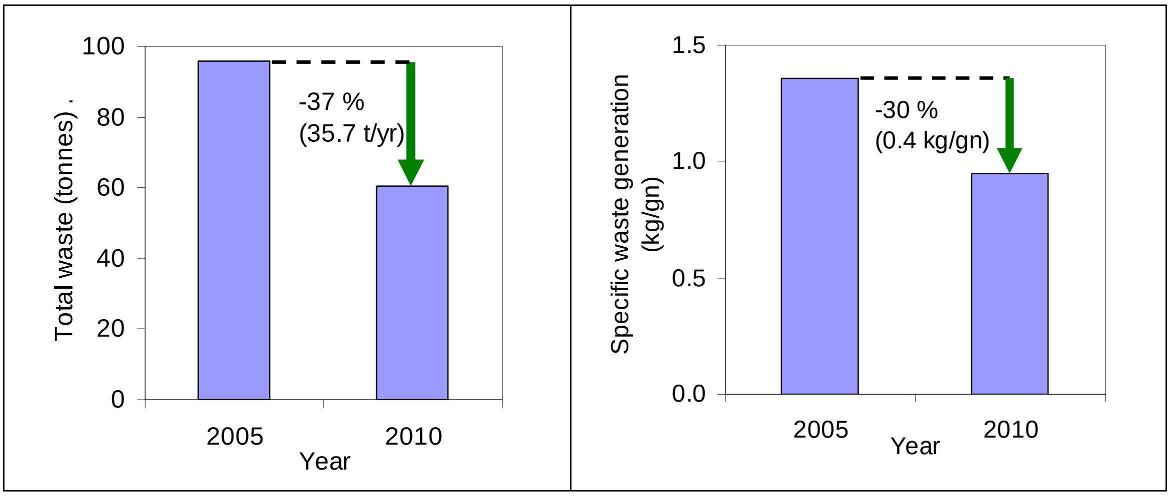

Figure 6.4: Trend in total (left) and specific (right) unsorted waste generation for a 189-room hotel between 2005 and 2010

Meanwhile, a reduction of waste generation per guest-night from the median of the 135 hotels displayed in Figure 6.5 (1.05 kg/guest-night) to the best-performing tenth percentile (0.59 kg/guest-night) would represent a 44 % reduction in the environmental pressures listed above associated with production and disposal of waste products. Thus, implementation of waste prevention measures could easily lead to a reduction in waste-incurred environmental impact of 30 % to 50 % for average hotels and other accommodation.

The Scandic Hotel group found that only 15 % of individual soaps and shampoos provided to guests were used. Following the installation of soap and shampoo dispensers and associated bulk buying (see Figure 6.7), Scandic Hotels reduced waste volume by 40 %, including a reduction of 11 tonnes per year in packaging waste.

In relation to bottled water alone, an estimated 2.7 million tonnes of plastic are used to bottle water globally each year, and 25 % of bottled water is exported across national boundaries (EEA, 2010). In addition to environmental pressures arising from production and disposal of the plastic (e.g. non-renewable resource depletion), transport of bottled water incurs environmental pressures including energy consumption, GHG emissions, air emissions and congestion, compared with minor pressures arising from the piped transport of drinking water from treatment works to consumers' taps (EPI, 2007). By replacing bottled water with filtered tap water provided in reused glass bottles, one 65-room five-star hotel in London avoids the purchase and disposal of 500 000 plastic bottles of 200 ml capacity and 200 000 plastic bottles of 1 L capacity, and 205 tonnes of glass bottle, every year (Rafayel Hotel, 2011).

Appropriate environmental indicator

<u>Indicators</u>

The total quantity of waste generated per guest-night is the most appropriate indicator of the intensity of waste generation, and the effectiveness of accommodation management measures to reduce it. To specifically reflect waste **avoidance**, sorted fractions sent for recycling should also be included in total waste generation. The density of waste varies considerably depending on the type and the degree of compaction. Therefore, the **weight** of waste generated is a more reliable indicator of performance in waste avoidance than the **volume** of waste generated, and one aspect of best practice is to monitor and record all waste generation by weighing waste fractions. In the absence of weighing, waste quantities may be expressed by volume, easily estimated from the number of waste receptacles (e.g. bins, skips) filled every day, week or month. The weight of waste may be estimated from (non-compacted) volumes according to estimated densities (Table 6.5).

Table 6.5: Average density of non-compacted waste fractions from different establishments

Type	Card	Paper & card	Mixed glass	Mixed recycling	Food	Metal	Mixed plastic	Mixed waste	B&B	Hotel	Hotel & restaurant	Pub
Density (kg/L)	0.03	0.08	0.27	0.06	0.52	0.05	0.05	0.1	0.079	0.05	0.064	0.1
Source: ITP (2008); WRAP (2011).												

<u>Benchmark of excellence</u>
Figure 6.5 displays the range of total waste generation (sorted plus unsorted) performance across hotels in a mid-range European hotel chain, based on aggregated monthly data for 2010. The median rate of waste generation across hotels in this chain is 1.05 kg per guest-night. Based on the top tenth percentile of hotels in this chain, the following benchmark of excellence is proposed:

BM: total waste generation (sorted plus unsorted) of ≤0.6 kg per guest-night.

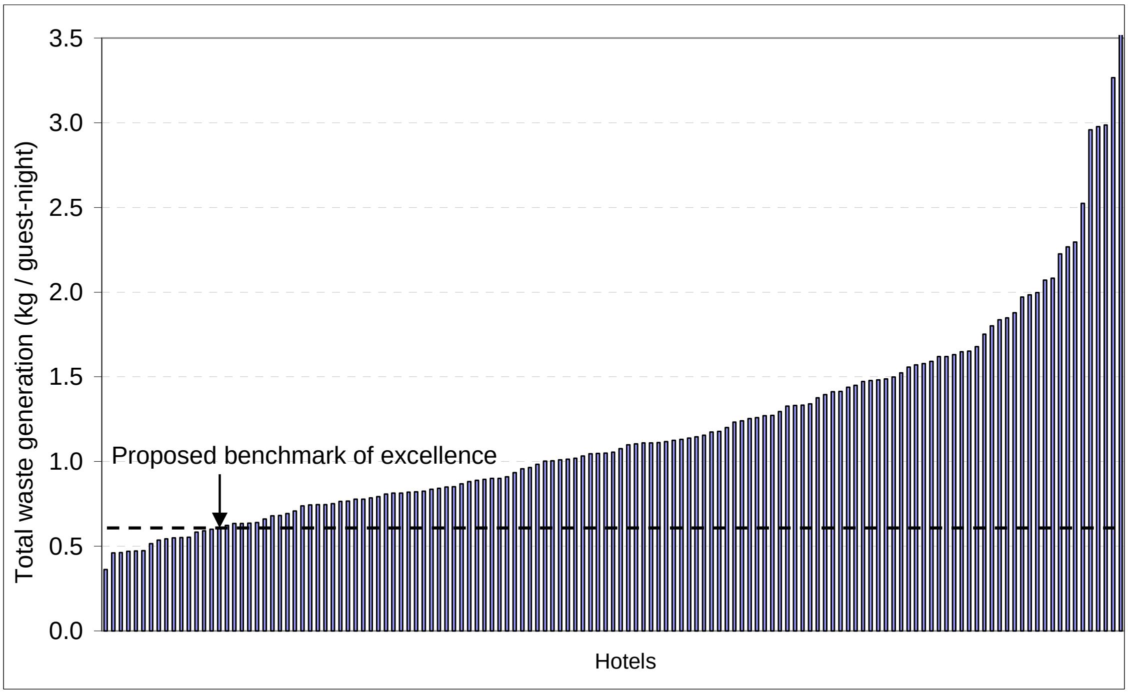

Figure 6.5: A distribution curve for total waste generation (sorted and unsorted fractions) from 135 hotels within a mid-range European hotel chain

Cross-media effects

Preventing waste is often associated with significant and multiple upstream, as well as downstream (i.e. waste disposal) environmental benefits.

One aspect where some care may be required is packaging minimisation. When considering the quantity of packaging in product selection, it is important to ensure that the risk of product spoiling is not increased, as this could more than offset any reduction in packaging waste. Also, product packaging is one criterion that should be considered alongside other, often more important, lifecycle environmental criteria (e.g. production method, use efficiency) when selecting environmentally responsible products.

Operational data

Useful guidance on waste prevention has been compiled on a European Commission website dedicated to the subject: http://ec.europa.eu/environment/waste/prevention/index.htm.

Firstly, it is useful for accommodation managers to generate an inventory of all the waste arising in different parts of the premises, and possible measures to prevent or reduce this waste. The main areas of waste generation are:

- guest rooms
- kitchen (see section 8.2 for organic waste management)
- bar area
- housekeeping stores.

A once-off survey may be performed to generate such an inventory, also identifying sources (e.g. packaging of specific products).

It is also important to regularly monitor and record the total quantity of waste sent for recycling or disposal, ideally following separation into fractions as defined in the subsequent section (section 6.2): organic, glass, paper and cardboard, plastics, metals, electrical items, hazardous wastes. The cost associated with disposal and recycling of these factions, based on local rates, can be calculated in order to indicate the achievable cost savings. Costs associated with excess purchasing should also be considered.

As an example, the Rafayel Hotel in London provides electronic newspapers for guest viewing on large TV screens in rooms, and has a 'no plastics' policy. Guests are provided with water filtered in-house and served in reusable glass bottles (Figure 6.6), using Vivreau bottling technology.

Many hotel chains use refillable soap dispensers (Figure 6.7), and a considerable amount of waste can be avoided by using reusable, or better still no, table cloths and place mats, and by using refillable condiment and other food containers.

Source: Rafayel Hotel (2011).

Figure 6.6: Reusable glass bottles for filtered tap water, and entertainment screen in rooms on which newspapers can be read, in a luxury hotel

Source: Scandic Berlin (2011).

Figure 6.7: Refillable soap dispenser, and tables set without tablecloths, and with reusable napkins and refillable condiment containers

Table 6.6: Summary of items to avoid, items to select and actions to prevent waste in accommodation

Avoid	Select	Do
– bought-in bottled water – single-use hygiene products – single-portion food products – disposable plates, cups and cutlery – excessive use of paper napkins – items with unnecessary or excessive packaging – offering newspapers and magazines	– refillable amenity dispensers in guest bathrooms – food sold in bulk packaging where appropriate – cloths instead of disposable paper towels – durable coasters instead of paper ones – electrical resistance or refillable burners instead of disposable heating fuel cartridges for buffet lines – cloth bags or baskets instead of plastic bags to collect and return towels, linens and guest laundry – refillable printer and copier cartridges – rechargeable batteries	– provide guests with filtered tap water – provide guests with reusable glasses and cups in rooms – put condiments and food servings in refillable containers – purchase chemicals in bulk and dispense them from refillable pump bottles or containers – give preference to vendors that supply their products in returnable and reusable containers – minimise the use of hazardous chemicals (e.g., drain cleaning chemicals, solvents and bleach) – provide electronic information and newspapers – print double sided – collect outdoor waste in canvas bags, wheelbarrows or carts rather than in disposable plastic – identify reuse possibilities

Source: ITP (2008); Travel Foundation (2011).

Accommodation managers may be able to influence suppliers to reduce packaging, or to use returnable and reusable packaging (e.g. Gavarni Hotel Paris, Strattons Hotel UK). However, packaging is just one of many sustainability criteria relevant to green procurement. Green procurement selection should be informed by identification of product-specific environmental hotspots, and products that perform well across these hotspots (section 2.2; section 8.1). One effective method to reduce packaging from existing suppliers, or new suppliers selected according to non-packaging-related green procurement criteria, is to return all packaging to them (Green Hotelier, 2011).

Applicability
Some hotel groups prefer to provide guests of higher classification hotels in certain countries with individually-wrapped single-use hygiene products, citing customer expectations in those countries (e.g. NH Hoteles, 2011). Nonetheless, effective waste prevention and avoidance can be implemented by all types of accommodation, including high end luxury hotels – as demonstrated by the example of the five-star Rafayel Hotel in London.

Economics
Replacing single-use products with durable alternatives can often generate substantial cost savings. For example, replacing disposable heating fuel cartridges with electric resistance elements in a buffet line of 10 chafers (water vessels for heating food) avoids the purchase of EUR 11 400 per year of disposable cartridges (Travel Foundation, 2011).

The Ascos Beach Hotel in Paphos, Cyprus, invested EUR 867 to purchase 3 000 reusable plastic cups to replace disposable plastic cups, and stopped using plastic bin liners in guest rooms. In the first year of operation, the disposal of 100 000 plastic cups was avoided, saving almost EUR 2 000, and 50 % fewer bin liners were disposed of, saving a further EUR 300. Guest satisfaction was not affected (Travel Foundation, 2011).

Driving force for implementation
Legislation is an important driver for preventing and managing waste. Some relevant legislation is listed in section 6, and on the European Commission's waste prevention website: http://ec.europa.eu/environment/waste/prevention/index.htm. In particular, the Waste Framework Directive (2008/98/EC) is an important driving force.

Waste prevention is closely related to resource efficiency and cost reductions. Avoiding excess products and packaging can reduce purchasing costs and disposal costs. The cost of waste disposal has increased sharply in most European countries over the past decade, and is likely to continue increasing owing to escalating landfill and incineration taxes.

In summary, the driving forces to prevent waste are:

- environmental responsibility
- legislation
- waste disposal costs
- waste handling costs
- excess product costs (partially used products and unnecessary packaging).

Reference companies
Gavarni Hotel Paris (FR), Strattons Hotel (UK), Rafayel Hotel (UK), Scandic Hotel group.

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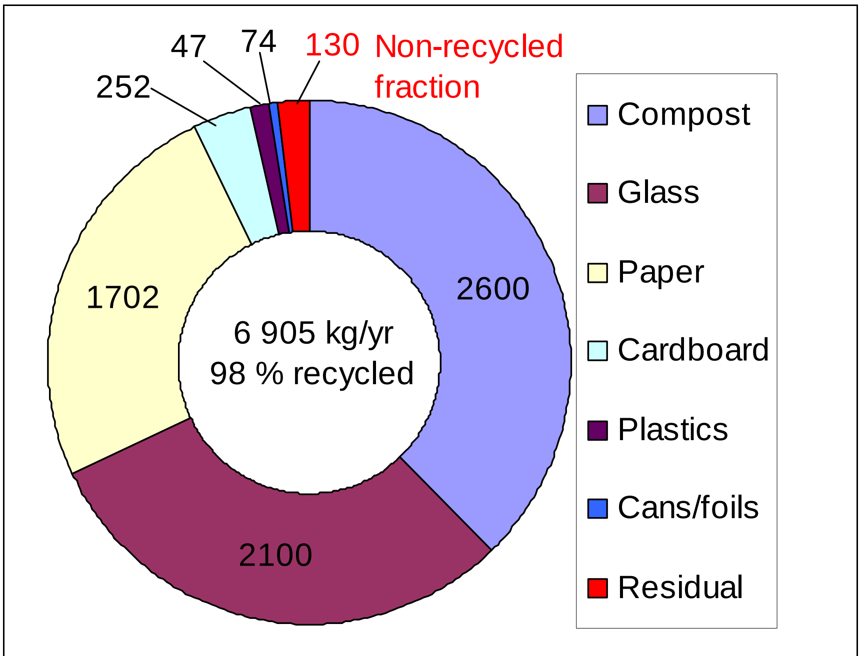
6.2 Waste sorting and recycling

Description

On average, hotels generate approximately one kg of unsorted waste per guest per night (ITP, 2008), equating to 66 tonnes per hotel per year in the UK (WRAP, 2011). Waste disposal costs are likely to increase steadily in the future due to diminishing landfill space and increasing collection and disposal costs. Poor waste management has implications for hygiene and health, environmental quality, resource and economic sustainability. As outlined in section 6, a multitude of regulations pertain to waste management and handling, including local, national and European waste regulations, health and safety regulations in relation to waste handling, noise regulations in relation to compaction and collection operations (Waste Management World, 2011). The largest waste fractions generated by hotels are glass, organic, cardboard and paper, metals and plastics. Organic waste originates mainly from kitchen activities, for example preparing breakfast and meals for in-house restaurants. Best practice for organic waste management is described in section 8.2, in the chapter addressing kitchens. Meanwhile, economic factors are driving widespread glass recycling, with a similar situation evolving for cardboard and paper fractions. This section therefore focuses on best practice for the management of non-organic waste, and especially plastic waste, arising in accommodation.

Hotels face a range of barriers to sorting and recycling their waste. They are to some extent limited by the waste management infrastructure in their locality, often owned and operated by the local authority, especially if they are not able to find other takers for waste fractions that the local system does not accept. In city hotels, available ground floor space may constrain the storage of multiple bins for separated waste fractions – front-of-house areas such as reception, lobby, restaurant and banqueting facilities are prioritised for ground floor space. However, experience shows that there are many innovative means of sorting and recycling waste in accommodation, in the process reducing disposal costs. Figure 6.8 presents an example of the high sorting and recycling rates achievable by best performers, summarising data for a small UK hotel where 98 % of waste is recycled. Interesting aspects of the hotel's waste minimisation strategy include the reuse of clear bottles in the kitchen and return of food and drink packaging for reuse by local suppliers.



Source: Envirowise (2008).

Figure 6.8: Sorted waste fractions recorded and recycled in a small 14-room boutique UK hotel and restaurant

As described in section 6.1, a relevant starting point for waste prevention, sorting and recycling is to record on-site waste generation by category and source. In addition, it may be necessary to perform or organise a study exploring local reuse and recycling options (Table 6.7). As outlined in Figure 6.3 (section 6), where possible, opportunities for product reuse should be sought before waste is sent for recycling. These may be on site or off site, and include options such as returning packaging to suppliers. Implementation of a successful waste sorting and recycling programme requires engaged management to coordinate technical and human resource requirements across all departments, including relevant staff training and time allocation (Table 6.7). In particular, staff should receive clear instructions on what types of waste are to be sorted and how, with specific responsibilities assigned. Ongoing monitoring and reporting of waste quantities should be monitored and reported so that recycling rates and unsorted waste disposal can be benchmarked to track progress. Consequently, hotels should seek to integrate waste management into an overall EMS (see section 2.1).

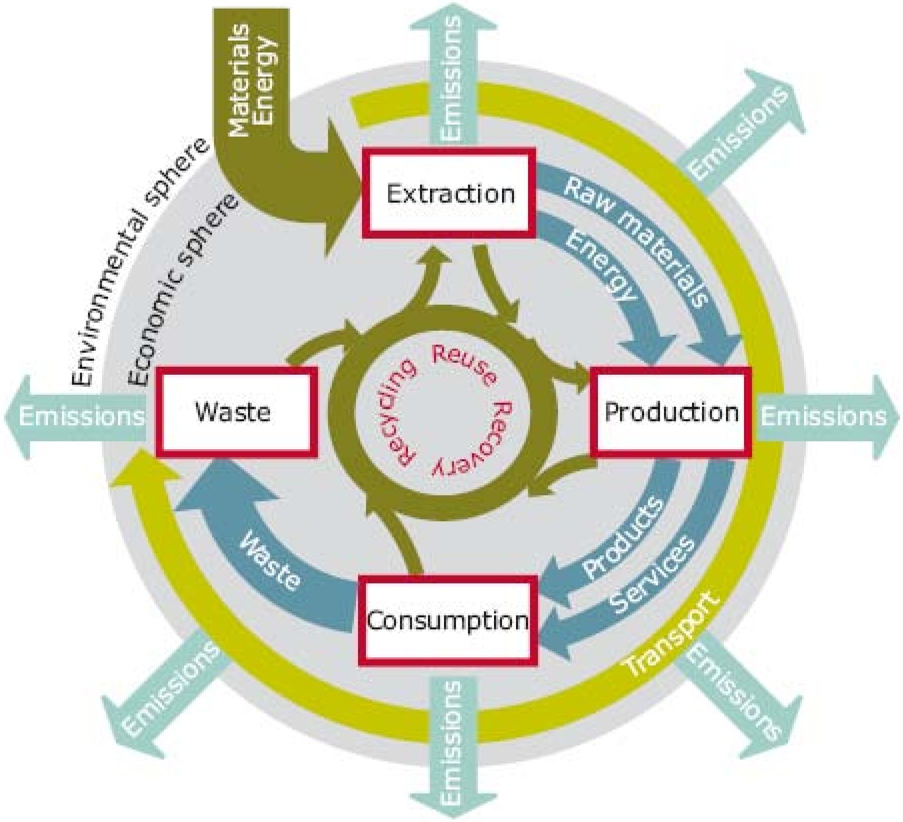
Table 6.7: Best practice measures to separate and recycle waste

Department	Measure	Description
All (management led)	Develop waste inventory and identify options	Survey of all areas and processes to identify types and sources of on-site waste generation. Identify waste recycling and packaging return options available locally
	Monitoring and reporting	Continuously monitor and periodically report waste generation and collection by fraction
Procurement	Procurement selection	Select products and packaging made from recycled and recyclable material
Housekeeping	Waste bins	Install separated waste collection bins in rooms
	Waste collection in rooms	Separate waste during room cleaning into fractions collected separately from accommodation premises
	Back-of-house waste management	Separate waste arising from public areas, maintenance of outdoor and indoor facilities, and other back-of-house areas into appropriate fractions for recycling and correct disposal
Catering	Green procurement	Consider packaging volume, production impact and recyclability when assessing products for green procurement (see section 8.1)
	Separation	Install and train staff to use conveniently located bins for separate collection of glass, plastics, and paper and cardboard in kitchen and dining areas. See section 8.2 for separate organic collection
Reception and public areas	Collection points	Install collection points for paper and magazines, batteries and other hazardous waste

Achieved environmental benefits

Lifecycle environmental benefits

Figure 6.9 displays the lifecycle chain for extraction, production, consumption and waste generation. Reuse, recovery and recycling within the economic sphere are associated with environmental pressures, most notably energy consumption and emissions. However, these actions avoid much greater pressures associated with extraction and waste disposal, particularly resource depletion, energy consumption and emissions.



Source: EEA (2010).

Figure 6.9:The lifecycle chain for extraction, production, consumption, waste management

Table 6.8 indicates the GHG emissions avoided by recycling one kg of different types of waste. Despite significant energy requirements to recycle some types of waste (e.g. glass transport and recycling), GHG emission savings are significant compared with disposal and production of new products with virgin materials.

Table 6.8: GHG emissions avoided per kg of different types of waste recycled

Material	Glass	Board	Wrapping paper	Dense plastic	Plastic film
kg CO_2	0.39	1.08	0.99	1.20	1.08
Source: WRAP (2011).					

However, recycling results in a range of environmental benefits, in addition to GHG reduction, compared with disposal. Table 6.9 summarises the range of reuse and recycling options for different types of material, and the main environmental benefits of reuse/recycling.

Table 6.9: Recycling options and associated environmental benefits for different materials

Material	Recycling option	Environmental benefit
Meat and fish	– Send for anaerobic digestion or composting, to local pig farm for feed (legislation permitting) or compost onsite using 'in vessel' composter	– Reduced GHG emissions, water pollution, landfill
Other organic waste	– Send for anaerobic digestion or composting, to local pig farm for feed (legislation permitting) or compost on site	
Garden greenery	– Compost on site, chip and use as mulch on site, or send for composting	
Used cooking oil	– Send for conversion to biodiesel	– Reduced resource depletion, water pollution and landfill
Cork	– Send to make insulation, tiles, pin-boards, soil mulch, etc.	– Reduced resource depletion and landfill
Aluminium cans and foil	– Send for recycling and use in aluminium industry	– Reduced resource depletion and landfill, and 75 – 90% reduction in energy and air pollution compared with virgin aluminium production
Glass	– Send bottles for reuse where possible, and send remaining glass fractions for crushing and recycling into new glass products	– Reduced landfill and 20 – 30% reduction in energy compared with virgin glass. Recycling one tonne saves 100 kg oil
Paper and card	– Separate into fractions (low- and high-grade) as specified by collectors and send for recycling	– Reduced resource consumption, landfill and energy
Plastics	– Return to supplier (packaging) or send for recycling into new plastic products through melting and remoulding or shredding Depends on types of plastic: see Table 6.11	
Other packaging	– Select new, or work with existing, suppliers to reduce non-recyclable packaging waste	
White goods	– Return to supplier for recycling and disposal	– Reduced soil, water and air pollution from leakages
Chemicals and pharmaceuticals	– Return to supplier or send to specialist contractor	
Batteries and lighting	– Return to supplier or send to specialist contractor	
Engine oils	– Send to specialist contractor	

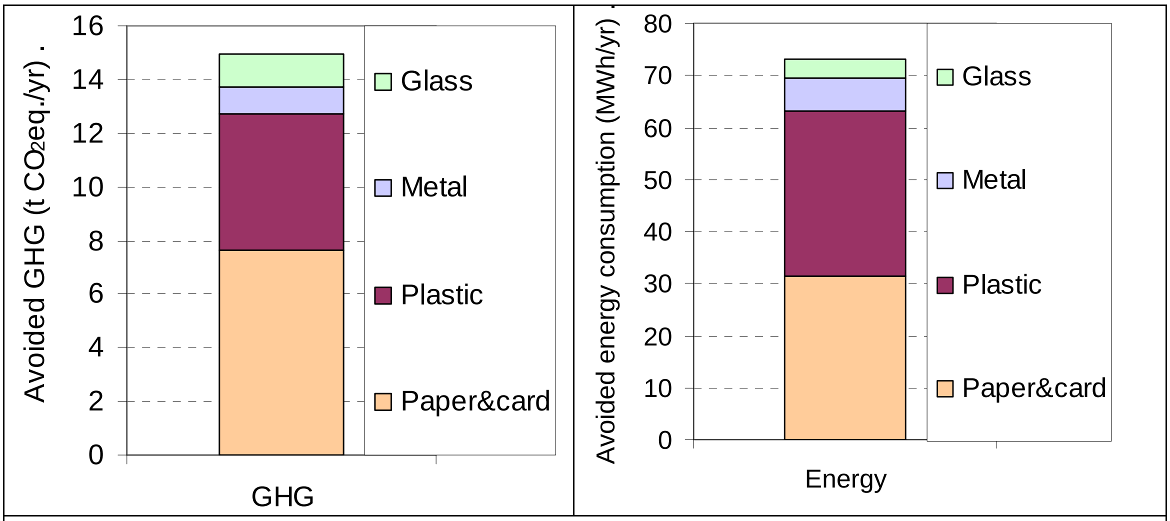
Accommodation premises savings

Table 6.10 summarises the energy and GHG emission savings associated with recycling different materials, and indicates the magnitude of environmental savings achievable for a small 14-room hotel (Figure 6.8).

Table 6.10: GHG and energy savings from recycling compared with land-filling, and an example of savings achievable for a small 14-room hotel (Figure 6.8)

Recycled fraction	GHG saving from recycling	Energy saving from recycling	Small hotel waste generation	GHG emissions avoided by small hotel with 84 % recycling rate	Eenergy saved by small hotel with 84 % recycling rate
	kg CO_2 eq./kg	kWh/kg	kg	Kg CO_2 eq./yr	kWh/yr
Paper & card	1.0	4.1	1 954	**1 700**	**6 730**
Plastic	1.10	6.9	74	**70.8**	**429**
Metal	3.30	20.5	47	**58.9**	**1 274**
Glass	0.39	1.17	2 100	**712.5**	**2 058**
Source: Envirowise (2008); Browne et al. (2009); WRAP (2011).					

Compliance across the entire hotel chain represented in presented Figure 6.12 with the proposed benchmark of 0.16 kg waste per guest-night would lead to a reduction in unsorted waste sent to landfill or incineration of 0.3 kg per guest-night. Compliance with the proposed benchmark across average hotels generating one kg residual waste per guest-night (ITP, 2008) would reduce the quantity of unsorted waste sent to landfill or incineration by 0.84 kg per guest-night. These reductions would translate into annual reductions in unsorted waste collection from a high occupancy 100 room hotel of 11 tonnes and 31 tonnes, respectively. In turn, these waste reductions would lead to annual GHG avoidance of over 13 t CO_2 eq., and annual energy avoidance of over 70 MWh, per hotel (Figure 6.10).



NB: Assumes average 80 % room occupancy, and 25 % double occupancy within occupied rooms, residual waste reduction from 1.0 to 0.16 kg per guest-night, residual waste fractions as per WRAP (2011).

Figure 6.10: Potential annual GHG and energy savings for a 100-room hotel arising from achieving residual waste of 0.16 kg per guest-night (excludes organic fraction)

Appropriate environmental indicator

<u>Indicators</u>

There are two primary indicators of performance in terms of sorting and recycling waste generated on accommodation premises:

- the proportion of waste that is sorted and sent for recycling (percentage mass of total waste)
- the quantity of unsorted waste sent for disposal (kg per guest-night).

Benchmarks of excellence
Figure 6.11 displays the range of recycling rates across hotels in a mid-range European hotel chain, based on aggregated monthly data for 2010. The median recycling rate across hotels in the chain is 56 %, and the top tenth percentile best performers achieve recycling rates above 84 %.

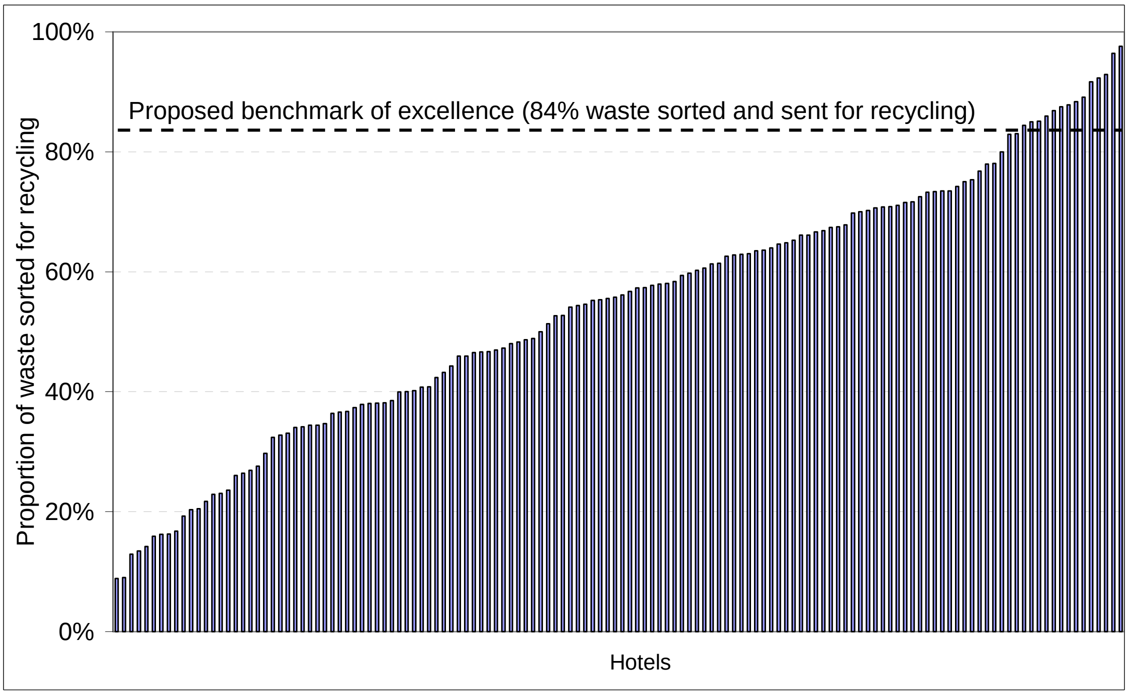


Figure 6.11: Distribution of recycling rates across hotels in a mid-range European hotel chain

Figure 6.12 displays the range of unsorted waste generated per guest-night (final waste sent for disposal) across hotels in a mid-range European hotel chain, based on aggregated monthly data for 2010.

The median quantity of unsorted waste per guest-night is 0.46 kg, and the top tenth percentile best performers generate less than 0.16 kg of unsorted waste per guest-night.

Thus, the following benchmarks of excellence are proposed:

BM: at least 84 % of waste, expressed on a weight basis, is recycled

BM: unsorted waste sent for disposal is less than 0.16 kg per guest-night.

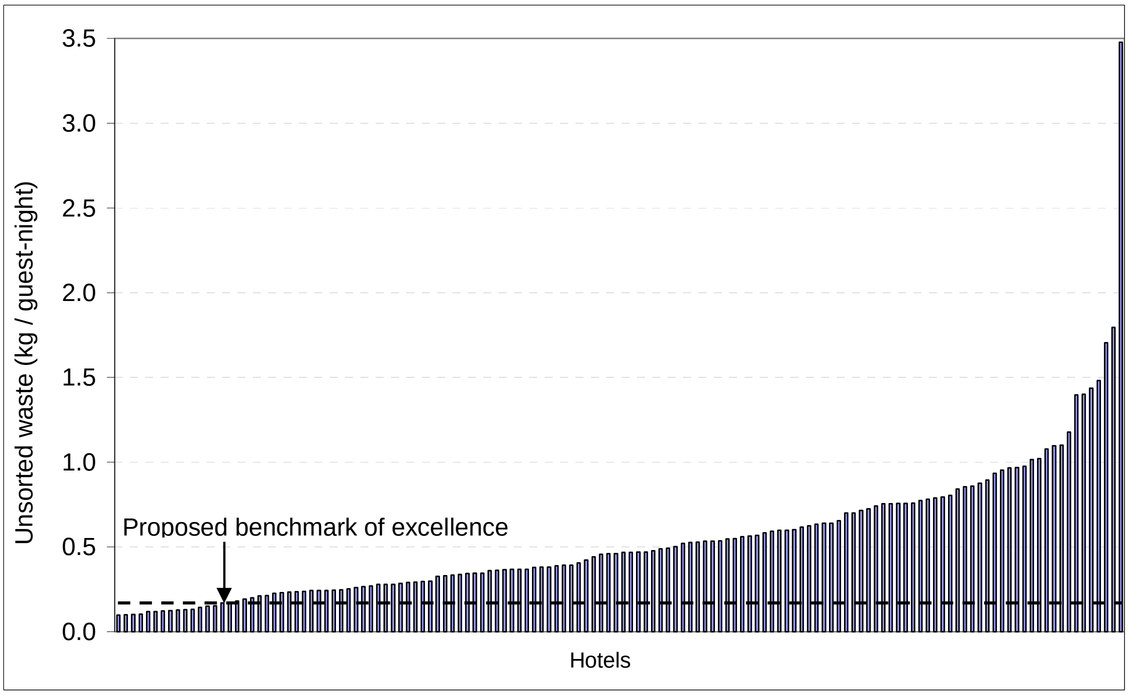
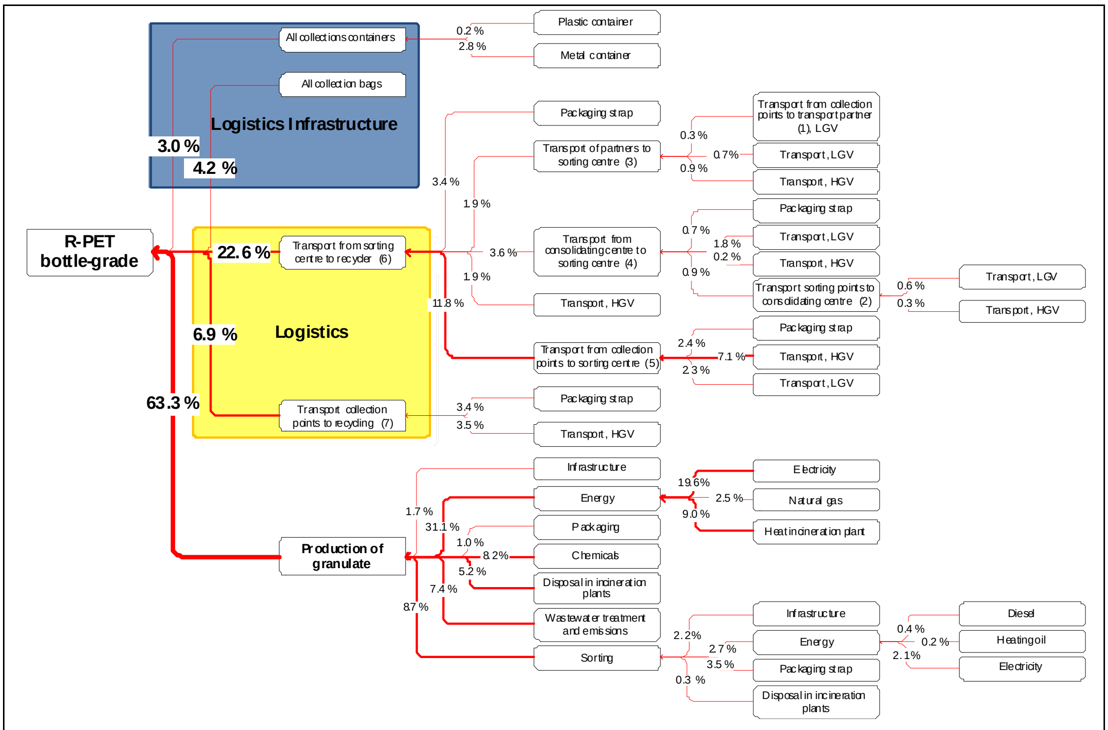


Figure 6.12: Distribution of unsorted waste sent for disposal across hotels in a mid-range European hotel chain

Cross-media effects

As represented in Figure 6.9, recycling is associated with energy consumption and other environmental impacts that arise during collection, transport and recovery operations. These impacts are usually considerably smaller than impacts arising from production from raw materials (Table 6.10). A detailed lifecycle assessment for PET recycling demonstrated that the environmental impact of recycling is comprised of logistics activities (37 % of overall burden) and production of PET (63 % of overall burden) (Figure 6.13). However, PET recycling is significantly more environmentally friendly than the incineration of the PET bottles in municipal waste incineration plants with waste heat recovery (Dinkel, 2008).

Packaging volume and recyclability is one of a number of important environmental criteria that should be considered in the context of lifecycle impacts when making procurement decisions (section 2.2). For many products, the production and/or use phases dominate lifecycle environmental impacts, so that procurement decisions based on packaging alone may not identify the best performing products from an overall environmental perspective.



NB: The impact was calculated according to the Swiss Ecological Scarcity Method (Frischknecht et al., 2008), Legend: HGV = Heavy goods vehicles, LGV = Light goods vehicles.

Source: Dinkel, 2008.

Figure 6.13: Environmental impact of the production of bottle-grade PET-flakes from recycled PET bottles

Operational data

<u>Hazardous waste</u>

A basic practice is to ensure that all hazardous waste, including chemicals, electronic equipment and fluorescent bulbs, is disposed of correctly, as required under relevant legislation and as recommended by producers (e.g. on packaging) or suppliers. Battery collection points may be provided at the reception for guests.

<u>Waste inventory and reuse-recycling feasibility study</u>

As for waste prevention described in section 6.1, developing an inventory of on-site waste types and sources is a relevant starting point for waste recycling and minimisation of residual waste. This requires management coordination and involves all departments, for example:

- housekeeping
- catering
- leisure facilities
- maintenance
- office.

Catering and housekeeping typically account for the majority of waste in accommodation. The initial waste inventory should be sufficiently detailed so that the major sources of all waste can be identified. Many sources can be identified from a simple tour of the premises, but in some cases there may be specific products to which large volumes of waste can be attributed, and that requires the involvement of specific relevant staff to identify. The information generated may then inform procurement decisions within a lifecycle context (see section 2.2 on supply chain management), and indicate existing recycling potential.

With respect to economic implications, charges for collection of different waste fractions vary considerably across, and sometimes within, European countries. Therefore, it is important to identify locally applicable costs associated with various reuse, waste recycling and disposal options. It may be possible to form partnerships with other local enterprises producing similar types of waste in order to efficiently implement recycling collection or delivery (e.g. by guaranteeing the existence of a sufficiently large recyclable waste fraction for providers to collect separately, or by making organised delivery of waste fractions to central waste management stations economic). Alternatively, it may be possible to reach agreements with suppliers who may take back used products. For example, magazines provided to guests in the Rafayel Hotel in London are returned to the publishers for recycling.

Housekeeping

Recycling bin in Scandic Berlin

Housekeeping staff may separate waste from guest rooms, but some hotel groups have a policy for staff, based on health and safety concerns, not to retrieve waste already placed in bins (Accor, 2007). One solution to this problem is the provision of recycling bins in guest rooms, such as those provide in Scandic Hotels (left, inset). These bins comprise three separate compartments to facilitate sorting of organic, paper and other materials (inset, left).

The Hilton Slussen in Stockholm separates waste into 26 different fractions (ITP, 2008). However, for a typical hotel, it is usually unnecessary to separate waste into so many fractions – depending on the collection and recycling service. The Savoy hotel in London sends over 95 % of waste for reuse or recycling. Waste from throughout the hotel, including rooms, is separated into eight fractions: glass, cardboard and paper, wood, plastic and metal, cork, organic oil, batteries, and electrical. Housekeeping staff recover recyclable waste from room bins. One company deals with the majority of the waste, and undertakes further separation after collection (The Savoy, 2011).

Catering

Management of organic kitchen waste is described in section 8.2. The Savoy in London incorporates a large kitchen for its restaurants, three smaller banqueting kitchens, and a staff canteen kitchen, and provides a particularly good example of catering waste management. Kitchen waste is carefully separated at source into the eight recycling streams listed above. Of particular note is the installation of a new automated system to monitor and change cooking oil, and store used oil centrally for collection to be converted into biodiesel. In addition, a use has been found for the thousands of bottle corks produced every week from the hotel and associated restaurants. Two 140-litre bins of corks are collected by catering staff every week and returned to Laithwaite's wine suppliers, who shred them to produce a mulch that is applied to their vinyards to help maintain soil moisture and suppress weeds (The Savoy, 2011).

Plastic waste recycling

Plastics represent a significant fraction of waste from accommodation that create environmental problems when sent to landfill owing to their slow decomposition. Many types of plastic are available across a wide range of products, some of which are easier and more likely to be recycled than others (Table 6.11). These may be identified by commonly used symbols similar to those displayed in Table 6.11 and referred to in the ISO 11469 standard relating to the generic identification and marking of plastics products. Depending on the area and service provider, mixed plastics may be collected for subsequent separation of recyclable fractions, or accommodation staff may have to separate specific recyclable fractions. In either case, an important aspect to consider in green procurement decisions is the use of difficult-to-recycle plastics such as polyvinyl chloride, low density polyethylene and polystyrene (Table 6.11) in consumable products and packaging. Packaging minimisation and reuse (without affecting product quality and longevity) is the most straightforward measure to reduce waste from a lifecycle perspective. Accommodation managers may request suppliers of preferred products to improve the environmental performance, including recyclability, of their packaging.

Lifecycle impacts of packaging are heavily dependent on factors such as whether or not recycled material is used in production, different packaging weights associated with alternative materials, manufacturing location and methods, transport distance, energy sources, fate of used products, etc. (Öko-Institut, 2008). In a study of alternative drinking cup options for the Euro 2008 football games in Germany, Austria and Switzerland, Öko-Institut (2008) used LCA methods to assess the environmental performance of different cup types. Based on the Eco-Indicator-99 method, cups were ranked in the following order of environmental preference (best first):

- reusable PP cups (1st)
- disposable cardboard cups (2nd)
- disposable PET cups (3rd)
- disposable biodegradable polyacetide cups (4th)
- disposable PS cups (5th).

The results from this study highlight the environmental superiority of light-weight reusable cups, and cardboard over polystyrene cups.

Table 6.11: Main types of plastic, their identifiers, typical applications, and recyclability

Polymer	Identifier symbol(*)	Typical relevant applications	Example	Recyclability
Polyethylene Terephthalate	01 PET	Drinks bottles; food containers; condiment containers.		Very good. Recycled into new bottles and clothes.
High Density PolyEthylene	02 PE-HD	Chemical containers (e.g. detergents, cosmetics); water pipes; garden furniture; other outdoor equipment such as water butts, potting trays, flower pots.		Good. Recycled to produce new bottles or pipes.
Polyvinyl Chloride	03 PVC	Bubble-wrap packaging; cling film for non-food use; electrical cable insulation; rigid piping; window and door frames.		Poor owing to additives.
Low Density Polyethylene	04 PE-LD	Shrink wraps; frozen food bags; squeezable bottles; cling films; flexible container lids.		Poor owing to economics and frequent contamination of films with e.g. food.
Polypropylene	05 PP	Reusable microwaveable ware; kitchenware; yogurt containers; margarine tubs; microwaveable disposable take-away containers; disposable cups; plates; bottle tops; nappies.		Poor. Wide range of types and grade make recycling difficult.
Polystyrene	06 PS	Egg cartons; packaging protection; disposable cups, plates, trays and cutlery; disposable take-away containers.		Poor owing to economics.
Other (e.g. polycarbonate)	07 O	Beverage bottles; baby milk bottles; compact discs; 'unbreakable' glazing; electronic apparatus housings.		Poor because often present in components of mixed plastic.

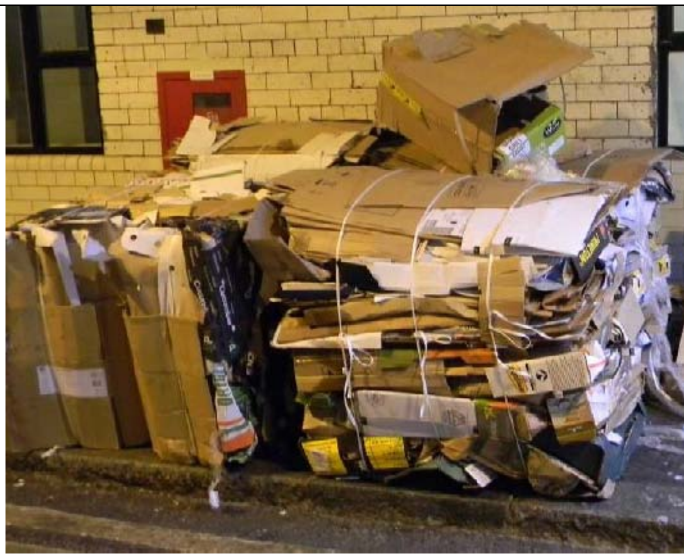
(*)American Society of the Plastics Industry. Symbols may vary across Europe (e.g. German DIN pre-fixes numbers with '0').

Source: Demesne (2011); Marius Pedersen (2011); Recyclemore (2011); British Plastics Federation (2011); Wikipedia (2011).

Storage and collection

Storage areas for waste fractions may be limited in some hotels, particularly those located in city centres. Compaction and densification of waste fractions using compactors, shredders or balers reduces storage area requirements and transport costs. Waste volume may be reduced 20 to 50 fold (Waste Care Corporation, 2011). The Savoy hotel in London compresses cardboard and paper waste into bales for collection, and stores plastic, metal and wood in a large compactor for collection and subsequent separation (Table 6.12).

Table 6.12: Waste compactor and compressed cardboard for collection from a large hotel

	
Source: The Savoy (2011).	

Donate items for reuse

Having addressed waste at source, the next step is to put appropriate systems in place to identify how the remaining waste can be redeployed, on site or by external organisations (ITP, 2008). Amongst others, Carlson Hotels Worldwide, Radisson Hotels & Resorts, Marriott International and Fairmont Hotels and Resorts donate untouched food from catering displays and trolleys, unwanted bed linens, mending kits and bathroom amenities to community projects such as homeless shelters, orphanages, homes for the elderly and drug rehabilitation centres, sometimes working through charitable organisations (Waste Management World, 2011).

Case Studies

Strattons Hotel

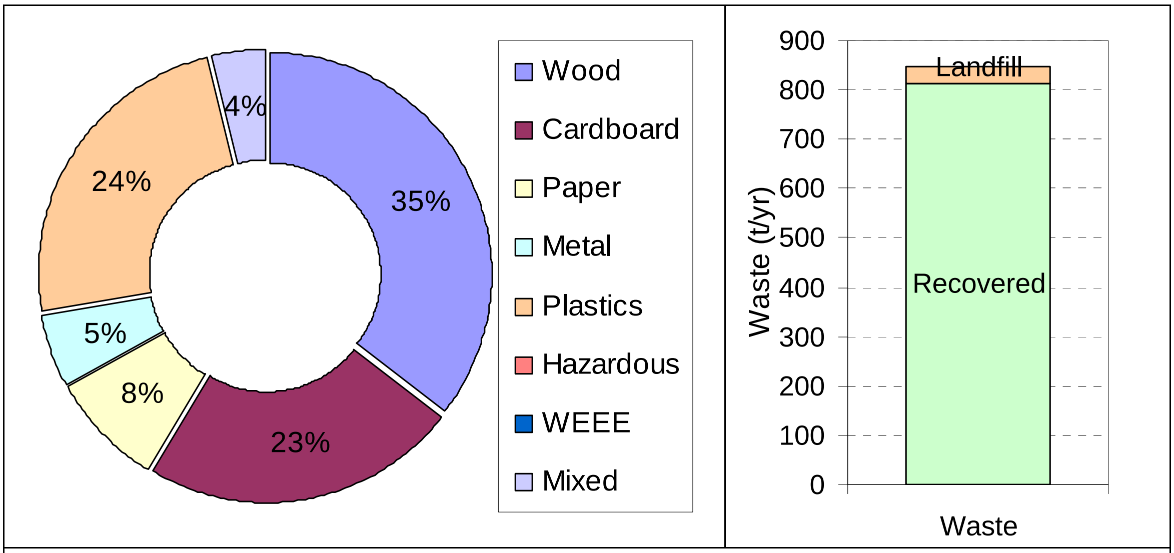
Strattons Hotel in Norfolk (UK) provides a good example of extensive reuse and recycling in a small boutique hotel (see Figure 6.8 above).

Hilton Slussen Hotel

Amongst larger high-end hotels, the Hilton Slussen in Stockholm sorts waste into 26 different bins. Introduction of a sorting and recycling scheme in 1997 reduced the 125 tonnes per month sent to landfill by 76 %, to 0.3 kg per guest-night. Cardboard was diverted to recycling, wooden pallets were diverted for heating buildings outside Stockholm, and other combustible materials were sent to generate district heating for apartments. Candle stumps were diverted to day care centres and to a church to be made into new candles for sale (ITP, 2008).

The Savoy

The Savoy hotel in London is a traditional luxury five-star establishment managed by the Fairmont Hotel Group. The establishment comprises 268 rooms, 62 suites (equivalent area of two rooms each), two restaurants, two bars and a tea room, and employs over 600 staff. Upon reopening in 2010 following a major refit, a comprehensive waste recycling programme was implemented in accordance Fairmont Hotel's Green Partnership Program (Fairmont Hotel Group, 2011). This included extensive and ongoing staff training – daily staff briefings incorporate environmental management topics, including waste separation, reuse and recycling. Consequently, over 95 % of non-food waste is now diverted from landfill (Figure 6.14), and unsorted waste generation for the hotel and restaurants is equivalent to approximately 0.3 kg per guest-night (this includes waste arising from 30 % non-resident restaurant customers). Organic waste amounting to a further 344 tonnes per year is separated and sent for energy recovery (see section 8.2)



NB: Data from first quarter 2011 annualised. Organic waste fraction excluded (see section 8.2).

Source: The Savoy (2011).

Figure 6.14: Non-organic waste fractions (left) and total volume (right) arising from The Savoy in 2011

Key actions of The Savoy's waste management programme include:

- purchasing department reduces packaging as part of green procurement (e.g. UKOS office suppliers rated top in The Sunday Times Best Green Companies 2010);
- housekeeping department sorts and recycles all items used by guests from rooms;
- installation of paper and food recycling bins in all departments;
- instigation of 'Food waste to Renewable Energy Scheme' that sends separated organic waste for heat and electricity generation by PDM Group (section 8.2);
- installation of an 'Oilsense' management and collection system for used cooking, to enable efficient reuse as biodiesel (section 8.2);
- all natural cork is collected by Laithwaites Wines, granulated and used as a mulch in their vineyards;
- an integrated pest management programme, operated by Ecolab Pest Control, minimises hazardous waste generation;
- implementation of a recycling programme for electronic waste and toner cartridges;
- redistribution of household goods and unclaimed lost property items to charity;
- donation of wooden crates to schools for arts and crafts uses;

– electronic document sending, double-sided printing and the use of whiteboards to minimise paper usage.

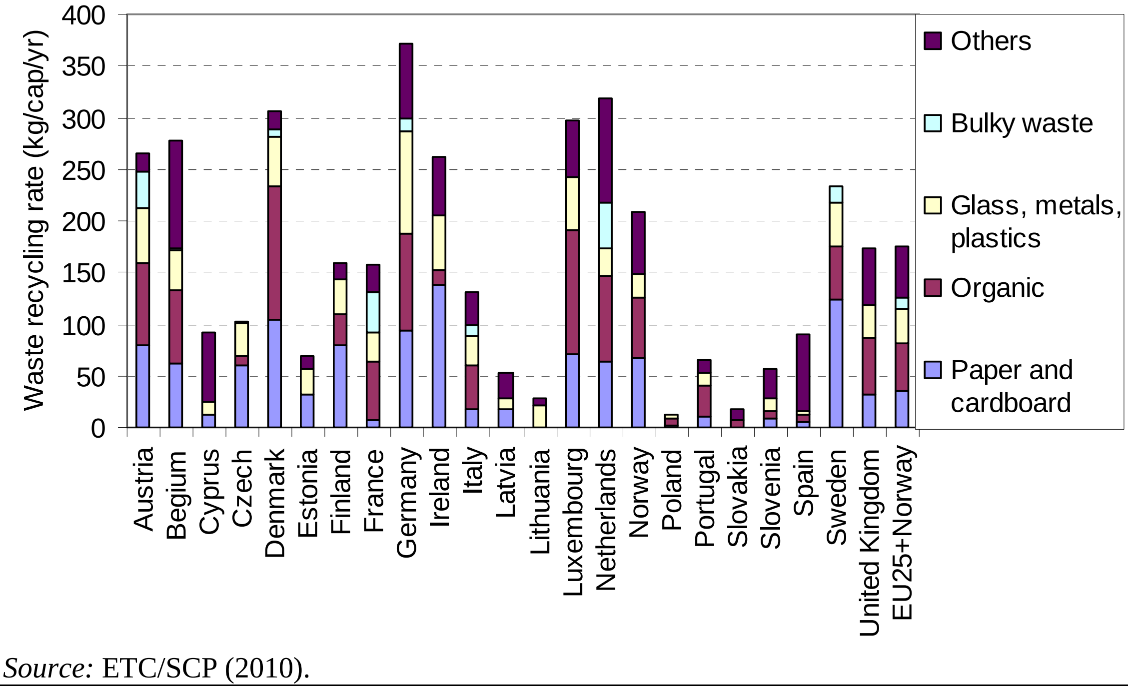
Applicability

All types, sizes and grades of accommodation can implement waste recycling (see also example of recycling on campsites in section 9.5).

Waste recycling options available to accommodation enterprises may be restricted in some locations. The provision of waste recycling services varies considerably across countries and localities, as indicated by the range of recycling rates across Europe (Figure 6.15; Figure 6.16). In areas where the municipality or private companies do not collect separated materials for recycling, accommodation managers can request the municipality to prioritise the provision of such services and seek alternative solutions, as required in such situations by ecolabel criteria for the EU Flower.

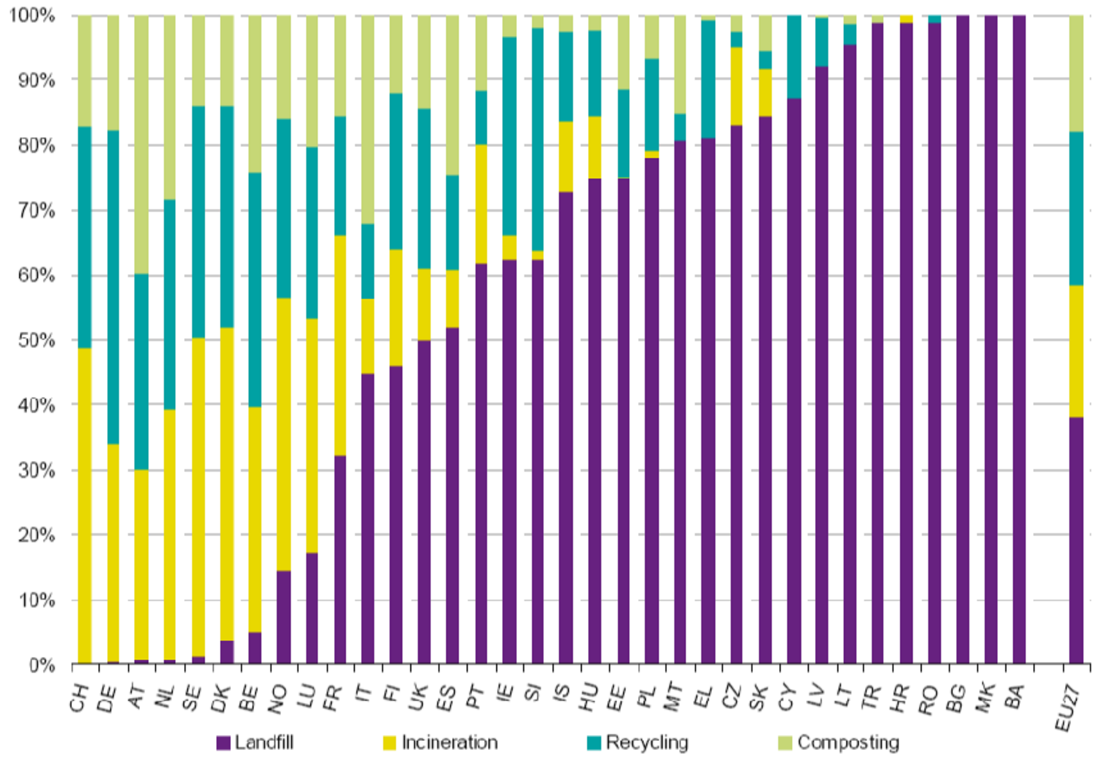
Even where collection services are not provided, proactive hotels are able to find solutions to waste recycling though cooperation with other local stakeholders, for example by arranging shared waste collection, or sending organic waste to local farmers for composting or biogas production.

In rural areas where collection services are less likely to be provided, it is usually possible to implement composting of the important organic waste fraction (section 8.2).



Source: ETC/SCP (2010).

Figure 6.15: Recycling rates for different fractions of municipal waste across EU Member States and Norway



Source: Eurostat (2010).

Figure 6.16: Percentage of municipal waste treated in 2009 by country and treatment category sorted by percentage of landfilling

Economics

Waste management cost per guest-night

Ecotrans (2006) calculated the average cost of waste per guest-night in a German hotel. The waste collection and disposal costs for one day involving 43 overnight stays and the provision of 58 warm meals amounted to EUR 10.10, translating to around EUR 0.23 per guest-night, and EUR 115 per tonne. Waste costs were apportioned equally between the provision of accommodation and hot meals (Ecotrans, 2006). The survey found that waste charges were dominated by residual and organic waste fractions.

Waste management cost by fraction

The economy involved in sorting and recycling of waste relate to collection rates associated with the different waste fractions. These vary considerably across and within countries. Collection of residual, organic and hazardous waste usually incurs a cost, whilst collection of separated paper, plastic and metal for recycling is often free of charge (though this varies across municipalities). However, installation of appropriate waste-handling equipment and staff time for sorting different waste fractions incur costs that will somewhat offset benefits of lower collection and disposal charges. One hotel in Freiburg, Germany, is charged for removal of all waste except cardboard, for which a significant payment is received (Table 6.13).

Table 6.13: A breakdown of waste management costs for one German hotel

Fraction	Volume	Transport	Disposal	Total cost	
	Tonnes	EUR/tonne			EUR
Waste for recycling	148.18	30.27	95.63	125.90	18 656.14
Building rubble sorted	7.88	11.68	6.50	18.18	143.22
Wood packaging	10.22	77.10	9.12	86.23	881.24
Mixed construction waste	10.16	18.11	91.96	110.07	1 118.30
Cardboard packaging	59.16	20.14	-61.60	-41.46	-2 452.85
Glass	50	28.76	4.63	33.39	1 669.54
Food waste	116.64	NA	103.69	103.69	12 094.00
Light weight recyclables	18.4	49.32	93.01	142.33	2 618.96
Fat from grease traps	28.9	84.78(*)	41.18	41.18	3 640.00
Container rental					4 640.00
Total					43 008.55
(*)Service costs to empty and clean grease traps (25 hours per year).					

<u>Hotel waste management savings</u>
The Savoy in London pays approximately EUR 110 per tonne for mixed waste collection, compared with free collection for separated recyclable materials, and receives payment of EUR 0.30 per litre for the 600 litres of waste cooking oil collected every month by a private company to produce biodiesel.

A reduction in unsorted waste of between 11 and 31 tonnes per year for a 100-room hotel (see 'Environmental benefit', above) would lead to annual cost savings of between EUR 1 210 and EUR 4 030, assuming collection costs of EUR 110 to EUR 130 per tonne of mixed waste and free collection of recyclable materials.

By reusing or recycling 98 % of waste, Strattons 14-room hotel and restaurant in the UK saves over EUR 1 000 per year in waste disposal costs (Envirowise, 2008).

Table 6.14: Some examples of economic savings arising from recycling actions

Hotel	Action	Annual waste reduction	Annual saving	Source
			EUR	
96-room conference hotel	Waste separation	72 t reduction in landfill	4 120	Sustainable South Land (2011)
Hotel and restaurant	Onsite composting	150 t organic waste reduction	30 000	Irish EPA (2008)
148-room conference hotel and restaurant	Food and general waste recycling	70 % reduction in landfill	21 480 (44 %)	Irish EPA (2008)
74-room hotel and restaurant	Introduction of organic and mixed recyclable bin	127 t food waste, 17.5 t glass, 6.5 t paper and cardboard, 0.65 t plastic	2 300	Foodwaste.ie (2010)

Driving Force for Implementation

Driving forces for implementing waste sorting and recycling include:

- corporate social responsibility
- waste legislation
- differentiated charges for collection of recycling waste and disposal of waste
- voluntary EMS or ecolabel criteria
- environmental marketing – waste management is a visible demonstration of environmental commitment.

Reference organisations

The Hilton Slussen hotel Stockholm; The Savoy hotel, London; Scandic hotels; Strattons hotel Norfolk (UK).

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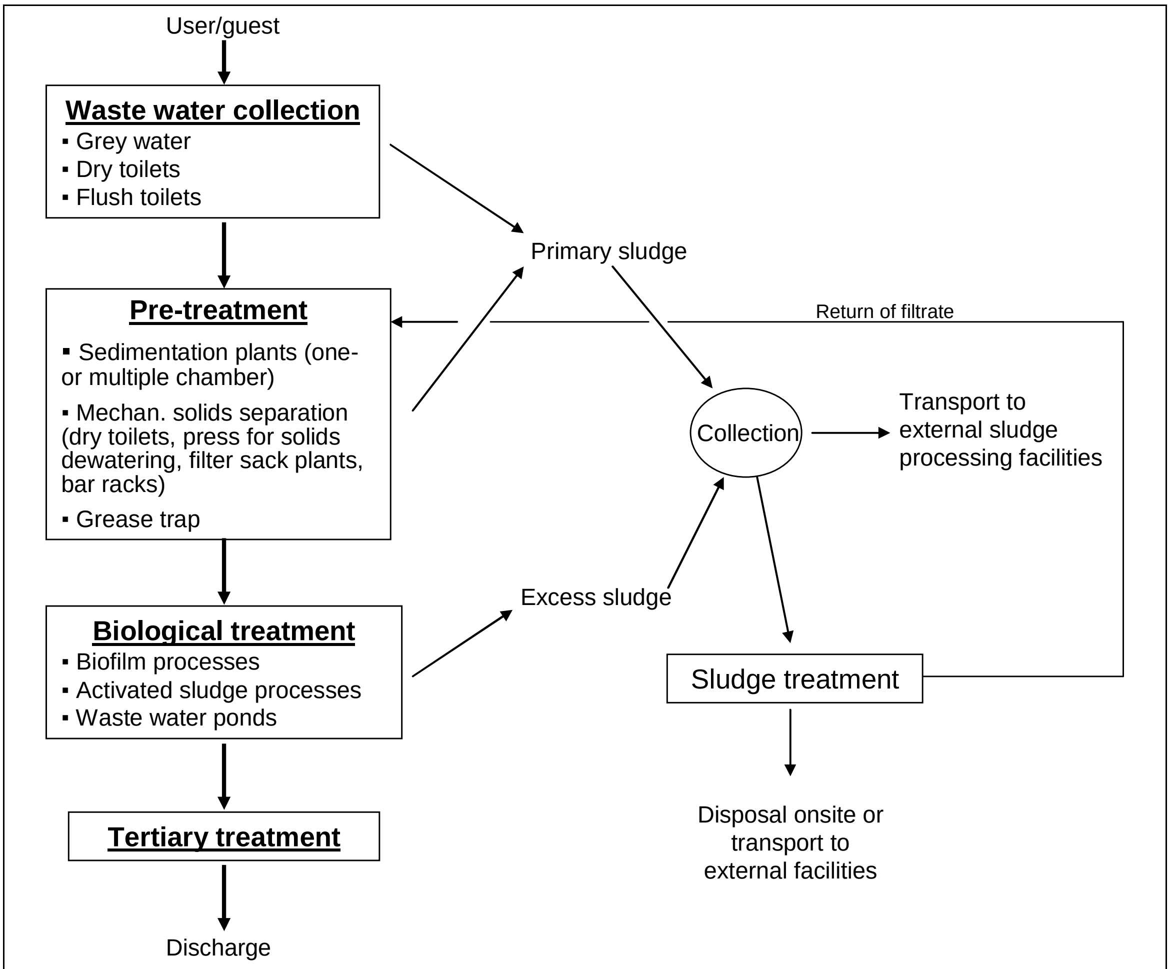
6.3 Wastewater treatment

Description

In case wastewater cannot be discharged to a sewer to be treated in a municipal effluent treatment plant (see section 3.3), individual local solutions have to be applied. Here, three different applications are described: for an individual hotel, a campsite and huts in the alpine region. Best practice is to apply well-designed pre-treatment (sieve/bar rack, equalisation, sedimentation), biological treatment with high BOD_5 removal and high nitrification and sludge treatment/disposal for all of these applications.

Due to the high variation of wastewater flow and load across different tourism seasons, the applied technique must be flexible and able to adapt to these special conditions. For hotels and campsites, in many cases, sequencing batch reactors have been proven to be a satisfactory option to fulfil these requirements. However, other types of biological treatment may also be appropriate as long as they achieve high removal efficiencies (see operational data).

In the alpine region, mountain huts may be connected to a municipal treatment plant in an adjacent valley via individual pipes (see Figure 6.22, below). This repesents best practice, but may not always be technically or economically viable, in which case individual wastewater treatment solutions, as described here, are required. Similarly, many rural tourist accommodations across Europe are outside the catchment areas of municipal treatment plants. The applicable techniques are illustrated in Figure 6.17.



Source: IEVEBS (2010a and b).

Figure 6.17: Sequence for wastewater treatment and sludge disposal for individual huts in the alpine region where discharge to a municipal effluent treatment plant is either technically or economically unviable

Biofilm plants have been demonstrated to be the most appropriate technology. If they are not applicable, due to local circumstances, activated sludge systems are recommended. Concerning biofilm reactors, priority is for reed bed filters. In case, they are not applicable, e.g. because of the altitude, priority may be given to trickling filters. Concerning wastewater treatment for individual huts in the alpine region, a compilation is provided under operational data. Due to the climate conditions, the treatment plants should be located within a building. In the alpine region, tertiary treatment should be applied. For this purpose, in principle, simple systems such as mechanical biofilters and reed bed filters have been proven to be appropriate (IEVEBS, 2010a and b).

Achieved environmental benefit

As suspended solids and organic compounds are removed to a high extent (BOD_5 removal of more than 95 %) and ammonia is nitrified to a high extent (at least 90 %), the pollution of wastewater is significantly reduced and the impact to receiving natural waters is minimised. Sludge disposal from plants for hotels and campsites should include anaerobic digestion and/or incineration according to standards meeting those defined in the Best Available Reference Techniques Reference Document on Incineration Plants (BREF WI, 2006).

Appropriate environmental indicator

Indicators

BOD_5, COD and ammonia concentration (mg/L) or specific factors such as g BOD_5/PE, COD/PE or NH_4-N/PE (where PE is the wastewater treatment system load, expressed as person equivalent), and removal efficiency (% removed) for the parameters BOD_5, COD, ammonia, total phosphorous and total nitrogen, are appropriate environmental indicators.

Benchmark of excellence

The following benchmark of excellence is proposed:

BM: where it is not possible to send wastewater for centralised treatment, on-site wastewater treatment includes pre-treatment (sieve/bar-rack, equalisation and sedimentation) followed by biological treatment with >95 % BOD_5 removal, >90 % nitrification, and (off-site) anaerobic digestion of sludge where possible

Cross-media effects

The most important cross media effects is due to the energy consumption to operate the treatment plant (mainly electricity for aeration) and the excess sludge produced from biological treatment. However, on one hand adequate treatment without energy consumption is not possible and on the other hand, the described systems are energy efficient. Performance data for plants with sequencing batch reactors are presented below (operational data). Surplus sludge is unavoidable and has to be disposed off properly.

Operational data

Information is presented for an individual hotel, a campsite and for huts in the alpine region.

Individual hotel

The wastewater from an individual hotel (Figure 6.18) is treated in a biological treatment plant designed for 33 m^3/d and 300 Person Equivalents (PE).

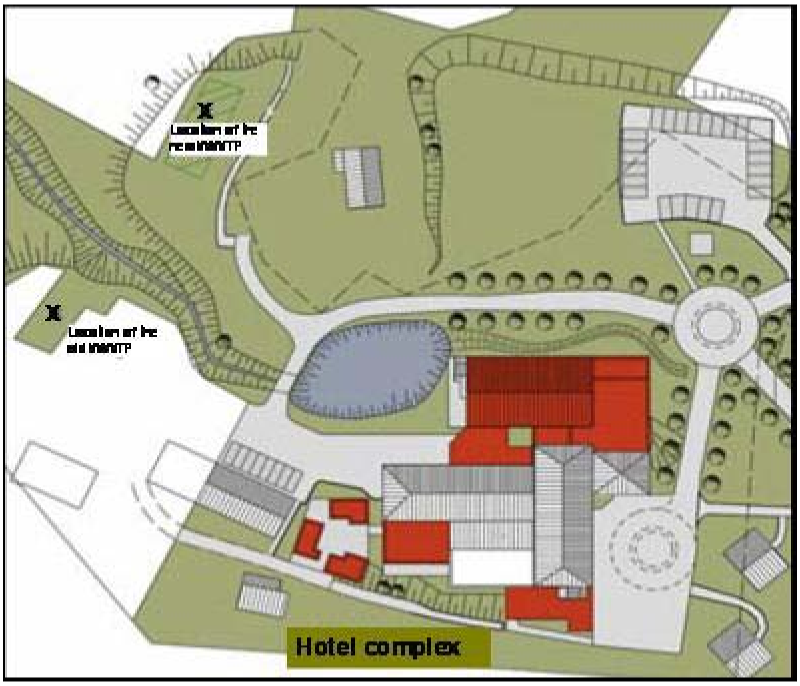


Figure 6.18: Location of the Hotel Schindelbruch and its wastewater treatment plant in Stolberg/Germany

The layout of the plant is shown in Figure 6.19, consisting of a sedimentation tank to eliminate coarse particles and an equalisation tank to collect the wastewater and to equalise its concentration and load. The biological stage is a sequencing batch reactor provided with forced aeration by compressors followed by a flow reducer to enable constant discharge flow (because of the discontinuous treatment process in the sequencing batch reactor).and the sampling manhole. Excess sludge is pumped to a collection tank from where it is transported to an external facility (anaerobic digester of a municipal wastewater treatment plant).

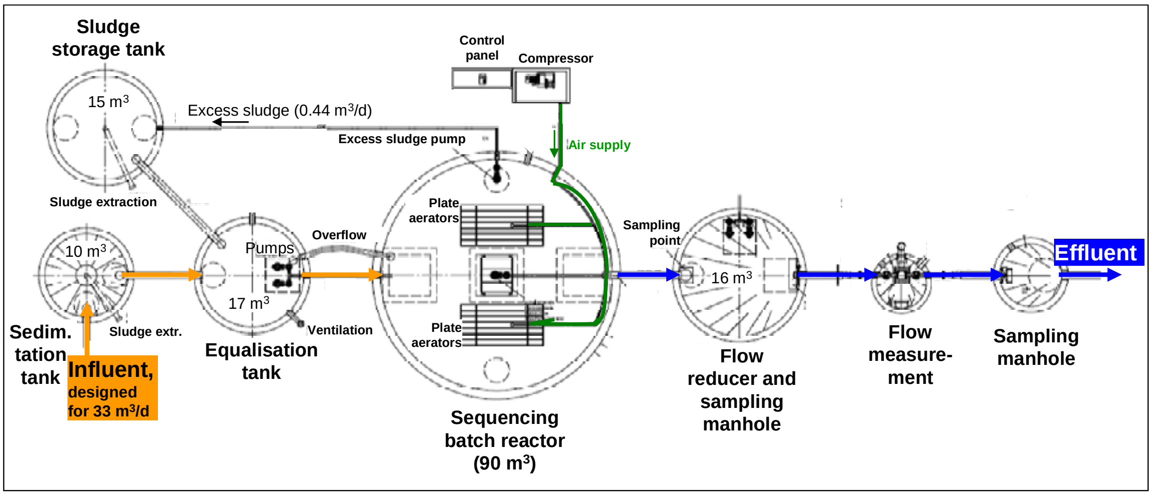


Figure 6.19: Layout of the biological treatment plant of the Hotel Schindelbruch, based on a scheme provided by Mall GmbH, it is designed for 300 person equivalents

The annual flow is about 12 400 m^3. The removal efficiency is 90 % for COD, more than 95 % for BOD_5, 81 % for NH_4-N, 77 % for total nitrogen and 44 % for total phosphorous. Available wastewater analysis carried out by an independent and certified laboratory in 2011are compiled in Table 6.15.

Table 6.15: Analysis of the wastewater after treatment for the plant of the Hotel Schnindelbruch

Sampling date	BOD_5			COD	NH_4-N	NO_3-N	org.N	total phosphorous
	influent	effluent	removal efficiency	effluent	effluent	effluent	effluent	effluent
	mg O_2/L	mg O_2/L	%	mg O_2/L	mg N/L	mg N/L	mg N/L	mg P/L
February 2011	220			60	1.1	6.2	7.3	2.4
March 2011	210			53	1.3	6.8	8.1	2.2
April 2011	238			78	1.4	6.8	8.0	2.0
May 2011	246	12.3	95.0	64	0.9	7.2	8.1	1.7
June 2011	266	12.7	95.2	62	1.1	6.5	7.6	1.4
September 2011	281	8.2	97.1	42	0.8	6.7	7.6	1.2
December 2011	294	6.8	97.7	39	0.6	6.1	6.7	1.1

The electricity consumption is about 25 kWh/d; about half of the consumption is used for the compressors to aerate the sequencing batch reactor.

The amount of excess sludge to be disposed off externally is about 0.45 m^3/d.

Campsite

The wastewater from a campsite near the city of Glücksburg in the very North of Germany, close to the Danish border (6.20), is treated in a biological treatment plant designed to treat 135 m^3/day wastewater in addition to 27 m^3/day ground water that infiltrates into the sewer system, and to serve 1 100 Person Equivalents (PE). In addition, the wastewater from about ten private houses (approximately 30 PE) is also treated in the plant. In winter, the influent load is very low, and peaks in summer when the campsite is full of guests.

6.20: Location of the campsite Glücksburg / Holnis in the very North of Germany close to the Danish border

The layout of the plant is shown in Figure 6.21, consisting of a sieve and bar rack to eliminate coarse particles and an equalisation tank to collect the wastewater and to equalise its concentration and load. The biological stage consists of two sequencing batch reactors provided with aeration air from compressors followed by two conditioning tanks and an effluent mixing sewer to enable constant discharge flow (because of the discontinuous treatment process in the sequencing batch reactor) and the sampling manhole. Excess sludge is pumped to a collection tank from where it is transported to an external facility (anaerobic digester of a municipal wastewater treatment plant).

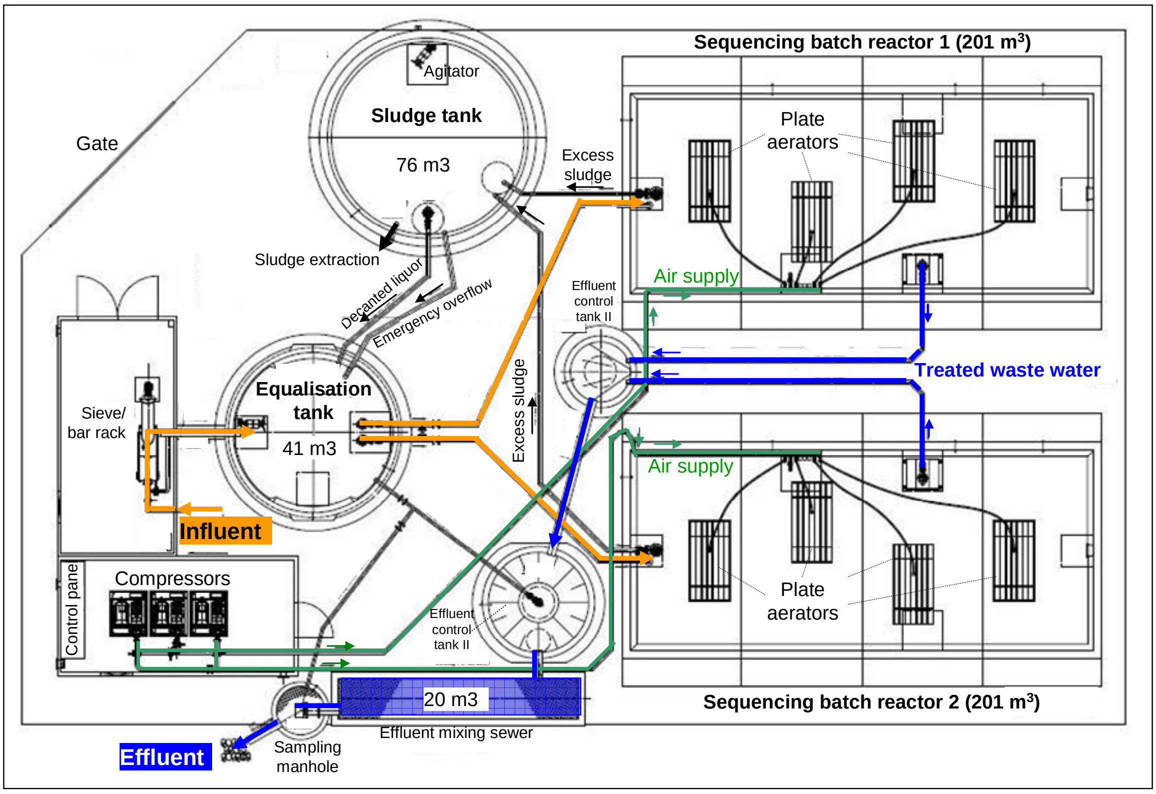


Figure 6.21: Layout of the biological treatment plant of the Campsite Glücksburg / Holnis, based on a scheme provided by Mall GmbH, it is designed for 1100 person equivalents (PE)

The annual flow is about 59 000 m^3. The removal efficiency for COD is more than 90 %, for BOD_5 more than 98 % and for ammonia about 95 %. Available wastewater analysis carried out by an independent and certified laboratory are compiled in Table 6.16. The values are very low. As BOD_5 is removed below the detection limit, the ammonia content is expected to be at least below 0.5 mg NH_4-N/L.

Table 6.16: Analysis of the wastewater after treatment discharged from the plant for the campsite Glücksburg / Holnis

Sampling date	Wastewater temp	pH	COD	BOD_5	Total phosphorus
	ºC		mg O_2/L	mg O_2/L	mg P/L
03.03.2011	4.9	8.1	17	<3	0.1
25.07.2012	18.6	6.9	26	<3	2.5
24.102011	10.9	7.0	27	<3	5.7
07.03.2012	5.4	8.0	19	<3	1.4

The electricity consumption is about 80 kWh/day; more than half of the consumption is used for the compressors to aerate the sequencing batch reactors.

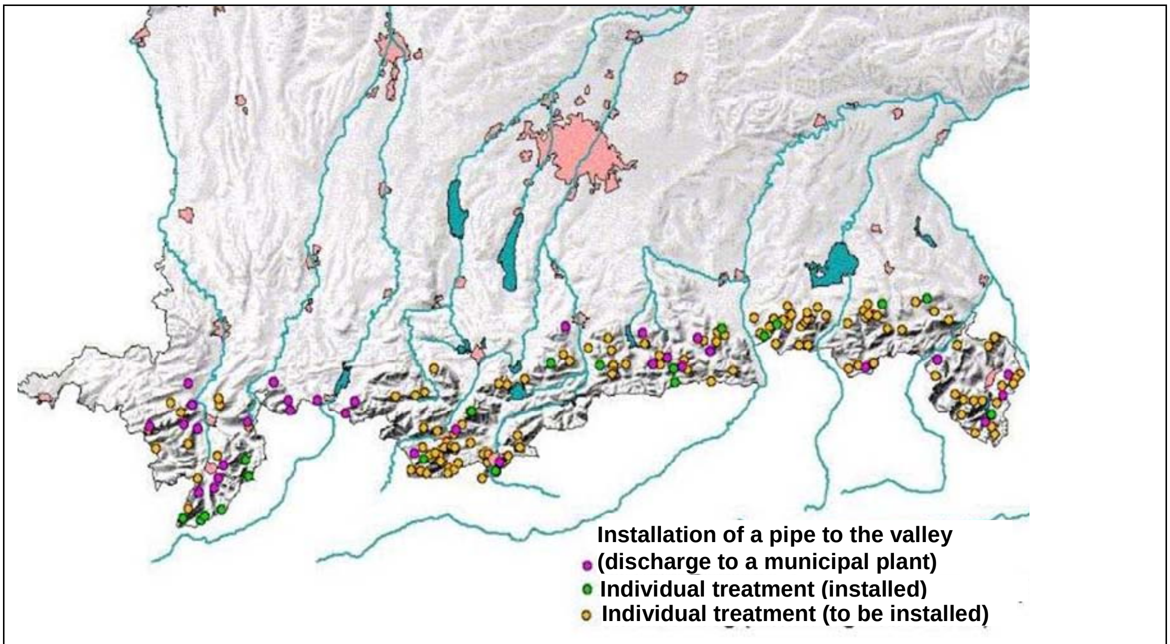
The amount of excess sludge to be disposed off externally is about 1.1 m^3/day.

Huts in the alpine region

There are cases where the installation of a wastewater pipe down to the valley to discharge the wastewater to a municipal wastewater treatment plant may be the best solution. Figure 6.22 shows two examples for this option.

Figure 6.22: Installation of a pipe to discharge wastewater down to the valley to a municipal wastewater treatment plant, (BLU, 2000)

Figure 6.23 shows that, as of the year 2000, this option had already been realised in many cases in the Bavarian alpine region, but for many others, individual solutions are required.



Source: BLU (2000).

Figure 6.23: Wastewater disposal of huts in the Bavarian alpine region, (BLU, 2000)

There are cases where water availability is limited or where treatment is more difficult, especially at high altitude. In these cases; it may be appropriate, to use separation toilets to collect urine separately to be transported to other facilities as well as dry toilets for faeces (Figure 6.24).

NB: the fall down pipe on the left is located immediately below the toilet.

Source: Jäger (2009) and Abegglen (2004).

Figure 6.24: Separation toilet (on the left) and separate dry collection of faeces (on the right)

Permeating liquid is collected and discharged to the greywater treatment system. The room of the dry toilet is vented to minimise odours. Then, the residual greywater from kitchen and bath room can be filtered in a sack filter and treated in a reed bed plant (Figure 6.25). In this way the load and wastewater emissions are minimised.

Source: Jäger (2009).

Figure 6.25: Example for a reed bed filter for the treatment of grey water from a hut at 2 245 m above sea level, designed for 30 PE60

Where no segregation is needed or carried out, treatment according to the scheme in Figure 6.17 is required. The available pretreatment systems are compiled in Table 6.17 with brief summaries of their applicability, properties and characteristics. They have to be selected according to the individual circumstances and conditions.

Subsequent to pretreatment, biological treatment and in many cases also tertiary treatment has to be applied. The applicability, properties and characteristics of the different available techniques are compiled in Table 6.18.

As already indicated above, biofilm plants have been proven to be most appropriate. If they are not applicable, due to local circumstances, activated sludge systems are recommended. Concerning biofilm reactors, priority is for reed bed filters. In case they are not applicable, e.g. because of the altitude, priority may be given to trickling filters. Concerning wastewater treatment for individual huts in the alpine region, a compilation is provided under operational data. Due to the climate conditions, the treatment plants should be established in a building. In the alpine region, tertiary treatment should be applied. For this purpose, in principle, simple systems such as mechanical biofilters and reed bed filters have been proven to be appropriate (IEVEBS, 2010a and b).

For a long time, the disposal of sludge from biological treatment remained problematic. Now, different options are available such as filter sack systems, reed bed plants, solar dryers and composters (Günthert, 2007; Günthert, 2008). Depending on legal requirements and individual permits as well as on the availability of land, it is also possible to apply the processed sludge on land close to the hut.

Table 6.17: Applicability, properties and characteristics of available pretreatment techniques for wastewater from huts in alpine regions (IEVEBS, 2010a and b)

		Pretreatment systems			
		Sedimentation plants	**Dewatering press**	**Dry toilets**	**Filter sack plants**
Applicability	**Spreading onsite permitted**	+	+	+	+
	Spreading onsite not permitted				
	in case of supply and disposal via a road	++ Transport in vaccum tank	+ space and weight minimised transport	+ space and weight minimised transport	+ space and weight minimised transport
	in case of supply and disposal via helicopter or cable lift/cable car	o wet sludge has to be dewatered for transport	+ space and weight minimised transport	+ space and weight minimised transport	+ space and weight minimised transport
	Limited tap water / water for use availability	in case of water shortage, dry toilets are recommended			
	Cost-intensive energy supply	++ usually no energy consumpt.	o const. energy consumpt.	o energy for aeration	++ low or no energy consum.
	Plant size				
	< 50 PE_{60}	++	++	++	++
	50 - 100 PE_{60}	++	++	+	o
	> 100 PE_{60}	++	+	o	-
Properties and charateris.	**Ease of operation and maintenance**	++	-	-	o
	Reliability	++	-	+	++
	Average assessment by operators	+	o	o	o

Legend: PE_{60}: Population Equivalent (60 g BOD_5/d)
++: very good/very highly appropriate; +: good/highly appropriate: o: satisfactory/appropriate

Table 6.18: Applicability, properties and characteristics of available biological treatment techniques for wastewater from huts in alpine regions (IEVEBS, 2010a and b)

		Biofilm processes				Activated sludge systems			Waste water lagoon
		Reed bed filter	**Trickling filter**	**Mechanical biofilter**	**Rotating biological contactor**	**Conventional activated sludge system**	**Sequencing batch reactor**	**Membrane bioreactor**	
Applicability	**Type of supply (applicability due to transport costs/efforts)**								
	Roadway	+	++	++	++	++	++	++	+
	cable lift / helicopter	+ / - no inoculation required	++ no inoculation required	++ no inoculation required	++ no inoculation required	++ transport costs low but annual inocluation with activated sludge required	++ transport costs low but annual inocluation with activated sludge required	++ transport costs low but annual inocluation with activated sludge required	+ / - no inoculation required
	Above sea level								
	< 1800 a.s.	++	++	++	++	++	++	++	++
	> 1800 a.s.	o	++	++	++	++	++	++	+ / -
	Summer and winter operation	+ / -	++	++	++	++	++	++	+ / -
	Energy efficiency (low consumption)	++	+	+	o	+ / -	+ / -	+ / -	++
	Open country topography (steep, bedrock)	+ / -	++	++	++	++	++	++	+ / -
	Legal requirements	in case of adequate dimension and combination with appropriate tertiary treatment, all systems usually meet the performance requirements							+ / -
	Plants above 150 PE_{60}	+ / -	++	++	++	++	++	++	+ / -
Properties and characteristics	**Treatment performance (tertiary treatment**	o longer start-up phase	o longer start-up phase	o longer start-up phase	o longer start-up phase	+ shorter start-up phase with inoculation (see above)	+ shorter start-up phase with inoculation (see above)	+ shorter start-up phase with inoculation (see above)	o longer start-up phase
		Provided well-done planning and regular maintenance, these systems, in adequate combination with pre-treatment systems and tertiary treatment, usually meet the legal performance requirements							+ / -
		signific. reduction of germs, in case tertiary treatm. is demanded, e.g. a UV plant can be added	in case there is a demand for tertiary treatment, an additional treatment stage (e.g. UV plant) can be provided					in case of tert. treatm. demand, add. germ removal ist not needed. A UV plant can be applied to be on the safe side.	in case of tert. treatm. demand, a UV plant has to be added
	Ease of operation and maintenance	++	+	+	+	o	o	data not available	++
	Reliability	++	+	o	o	o	o	data not available	++
	Assessment by operator	++	+	+	+	+	o	+	++
	Assessment of total costs (capital value)	1800 - 3900 EUR/PE	2200 - 3900 EUR/PE	3300 - 5700 EUR/PE	2700 - 5300 EUR/PE	4900 - 7900 EUR/PE	3600 - 4400 EUR/PE	no info due to low number of available plants	no info due to low number of available plants
	Investment costs	average	average	high	low	low	low	average	very low
	Reinvestment expenses	very low	low	low	low	high	high	high	very low
	Operation costs	very low	low	low	average	high	high	high	very low

Legend: PE_{60}: Population Equivalent (60 g BOD_5/d)
++: very good/very highly appropriate; +: good/highly appropriate: o: satisfactory/appropriate; + / -: sufficient/of limited suitability

Applicability

The different techniques described for the biological treatment of wastewater from individual hotels, campsites and huts in the alpine region are applicable without limitations. There are different options depending on the individual circumstances, but in principle the described techniques for pretreatment and biological treatment are applicable to all cases of the aforementioned categories.

Economics

Plant for the Hotel Schindelbruch (described above)
Investment costs: 145 000 EUR net (turn key); i.e. 500 – 1 000 EUR/PE. The operational costs are as follows

- Electricity: 5.9 EUR/PE (price for one kWh: 0.21 EUR)
- External sampling and analysis: 4.9 EUR/PE
- Maintenance: 3.2 EUR/PE
- Repairs: 4.6 EUR/PE
- Personal costs 7.0 EUR/PE
- Disposal costs for sludge and residues from sedimentation: 14.2 EUR/PE

This is in total 39.8 EUR/PE, equivalent to 0.96 EUR/m^3.

Plant for the campsite Glücksburg / Holnis described above
Investment costs: 540 000 EUR net (turn key), i.e. also 500 – 1000 EUR/PE. The investment was made by the city Glücksburg as it is competent for the discharge of wastewater. The campsite operator has to pay a fee on the basis of each cubic meter of wastewater discharged to the plant.

The operational costs are as follows

- Electricity: 5 900 EUR (price for one kWh: 0.21 EUR), equivalent to 5.4 EUR/PE
- External sampling and analysis: 8.1 EUR/PE
- Maintenance: 1 EUR/PE
- Repairs: 3.5 EUR/PE
- Personal costs (20 hours/month): 7.7 EUR/PE (35 EUR/working hour)
- Sludge disposal costs: 7.9 EUR/PE (21 EUR/m^3 sludge)

This is in total 33.6 EUR/PE, equivalent to 0.63 EUR/m^3.

For the installation of a wastewater pipe down to the valley to discharge the wastewater to a municipal treatment plant, the following costs have been reported (although these values are now more than 10 years old, and will now be higher): 45 – 340 EUR/m (average: 160 EUR/m) and 350 – 4 100 EUR/PE (average: 1 400 EUR/PE) (BLU, 2000).

No detailed figures for the different treatment techniques of the wastewater from huts in the alpine region could be identified.

Concerning sludge processing techniques, investment costs between EUR 7 000 and EUR 25 000 have been reported (Günthert, 2008).

Driving force for implementation

On one hand, legal requirements represent one of the most important driving forces to implement the techniques described. On the other hand, an awareness of environmental damage and responsibility to operate tourist accommodation in a sustainable manner are also relevant driving forces to go beyond regulatory requirements.

Reference applications

See the examples presented above under operational data.

Reference literature

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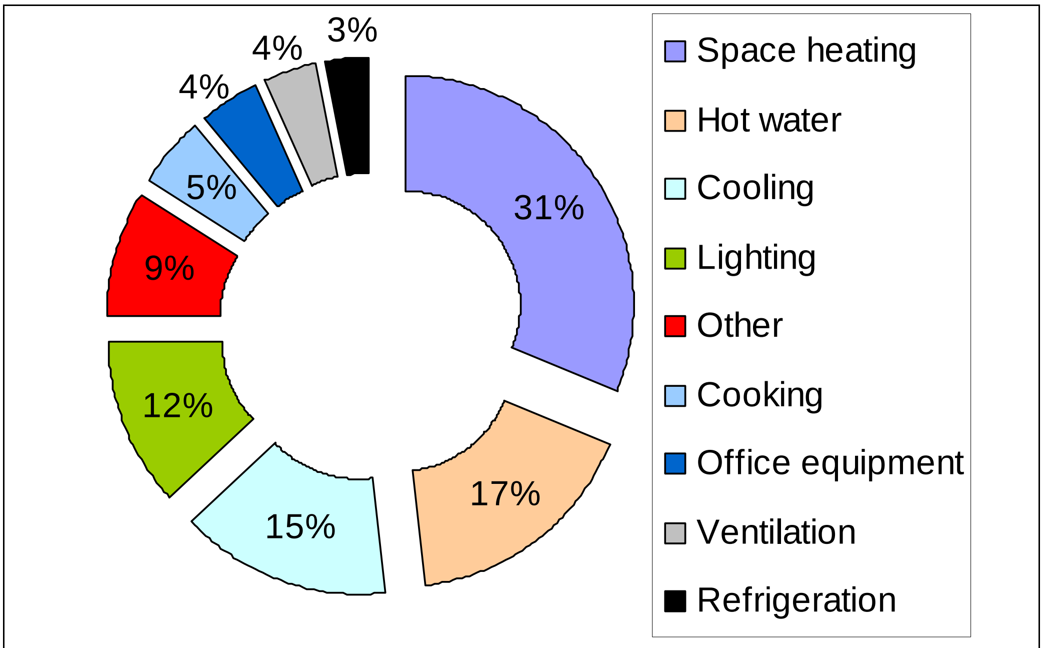
7 MINIMISING ENERGY CONSUMPTION IN ACCOMMODATION BUILDINGS

Accommodation and energy consumption

Accommodation is a significant but not major contributor to global energy consumption and associated CO_2 emissions, accounting for approximately 1 % of the latter (HES, 2011). Whilst the 5.45 million hotel rooms in Europe represent half the global total number, European accommodation is estimated to be responsible for just 21 % of GHG emissions arising from accommodation globally (HES, 2011), suggesting better-than-average energy efficiency in European accommodation. Nonetheless, energy efficiency has traditionally represented a low priority for accommodation, and there is considerable scope for energy savings in the sector, contributing to cost and GHG emission reductions.

Processes responsible for final energy consumption in accommodation

The breakdown of total energy consumption for a typical hotel is displayed in Figure 7.1. This breakdown, and the proportion of energy sourced from electricity compared with fuels such as natural gas, propane, liquid petroleum gas and fuel oil, varies considerably across accommodations depending on the level of services offered, building design, climate, occupancy, local energy infrastructure and local regulations. Electricity accounts for approximately 40 % of energy consumed in a hotel (HES, 2011). Of this, approximately 45 % is used for lighting, 26 % for HVAC, 18 % for other, 6 % for water heating and 5 % for food services (Leonardo Energy, 2008). Kitchens and laundries typically account for approximately 10 % and 5 % of energy consumption, respectively, in a large hotel, although these figures vary considerably depending on the size of the hotel restaurant and the amount of laundry that is processed on site. Kitchens may represent up to 25 % of energy consumption (Farrou et al., 2009). Energy consumption in kitchens is addressed in section 8.4, and energy consumption in laundries is addressed in sections 5.4 and 5.5.



Source: Data from HES (2011).

Figure 7.1: Energy consumption by end-use in hotels

Opportunities to reduce final energy consumption in accommodation

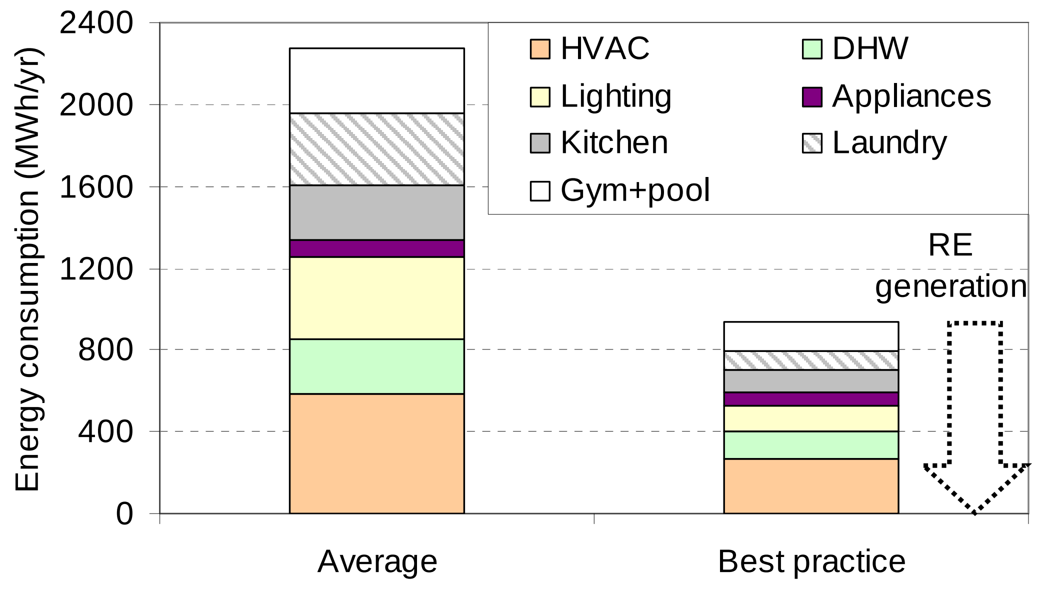
Energy saving opportunities in accommodation mirror those for buildings more generally (e.g. EC, 2012). Table 7.1 presents a ranking of energy efficiency and renewable energy (RE) measures according to financial attractiveness in Northern Ireland. It is clear that measures to reduce energy demand are the most cost effective, usually resulting in significant financial savings. Measures to meet demand with renewable energy sources, for example by installing solar water heating, may be associated with significant financial costs. However, the situation differs considerably across countries and at an enterprise level depending on factors such as climate and financial support for renewable energy installation.

Table 7.1: Financial attractiveness of different energy demand and supply measures in Northern Ireland, ranked in descending order

Financial savings	Financially neutral	Small financial cost	Significant financial cost	Large financial cost
1. Energy Management Systems 2. Building envelope insulation 3. Heating controls 4. Low energy lighting 5. Most efficient boilers	6. Small hydro 7. Small biomass heat 8. Large wind 9. Small biomass heat 10. Co–firing biomass with coal	11. Small wind 12. Large biomass CHP 13. AD CHP	14. Micro wind 15. Solar water heating	16. GSHP 17. Solar PV
Source: Carbon Trust (2008).				

Figure 7.2 and Table 7.2 provide an overview of the opportunities to reduce energy consumption in accommodations through the model example of a 100-room hotel, based on average and best practice performance across major energy-consuming processes described throughout this document. Excluding renewable energy (RE) supply measures, implementation of best practice measures to reduce energy demand could reduce energy consumption for a 100-room hotel with a pool and leisure area by 1 336 MWh per year (56 %), equivalent to an energy bill reduction of over EUR 93 000 per year assuming 40 % of the final energy saving is electricity and 60 % is natural gas. Use of RE resources, such as geothermal heating and cooling, wood heating, and wind electricity in particular, could further reduce net primary energy consumption.

Table 7.2 shows that the largest energy savings, up to 323 MWh per year for a 100-room hotel, can be achieved by reducing demand for and optimising the provision of heating ventilation and air conditioning (HVAC). The next greatest opportunity for energy savings of up to 265 MWh per year arises through the installation of energy-efficient and intelligently controlled lighting, followed by optimisation of laundry processes. Pool and leisure areas, kitchens and domestic hot water (DHW) heating also present major opportunities for energy savings where present on accommodation premises. Implementation of energy monitoring and management is integral to all best practice energy efficiency and renewable energy measures. Table 7.2 lists the main best practice measures, and sections of this document in which they are described, to reduce energy consumption across each of the main processes.



NB: Assumes average occupancy rate of 80 % of rooms (of which 25 % double occupancy).

Figure 7.2: Modelled average and achievable best practice energy consumption for a 100-room 5 300 m² hotel based on demand reductions and assumptions in Table 7.2

Savings presented in Table 7.2 exclude those achievable from the implementation of RE, which are described in section 7.4 with regard to aerothermal, hydrothermal and geothermal energy exploited via heat-pumps, and in section 7.6 regarding solar, wind and biomass resources. Although reducing energy demand has the greatest immediate potential to reduce primary energy consumption and associated environmental impact, the installation of RE capacity has an important effect on developing and mainstreaming RE technologies and markets. Thus, whilst measures to reduce energy demand are prioritised on the energy management ladder for accommodations (sections 7.1 to 7.5), sourcing renewable energy (section 7.6) is considered to have an important long-term environmental benefit beyond its immediate impact.

Table 7.2: Modelled energy savings achievable from best practice in a 100-room hotel, and portfolio of associated best practice

Process or area	Saving MWh/yr	Savings calculations	Best practice measures	Section
HVAC	323	Best practice and average practice HVAC plus DHW heating of 75 and 161 kWh per m^2 per year, respectively, taken from hotel chain non-electricity demand data (Figure 7.14 in section 7.2). DHW consumption (below) subtracted	Energy management	7.1
			Improved building envelope	7.2
			Optimised HVAC	7.3
			Geothermal heating/cooling or wood heating	7.4 or 7.6
Lighting	265	Best practice is represented by 25 kWh per m^2 per year lighting energy consumption, based on installation of low energy lamps and intelligent control (section 7.5). Average lighting consumption three times higher	Energy management	7.1
			Efficient lighting	7.5
			Solar PV or wind electricity generation (on site or off site)	7.6
Laundry	263	Average practice based on 4 kg laundry per occupied room per day requiring 3 kWh per kg to process. Best practice based on 3 kg per room per day requiring 1 kWh per kg to process on a large-scale (perhaps off site)	Energy management	7.1
			Reduced laundry generation (bedclothes reuse)	7.3
			Optimised small- and large- scale laundries	5.4 and 5.5
Pool and leisure area	168	Assumes 200 m^2 pool and leisure area, with typical and best practice energy consumption of 1 573 and 735 kWh per m^2 per year, respectively (Carbon Trust, 2006: section 5.6)	Energy management	7.1
			Optimised pool management	5.6
			Integration with optimised HVAC system	7.3
Kitchen	164	Assumes 1.5 cover meals per guest per day. Average and best practice represented by 5 and 2 kWh per cover meal, respectively (section 8.4).Energy consumption can vary widely depending on type of meals produced	Energy management	7.1
			Optimised cooking, ventilation and refrigeration	8.4
			Integration with optimised HVAC system	7.3
DHW	133	Assumes DHW consumption of 60 L per guest, heated by 50 ºC, for best practice, and twice this heating energy for average practice	Energy management plan	7.1
			Low flow water fittings in guest areas	5.2
			Solar thermal or wood heating	7.6
Other electrical appliances	20	Best practice is represented by mini-bar electricity consumption of 0.8 kWh per room per day plus TV standby at 1 W plus TV operating at 100 W 1.5 hours per room per day (section 7.5), plus equivalent electricity in non-guest areas. Average practice is twice this level	Efficient electrical equipment	7.5
			Energy management	7.1
			Solar PV or wind electricity generation (on site or off site)	7.6

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7.1 Energy monitoring and management systems

Description

Implementing an energy management plan is a core EMS requirement, and follows principles described in section 2.1. The basic sequence of actions representing implementation of an energy management plan is shown in Figure 7.3. Fulfilling best practice for this technique may facilitate formal accreditation according to ISO 14001, the HI-Q management system for hostels, and other formal EMS used by accommodation. Energy monitoring and reporting is also a core requirement for environmental standards such as the EU Flower for tourist accommodations, the Nordic Swan for hotels and hostels. Various tools exist to assist accommodation managers with energy benchmarking, most notably the free Hotel Energy Solutions (HES) 'e-toolkit' developed by the UNWTO, UNEP and others, available at: http://www.hotelenergysolutions.net/en/content/e-toolkit

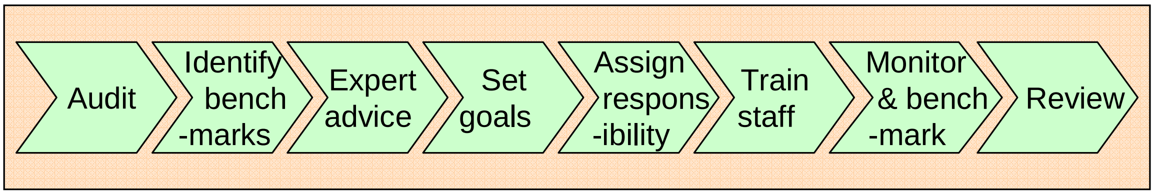


Figure 7.3: Sequence of key actions to implement an energy management plan

Sections 7.2 and 7.3 describe best practice to reduce energy demand specifically for heating and cooling, whilst section7.5 describes best practice to reduce electricity consumption for lighting and other electrical appliances in guest areas, and section 7.6 refers to the installation and sourcing of RE.

This BEMP technique relates to measures outlined in Table 7.3 relating to implementation of a comprehensive energy management plan that includes benchmarking energy efficiency throughout accommodation premises. The two measures underpinning this BEMP technique are:

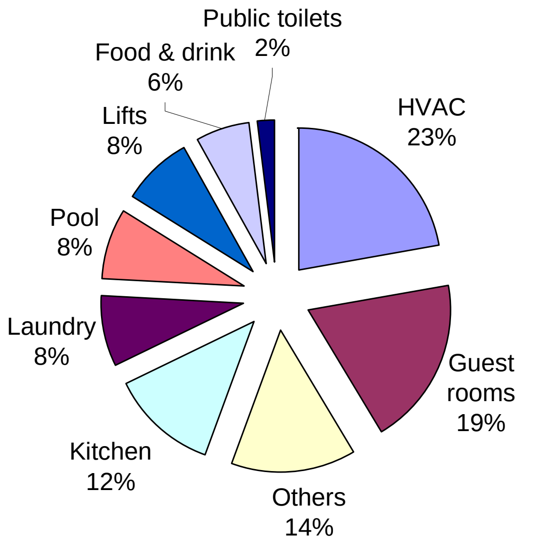
- an audit of major energy consuming equipment and processes
- monitoring of energy consumption across major energy consuming processes and areas.

Table 7.3: Best practice measures for the monitoring and management of energy consumption in accommodation premises

Measure	Description	Applicability
Energy audit and monitoring	Draw up inventory of main energy-consuming devices. Monitor energy consumption at least on a seasonal basis and calculate energy consumption per m^2	All accommodations
Sub-metering	Install electricity and, where possible, gas or oil, sub-meters for different building zones to include at least kitchens, laundry areas, spa and pool areas, rooms and hallways	Larger premises
Energy management plan	Identify priority measures to reduce energy consumption. Derive appropriate benchmarks for particular processes, and overall based on energy consumption per m^2, and define targets to drive continuous improvement	All premises
Automated control	Implementation of an automated control system, including key-card activation of room electricicity and HVAC systems (except fridges), and deactivation when windows opened. Ideally integrated into a Building Management System for large premises	Larger premises
Inspection and maintenance	Regularly inspect energy-consuming and control equipment and repair or replace damaged equipment. In particular, ensure that boilers, sensors, thermostats and fans are working correctly. Inspect pipes and ducts for leaks. Manually check gauges to verify digital readings	All accommodations
Staff and guest training	Train staff to turn off unnecessary lighting and devices on standby, and to close window blinds in summer, for example during room cleaning. Inform guests of simple actions to reduce energy consumption	All accommodations
Adequate insulation	Make sure that all water and HVAC pipes are adequately insulated to minimise energy losses	All accommodations

At its most basic for small premises, an energy audit involves the compilation of an inventory of energy-using equipment, combined with estimated usage patterns, to estimate the main sources of energy demand. Preferably, an energy audit should be carried out by a trained energy expert, in-house or external. Initial audit information is usually sufficient to inform accommodation managers on preliminary actions to reduce energy consumption. These range from requesting staff to turn off all unnecessary lighting, through replacing older devices with new energy efficient models, to modifications of the HVAC system and retrofitting of the building envelope.

Typically, the energy consumption of numerous energy-instensive processes occurring on accommodation premises is not monitored separately. For example, despite kitchens being responsible for approximately 15 % of energy consumption in a typical hotel, and a strong correlation between the number of food covers served in hotel restaurants and total hotel energy consumption (Bohdanowicz and Martinac, 2007), kitchen energy consumption is rarely monitored separately. One proposed aspect of best practice is to install sub-meters for kitchen electricity and gas (and water) consumption. Similarly, on-site laundry operations can have high energy requirements (section 5.4 and 5.5), as can pool and spa areas. Therefore, a key best practice measure is the installation of sub-metering for electricity and fuel consumption across major energy-consuming processes or areas. Figure 7.4 provides an example of detailed electricity sub-metering data.



Source: Data from ITP (2008).

Figure 7.4: Sub-metered electricity consumption data for a 300-room hotel in Germany

Maintenance, staff training and guest information are all important aspects of energy management on accommodation premises. The EU Flower ecolabel for accommodation requires accommodation managers to organise appropriate staff training, and to provide guests with information to reduce energy consumption, such as reminders to switch off lights. The EU Flower ecolabel for accommodation also requires at least annual maintenance and servicing of boilers and air conditioning systems (more often if needed or required by law) by appropriately qualified professionals.

Detailed information on best practice in energy monitoring can be found in the European standard for energy management systems (EN 16001) that also provides guidance. Compliance with that standard may be used as an indicator of best practice. EN16001 recommends that the following aspects of energy management within enterprises be audited:

– effective and efficient implementation of energy management programmes, processes and systems
– opportunities for continual improvement
– capability of processes and and systems
– effective and efficient use of statistical techniques
– use of information technology.

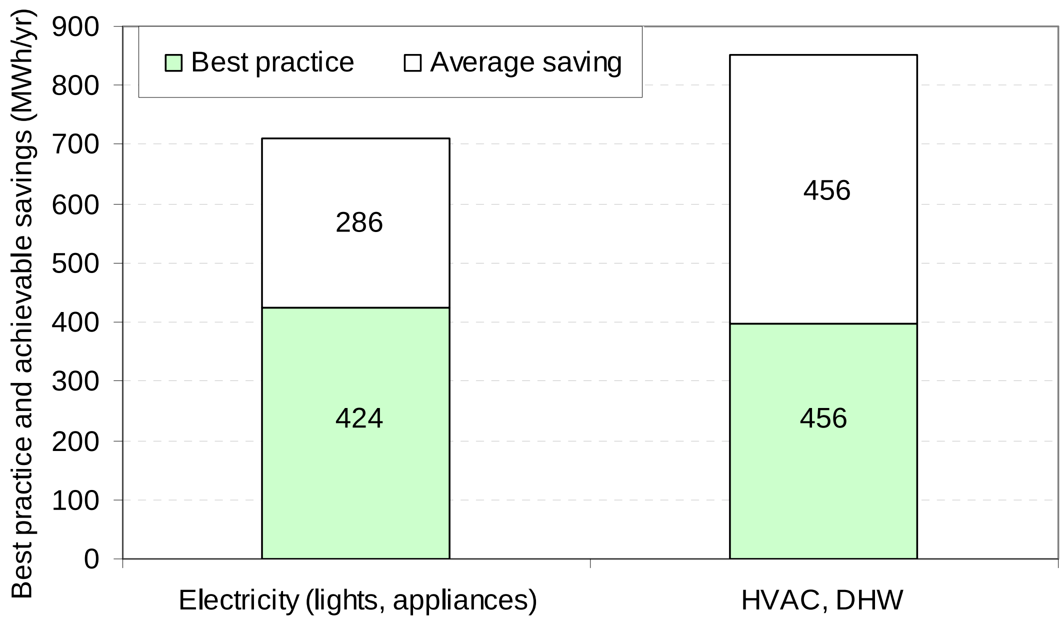
Achieved environmental benefit

Energy management

Energy monitoring and management itself can typically lead to immediate energy savings in the region of 10 %, through the identification of basic corrective actions (HES, 2011). Using monitoring to reduce diurnal imbalances in demand (i.e. increasing the proportion of electricity used at night) can reduce peak electricity demand and facilitate electricity suppliers to maximise use of efficient baseload generating capacity (including renewables).

Building energy optimisation

Monitoring and managing energy consumption is a prerequisite to implement targeted energy efficiency and RE measures throughout accommodation premises (i.e. building energy optimisation), the environmental benefits of which are detailed in subsequent sections of this chapter. Figure 7.5 displays the potential energy savings for a 100-room hotel based on implementation of best practice, compared with average performance of hotels in an anonymous mid-range hotel chain (Figure 7.7). For average hotels, implementation of best practice, informed by a comprehensive energy management plan, could reduce total energy demand by 742 MWh per year.



NB: HVAC = Heating, Ventilation, Air Conditioning; DHW = Domestic Hot Water. Based on average and best practice non-HVAC electricity demand of 134 and 80 kWh/m^{2}yr (see section 7.5). Based on average and best practice HVAC demand of 161 and 75 kWh/m^{2}yr. Assumes hotel heated and cooled area of 5 300 m^2.

Figure 7.5: Annual electricity consumption and HVAC consumption for a 100-room hotel based on best practice, and savings compared with average consumption

Appropriate environmental indicator

Indicators specifically related to heating and cooling energy consumption are described in sections 7.2 and 7.3, whilst section 7.5 specifies indicators related specifically to electricity consumption and section 7.6 refers to indicators for RE sourcing. This section focuses on benchmarking overall energy performance based on aggregation of relevant energy consumption data.

<u>Management indicators</u>

Best practice for energy monitoring can be summarised in the following three management indicators:

- sub-metering of all major electricity- and fuel- consuming processes on the accommodation premises (within a building management system for large premises)
- collation and processing of energy consumption data to enable energy efficiency benchmarking at the process and premises level
- implementation of an energy management plan informed by benchmarking results, incorporating process level energy targets, appropriate maintenance and staff training.

<u>Current performance indicators</u>

Enterprises usually have the data necessary to calculate total final energy consumption (Table 7.4). Two denominators may be used to derive indicators capable of benchmarking energy consumption across enterprises: guest-nights and serviced (heated and cooled) floor area (m^2).

Energy indicators based on these separate denominators correlate, but not particularly strongly (Figure 7.6). Final energy consumption per guest-night is strongly influenced by the level of service offered by accommodation (e.g. room size, area and equipment used for accompanying services such as eating and leisure), and by occupancy rate. Final energy consumption per m^2 serviced area is less influenced by different levels of service or occupancy rate, and conforms with typical building energy efficiency benchmarks, enabling a more robust comparison of building energy performance across accommodation establishments.

Table 7.4: Common units of energy delivered to accommodation, and appropriate conversion factors to calculate final energy consumption, primary energy consumption and GHG emissions

Energy source	Common unit	Net calorifc value per unit (kWh_{final})	Primary energy ratio ($kWh_{primary}$/ kWh_{final})	Lifecycle CO_2 eq. (kg/kWh_{final})
Electricity mix(*)	kWh	1.0	2.7	0.550
Natural gas	m^3	7.4	1.1	0.202
LPG	kg	13.9	1.1	0.242
Gas oil	L	10.3	1.1	0.327
District heating(*)	Tonne steam	698	0.8 – 1.5	0.24 – 0.41

(*)primary energy ratio and lifecycle CO_2 emission factors vary depending on generation sources (average factors shown)
Source: ITP (2008); Passivehouse Institute (2010); DEFRA (2011).

Therefore, the recommended key performance indicator for energy efficiency in accommodations is:

- total final energy consumption (kWh) expressed per m^2 serviced area.

The above indicator also corresponds with EU Flower mandatory criteria for energy monitoring on accommodation premises that require a procedure for the collection of data on overall energy consumption, expressed as kWh, on a monthly or at least annual basis, normalised per overnight stay and per m^2 of indoor area.

In order to recognise the benefits of RE installation (section 7.6) without necessarily calculating primary energy consumption or lifecycle GHG emissions (below), the on-site renewable contribution may be excluded from the final energy consumption.

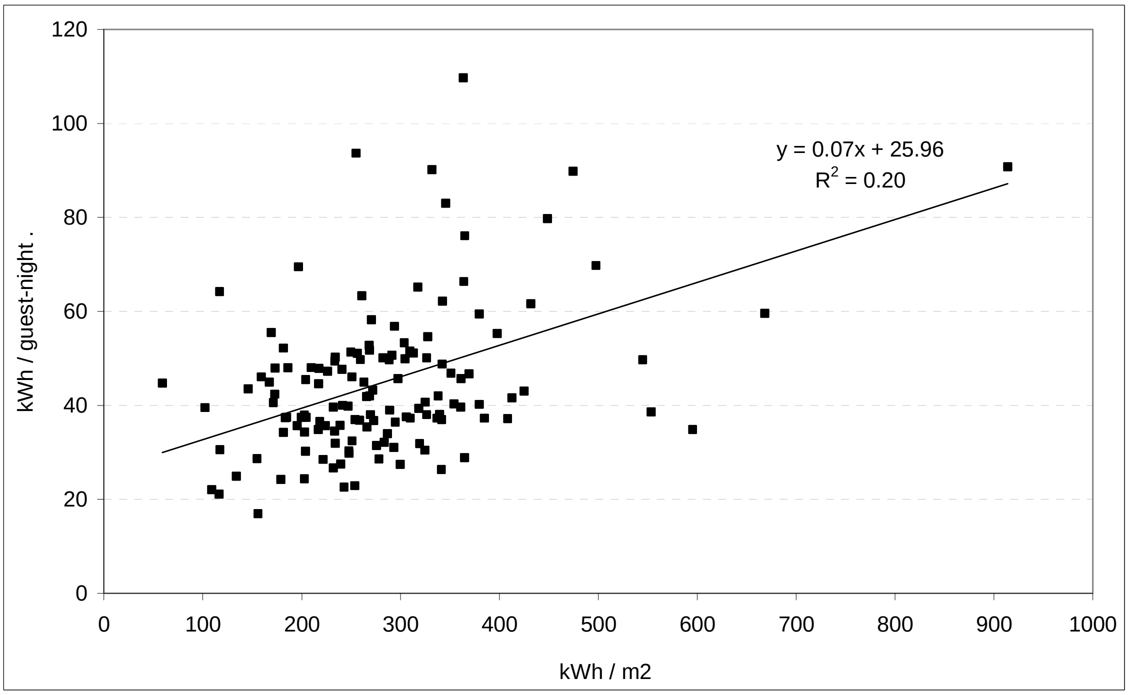


Figure 7.6: Relationship between final energy consumption expressed per guest-night and per m² heated and cooled area for hotels across a mid-range hotel chain

Recommended indicators

Primary energy demand is not usually reported by accommodation enterprises, but could provide a useful summary of energy performance that reflects both demand and supply improvement measures, such as the installation of on-site RE sources (section 7.6).

Total primary energy consumption is a function of both final demand and energy sources (Table 7.4). Each unit of electricity consumed may represent primary energy consumption of between less than one and more than four units of primary energy, after accounting for extraction of fuels, conversion efficiencies in power stations, and transmission losses. Often for building primary energy calculations, a ratio of 2.7 is used for electricity (Passivehouse Institute, 2010). Meanwhile, gas is typically attributed a PER of 1.1 (Table 7.4) and RE sources are attributed primary energy ratios of less than 0.2 (see Table 7.32 in section 7.6).

Business sustainability reporting often involves reporting on GHG emissions, ideally based on international standards such as the International GHG Protocol (WRI, 2004). Lifecycle CO_2 eq. factors for different energy carriers are included in Table 7.4. Note that for accurate comparison between on-site fuel combustion and energy from electricity, district heating or renewable sources, **lifecycle** and not direct emissions should be compared. As with primary energy factors, supply-specific CO_2 emission factors for electricity and district heating/cooling may be available from national statistics or energy providers.

Based on the above, a further recommended best practice for accommodation is to calculate and report total primary energy consumption per m², accounting for all energy sources, and total energy-related GHG emissions. These can be calculated by multiplying final energy consumption by appropriate PERs and CO_2 emission factors in Table 7.4, but should use supply-specific factors for electricity and district heating/cooling, where these are available from energy providers or national statistics.

Benchmarks of excellence

Two benchmarks of excellence are proposed: (i) a management benchmark; (ii) a performance benchmark. The proposed benchmark of excellence reflecting best management practice is:

BM: implementation of a site-specific energy management plan that includes: (i) sub-metering and benchmarking all major energy-consuming processes; (ii) calculation and reporting of primary energy consumption and energy-related CO_2 emissions.

The European standard for energy management systems (EN 16001) acknowledges that *'organisations will not necessarily have sufficiently comprehensive metering installed, and that introducing it will potentially be costly, time-consuming and disruptive. However, where appropriate, it should have a demonstrable plan for improving the provision of meters.'* This guidance may be used for interpreting the benchmark of excellence for older buildings, SMEs and micro-enterprises.

Based on the performance of 131 mid-range European hotels (Figure 7.7), the following benchmark of excellence is proposed for overall energy performance in existing accommodation buildings:

BM: total final energy consumption ≤180 kWh per m^2 heated and cooled area and per year.

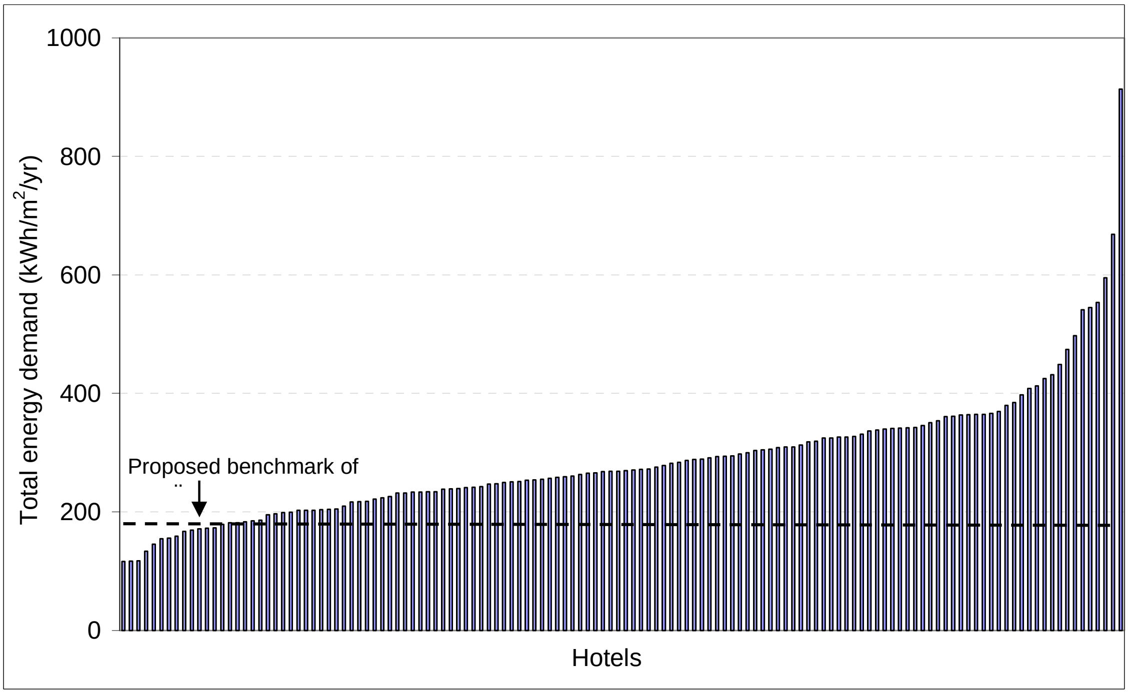
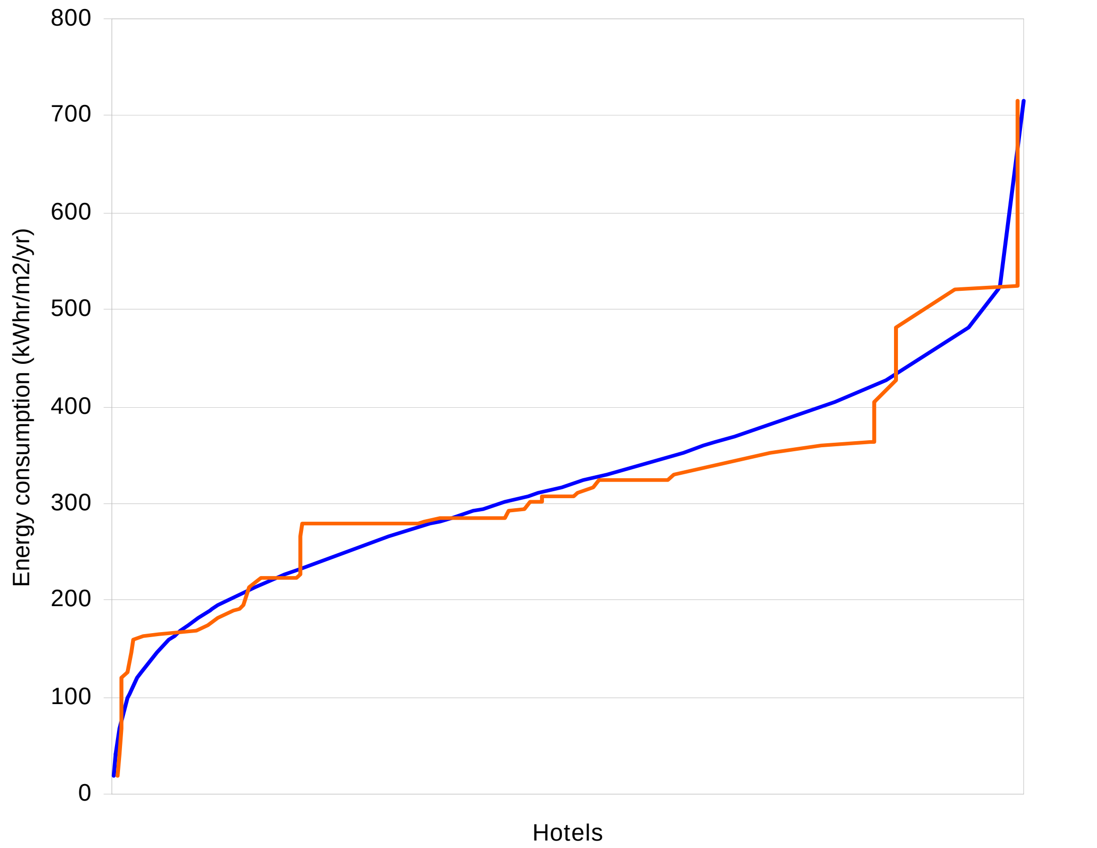


Figure 7.7: Total energy demand per m^2 heated and cooled area across a mid-range hotel chain, and proposed benchmark of excellence



NB: The orange line represents the data collated from these studies, and the blue line is the line of best fit for a normal distribution with mean 319 kWhr/m^{2}yr and standard deviation of 105 kWhr/m^{2}yr.
Source: HES (2012).

Figure 7.8: Total energy consumption across 1511 hotels, based on data collated in a meta-analysis of 20 studies on European hotel energy consumption

The above benchmark for existing buildings is corroborated by data for 1 511 European hotels collated for the HES project in a meta-analysis of European hotel energy studies, a visual overview of which is presented in Figure 7.8. Those data indicate a very similar performance distribution to the 131 hotels in the mid-range hotel chain (Figure 7.7).

The above benchmark is not particularly challenging for new accommodation buildings, or in buildings where geothermal heating and cooling, or other RE options, are implemented and not accounted for in final consumption data. For example, the Boutiquehotel Stadhalle in Vienna includes a PassiveHouse standard extension, wind turbines and solar PV electricity generation, and reports annual final energy consumption of less than 13 kWh/m^{2}yr (Table 7.11 in section 7.2). Similarly, Crowne Plaza (2011) claim that their Copenhagen Towers hotel consumes less than 43 kWh/m^{2}yr owing to the exploitation of geothermal heating and cooling (section 7.4). Therefore, a separate benchmark of excellence is proposed in section 7.2 for new buildings based on compliance with the exemplary Minergie P and PassiveHouse standards.

Cross-media effects

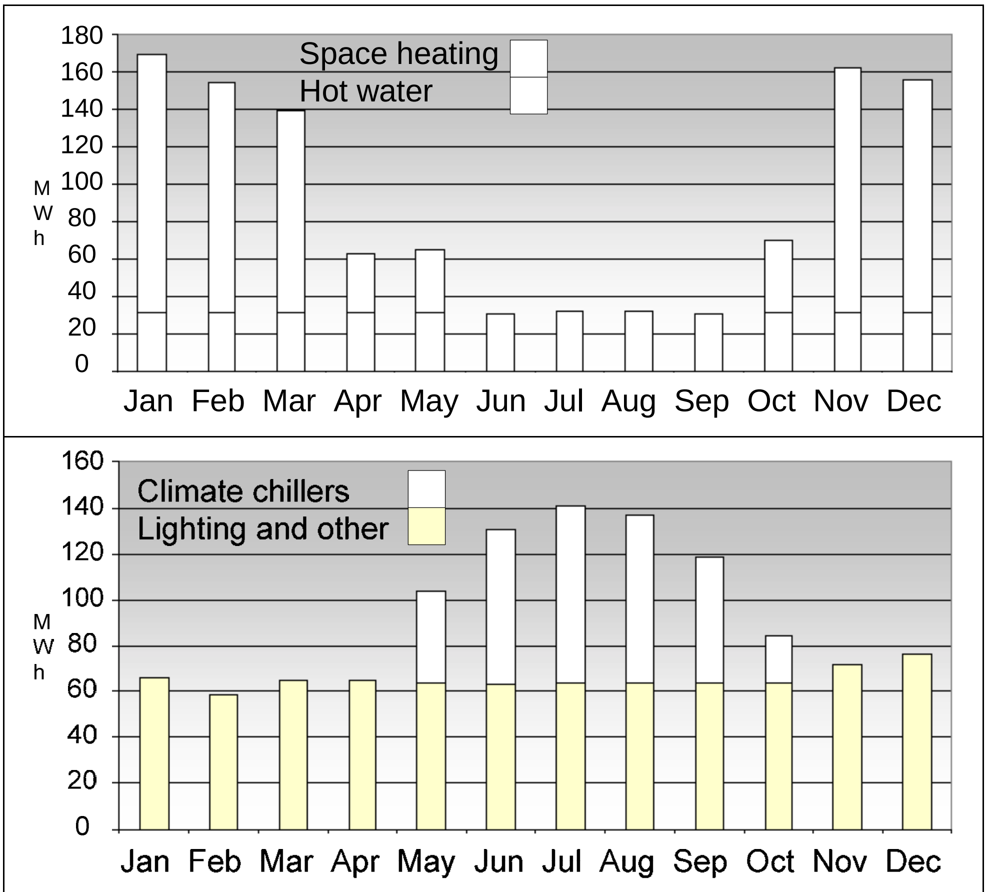
There are no significant cross-media effects associated with energy monitoring and benchmarking.

Operational data

Continuous monitoring

Continuous monitoring assists with the identification of energy-saving options, and, where sub-metering is not possible, may offer insight into consumption for specific processes. Continuous monitoring data may be used to inform the timing of different energy using processes throughout the day, in order to reduce peak demand and shift demand to night-time wherever possible (night-time electricity is often charged at a lower rate, and can have a lower environmental burden than peak load electricity). Gas and electricity suppliers may offer basic continuous monitoring and consumption reports for total electricity or gas consumption free of charge for business customers (e.g. British Gas, 2012). Building Management Systems (BMS) generate more sophisticated continuous monitoring for all sub-metered areas.

Where continuous monitoring is not possible, seasonal and monthly monitoring can offer insight into the demand patterns for different processes, and may indicate opportunities to save energy. As an example, Figure 7.9 displays the monthly load patterns for thermal energy and electrical energy demand in a Greek hotel, divided into four process classes: (i) space heating; (ii) domestic hot water heating; (iii) space cooling; (iv) lighting and other.



Source: ÅF-Energikonsult (2001).

Figure 7.9: Monthly thermal load pattern (above) and electrical load pattern (below) for a Greek hotel

Figure 7.9 highlights the importance of climate in determining seasonal patterns of energy consumption. In winter in Greece, total energy demand is dominated by thermal energy for space heating, whilst in summer in Greece space cooling accounts for almost half of total energy demand. In summer, over 80 % of energy consumption is supplied by electricity. Heating and cooling requirements are associated with the number of heating degree days (HDD) and cooling degree days (CDD), and may be summarised over a year for different locations based on climatic data (Figure 7.10).

According to the EUROSTAT method, HDD are the number of days when the outdoor temperature is lower than 15 °C, multiplied by the number of degrees difference between the mean daily temperature and 18 °C, expressed by the formula:

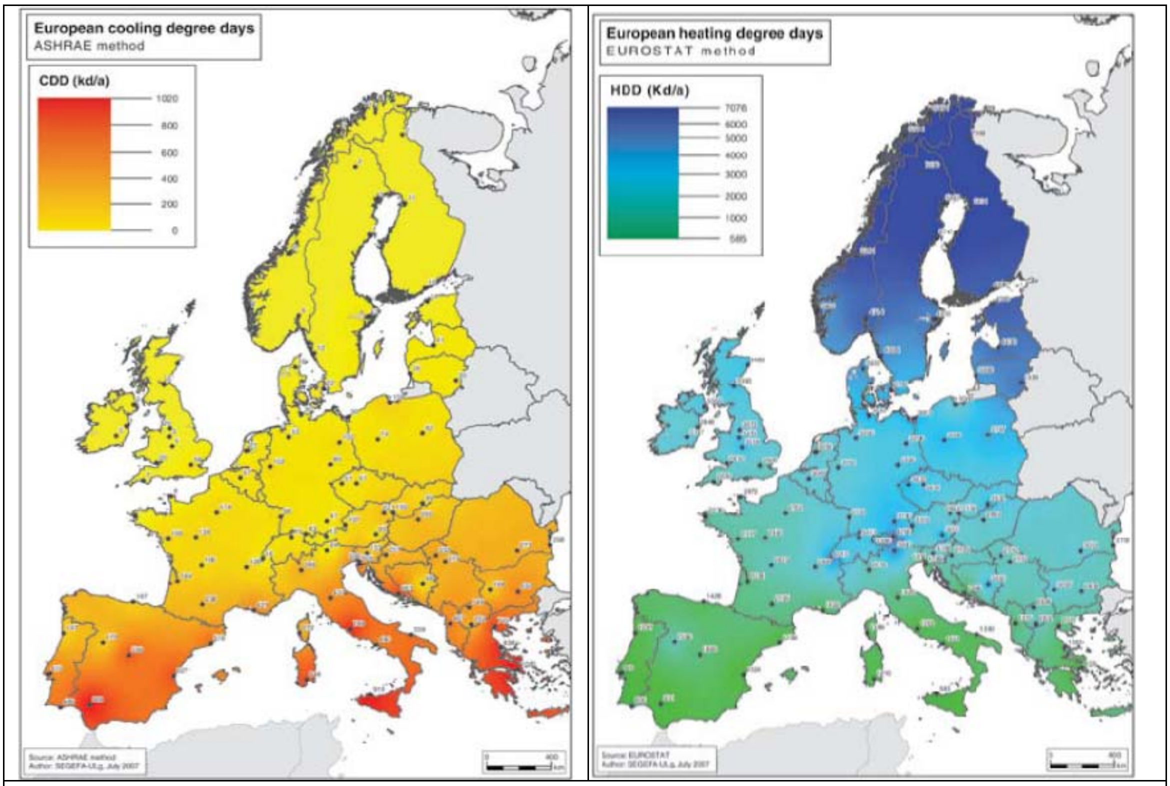
$$HDD = (18 - T) \times \Delta t$$

where T is average daily temperature in °C, and Δt is the time in days, and (18 – T) is considered null when the value of T is 15 °C or more.

Cooling degree days can be calculated according to a similar methods, for example that of ASHRAE (ASHRAE, 2009):

$$CDD = (T - 18.3) \times \Delta t$$

The base temperature used varies (18.3 °C used in ASHRAE method, 22 °C typically used in the UK). Heating and cooling degree days determine the balance between heating and cooling energy demand, but not necessarily the total amount of energy required for space heating and cooling. Appropriate design features, especially the insulating properties of the building envelope, mitigate against climate influences on heating and cooling demand. This is described in more detail in section 7.2.



Source: Boermans et al. (2006).

Figure 7.10: Spatial variation in cooling degree days (CCD) and heating degree days (HDD) across Europe

<u>Energy sub-metering</u>

Table 7.5 summarises the main areas of energy consumption, and associated types of energy data, throughout accommodation premises. HVAC systems require electricity for ventilation

and control, and usually also for cooling, and may use either electricity, delivered fuel combusted onsite or delivered steam for heating. At least, energy conumed for HVAC and domestic hot water (DHW) production should be should be monitored separately from electricity consumed for lighting and other appliances.

Table 7.5: Areas and processes responsible for a high proportion of energy demand in accommodation premises, and data sources for energy consumption

Area	Process	Data sources
Bedrooms	– HVAC – Water heating	– Electricity consumption (sub-metered) – Onsite fuel consumption (natural gas, propane, LPG, heating oil, steam consumption)
Bedrooms	– Lighting – Televisions – Minibars and other appliances	– Electricity consumption (sub-metered)
Kitchen	– Lighting – Cookers – Dishwashers – HVAC – Water heating	– Electricity consumption (sub-metered) – Onsite fuel consumption (natural gas, propane, LPG, heating oil, steam consumption)
Laundry	– Lighting – Washer extractors – Ventilation – Water heating	– Electricity consumption (sub-metered) – Onsite fuel consumption (natural gas, propane, LPG, heating oil, steam consumption)
Pool and spa	– Lighting – Pool and spa processes – HVAC – Water heating	– Electricity consumption (sub-metered) – Onsite fuel consumption (natural gas, propane, LPG, heating oil, steam consumption)

Sub-metering is straightforward and relatively common for electricity. The Savoy hotel in London provides an example of best practice with respect to monitoring. In total, there are 130 sub-meters in the hotel, spanning 12 separate monitoring areas: (i) Simpson's-in-the-Strand restaurant; (ii) mechanical plant; (iii) back-of-house; (iv) front-of-house; (v) main kitchen; (vi) Lincoln kitchen; (vii) Lancaster kitchen; (viii) Beaufort kitchen; (ix) Savoy Grill restaurant; (x) north block rooms; (xi) south block rooms; (xii) lifts. Continuous monitoring data are analysed monthly by a private consultancy, and are used to optimise electricity demand (The Savoy, 2011).

Metering of natural gas by suppliers at the entry to accommodation premises for billing purposes requires calculation of standard units based on temperature and pressure corrections. Sub-metering of natural gas flows to different areas and processes within the premises is not common practice across accommodation establishments, and has traditionally relied upon relatively expensive instrument and piping retrofits. Relatively inexpensive flow meters are now available, for example based on insertion of a tube within the gas pipe to generate a stable flow pattern and connection to a thermal mass flow meter (e.g. Eldridge Products Inc., 2010). Such meters can be installed in gas supply pipelines adjacent to inflows to large gas-consuming appliances (e.g. boilers) or major consumption areas (e.g. kitchens). Similarly for oil, flow meters may be installed in oil supply pipelines immediately prior to appliances such as boilers. The Savoy monitors both electricity and gas consumption separately for each kitchen.

Smaller premises may depend on bottled gas (propane or LPG) for heating and cooking, in which case the number of bottles used over a month or season can be used to estimate consumption.

Maintenance

Correct and regular maintenance of energy-using equipment and distribution systems can prevent significant energy efficiency losses. Important inspection and maintenance measures to prevent energy losses include:

- servicing of all major energy-using equipment in accordance with supplier recommendations
- seasonal adjustment of condenser settings on refrigeration units
- regular cleaning of condensing coils on refrigeration units
- cleaning of all vents and removal of debris or objects restricting air flow
- regular inspection, cleaning and replacement of all filters
- inspection and repair of insulation on air and water pipes.

Gas boilers should be serviced once a year; oil boilers twice a year (Carbon Trust, 2007). Maintenance of air conditioning systems is stipulated by Regulation (EC) No 842/2006 of the European Parliament and of the Council according to the quantity of fluorinated gases contained in the unit, as follows:

- at least once every twelve months for applications containing ≥3 kg fluorinated gases (this shall not apply to equipment with hermetically sealed systems, which are labelled as such and contain less than 6 kg of fluorinated gases);
- at least once every six months for applications containing ≥30 kg fluorinated gases;
- at least once every three months for applications containing ≥300 kg fluorinated gases.

Regular inspection and replacement of air filters is particularly important for the efficient operation of HVAC systems, and on large systems, pressure gauges should be installed to indicate change times.

Staff training and guest advice

Guests wish to relax when staying in tourist accommodation, and often have little knowledge of the energy they are consuming, leading to wasteful actions. Accommodation managers are reluctant to burden guests, but may guide guests with practical tips that can also be applied in their homes, and that are designed not make them feel guilty. Ideally, these tips should be displayed in different formats throughout relevant areas of the accommodation. Hotel Energy Solutions offer communication materials for accommodation guests, providing tips on unplugging unused devices, adjusting thermostats correctly, opening windows appropriately, turning off unnecessary lighting, etc. (HES, 2011).

Building Management Systems

A BMS continuously monitors, records and controls energy (and water) consumption throughout a building via a network of sensors and controllers connected to a central processing unit and interface. One example of a BMS application is the 536-room Scandic Berlin hotel, where a central BMS controls heating and cooling delivered to each room according to: (i) occupancy; (ii) whether or not the window is open; (iii) temperature specified by the guest. All energy for heating and cooling (ultimately provided by hot and cold water from a district heat system) is automatically recorded, but manual backup readings are taken twice per day at the district heating inlet valves as a backup and to check for system malfunctions (Figure 7.11). Electricity consumption throughout the hotel is also continuously monitored. All data are summarised and used to inform an energy management plan, and summary data are forwarded to Scandic head office for compilation of organisation-level environmental performance indicators (see best practice in section 2.1). Energy consumption per guest-night is benchmarked against 1996 performance (Scandic Berlin, 2012).

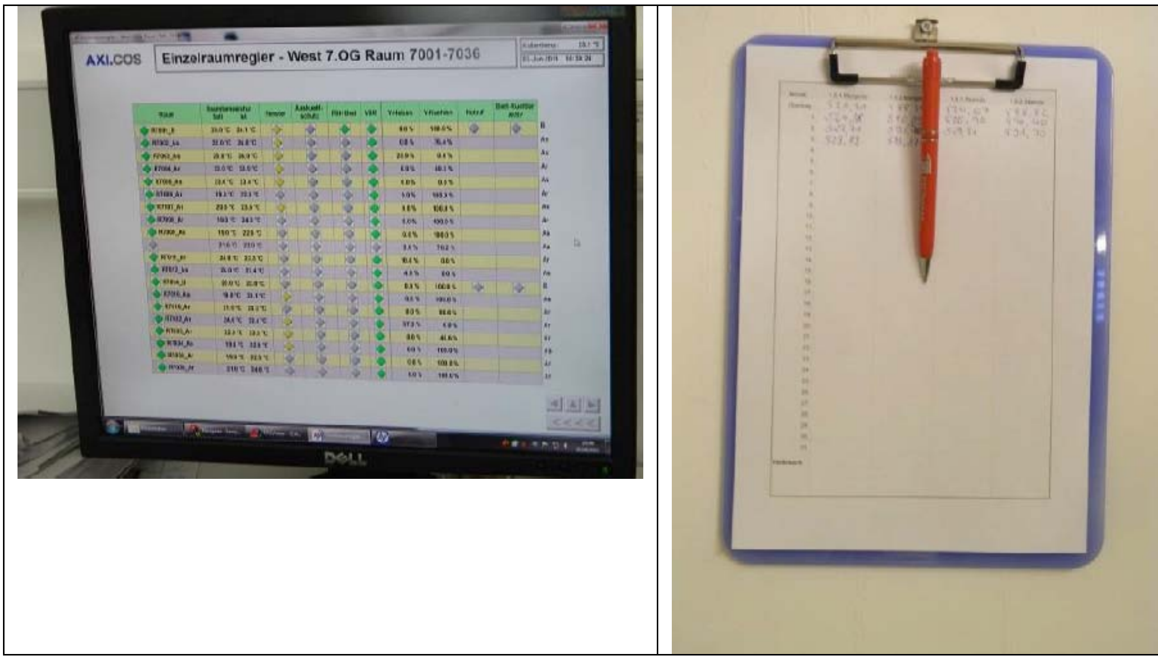


Figure 7.11: A BMS incorporating individual room heating/cooling control is backed up by manual recording of total heating and cooling energy consumption for the 536-room Scandic Berlin hotel

Applicability

Energy monitoring and benchmarking can be performed by all enterprises. With respect to the benchmark for total energy demand, even hotels situated in old buildings can achieve this level of performance. The ten percentile best performing hotels in Figure 7.7 include a range of old and new buildings, recently and not so recently renovated, including one building originally constructed in the 1770s and renovated in the 1980s.

Economics

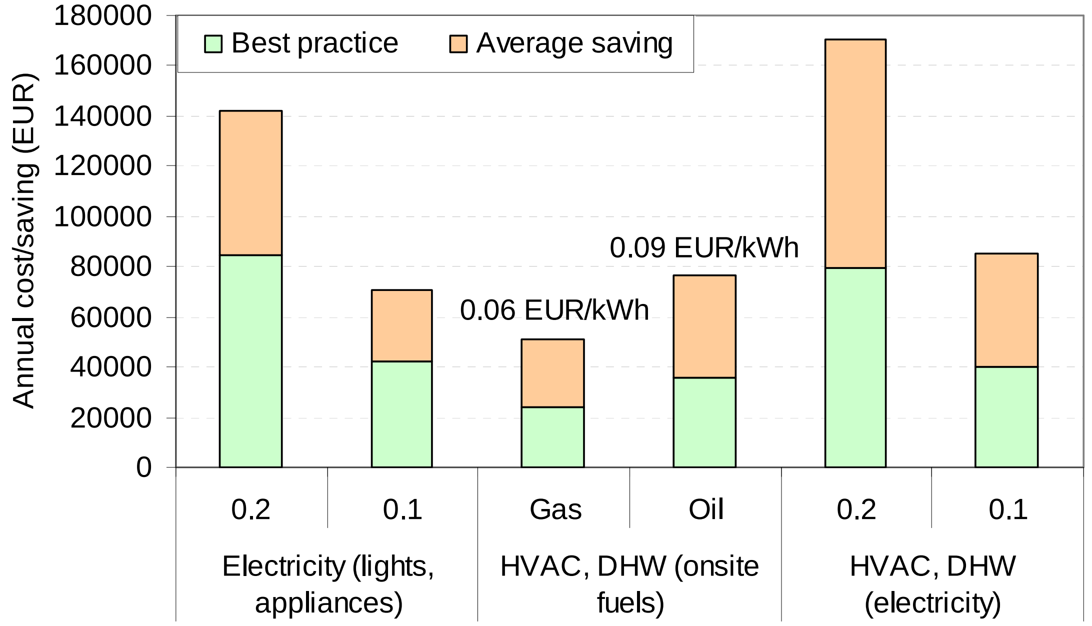
Good energy management is the first and least costly option to reduce energy consumption and reduce associated environmental pressures, such as GHG emissions. It is usually associated with significant economic benefits (Carbon Trust, 2008).

<u>Energy prices</u>

The main sources of energy used in accommodation are electricity, natural gas and heating oil. Delivered energy prices vary considerably across Member States, especially for electricity, the price of which also depends on the magnitude of consumption (Energy EU, 2011). For gas and heating oil, economic implications may be approximated using average prices of 0.06 and 0.09 EUR/kWh, respectively (corresponding to EUR 0.93 per litre for heating oil), but the economic implications of electricity savings are strongly dependent on country- and contract- specific prices.

<u>Potential cost savings</u>

Figure 7.12 presents estimated costs of HVAC energy consumption, and non-HVAC electricity consumption, for a 100-room hotel (5 300 m^2) based on best practice and two electricity prices. Depending on the electricity price and fuel source for HVAC, total savings of between EUR 56 000 and EUR 148 000 per year are possible for a 100-room hotel.



NB: HVAC = Heating, Ventilation, Air Conditioning; DHW = Domestic Hot Water.
Based on average and best practice electricity, and HVAC and DHW demand (see Figure 7.5). Assumes electricity prices of 0.1 and 0.2 EUR/kWh, a gas price of EUR 0.06/kWh and an oil price of 0.93 EUR/L (Energy.EU, 2011).

Figure 7.12: Energy costs for best practice in a 100-room hotel, and savings compared with average performance, for: (i) lighting and appliance electricity consumption, and either (ii) HVAC and DHW provided by oil or gas, or (iii) HVAC and DHW provided by electricity

Reducing peak electricity demand, and increasing the proportion of electricity used at night, can significantly reduce electricity costs. In the UK for example, night-time electricity costs EUR 0.08 per kWh, compared with an average price of EUR 0.11 for large consumers in the UK (The Savoy, 2011; Energy.EU, 2011). Implementation of a comprehensive energy management plan is a prerequisite to realising the savings detailed above.

Regularly servicing boilers can save up to 10 % on annual heating costs (Carbon Trust, 2007). Payback for the insulation of boilers, ducting and piping is usually within a few months.

Implementation costs

Implementation of an energy management plan that includes monitoring and benchmarking will at minimum involve the costs of employee time for data processing. Energy audits are performed by external experts, and may cost hundreds to thousands of euro depending on the size of the premises. Usually, such costs can be paid back within months through implementation of basic efficiencies identified by the audit, and external experts may guarantee a refund on the audit cost if they cannot identify energy savings of at least 10 %.

Investment costs

Investment costs for equipment and specific energy-saving BEMPs are described in subsequent sections. Whilst payback is often relatively short, obtaining the necessary capital can sometimes pose a challenge for micro-, small- and medium-sized enterprises in the current climate of restricted bank lending. Chapter 10, addressing SMEs, contains a brief case study of a Spanish hotel that used an Energy Service Compnay (ESCO) to implement energy saving measures, thus avoiding the need to find capital for upfront investment.

Driving force for implementation

The main driving force to implement an effective energy monitoring and management plan is to reduce energy consumption, which in turn reduces costs, increases competitiveness, and reduces exposure to energy price volatility.

In addition, reducing energy consumption is the main option available for accommodation managers to reduce direct GHG emissions, fulfilling corporate responsibility and public relations objectives. Visitors are increasingly aware of energy-saving measures implemented in accommodation (HES, 2011).

Reference organisations

Reference organisations for energy sub-metering and reporting include The Savoy, London, and Scandic Hotels.

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7.2 Improved building envelope

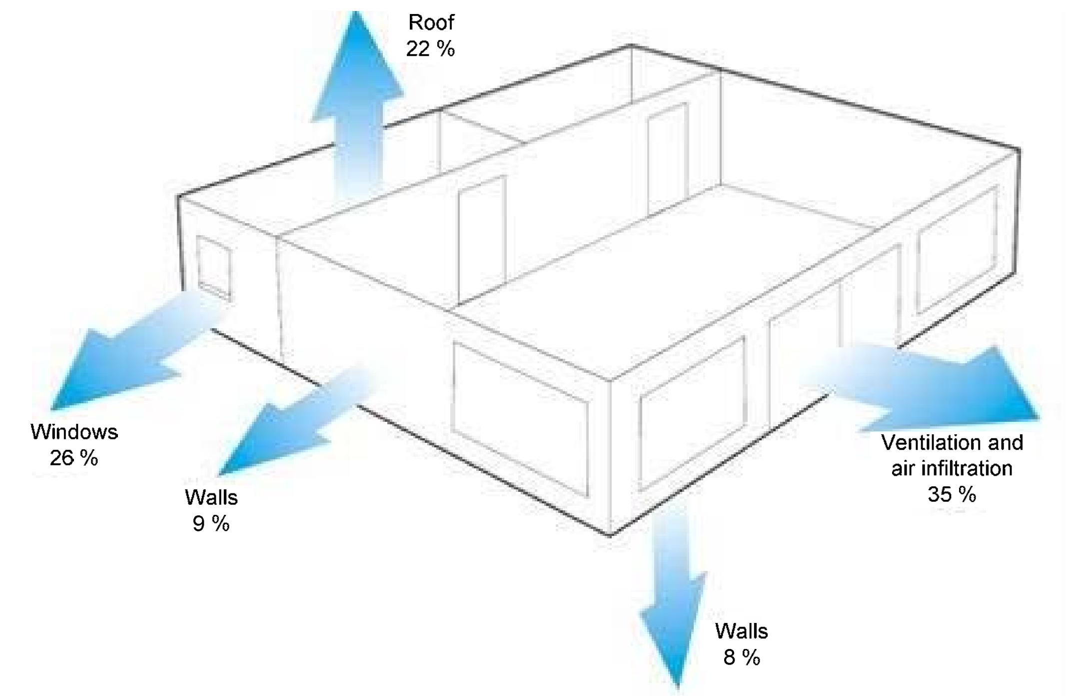
Description

Factors affecting building energy use include the age of the building, time of last major renovation, architecture, structural characteristics, size, systems, facilities and climate conditions. The single most important factor affecting energy consumption for heating and cooling is the quality of the building envelope in terms of insulation and air-tightness. A good quality building envelope can mitigate climatic effects on energy consumption. This is indicated by data relating to energy demand for heating office buildings that show average heating demand of 69 kWh per m^2 and yr in Oslo compared with 138 kWh per m^2 and yr in Milan (Schlenger, 2009).

Figure 7.13 represents origins of energy losses from a typical commercial building, highlighting the major role of ventilation including air infiltration, and for a hotel, highlighting the high heat losses from windows and doors. Optimising building energy performace requires consideration of the building envelope and HVAC system in an integrated manner. The greatest energy savings are realised when building envelope improvements are combined with controlled ventilation systems incorporating heat recovery from exhaust air. HVAC optimisation is described in the subsequent section (section 7.3). Features of the building envelope critical to energy loss are:

- insulation system (roof, walls, floor)
- window glazing (especially number of glazing panes)
- air-tightness (doors, windows, etc.)
- orientation of glazed areas and shading.

Best practice described for this technique goes beyond requirements of legislation and local building codes related to the energy performance of buildings, and also beyond EU Flower ecolabel criteria on building envelope quality. Further technical information on general aspects of best practice with respect to building envelopes can be found in EC (2011) and EC (2012).



Source: Carbon Trust (2007).

Source: Ecocamping (2011).

Figure 7.13: Sources of energy losses for a typical commercial building envelope (above), and a thermal image indicating areas of high heat loss (yellow and red areas) from a hotel building

Achieved environmental benefit

As presented in Figure 7.5 of the previous section, reducing energy demand for heating and cooling from 160 to 75 kWh/m^{2}yr could reduce energy consumption by 456 MWh per year for a 100-room hotel with 5 300 m^2 serviced area.

For the example of the Victoria Hotel, below, improvement of the building envelope led to a reduction in energy consumption of between 18 % and 40 % for the relevant part of the building (the 36-room extension). This benefit would have been considerably greater had the building envelope improvement been implemented alongside installation of a centralised HVAC system with heat recovery.

Appropriate environmental indicator

Performance indicators

Technically, energy demand for heating and cooling, expressed as kWh per m^2 per year, is the most appropriate indicator for building envelope performance. Building energy demand can be calculated from models that integrate factors including the U-values of building envelope components, internal heat gains from people and equipment, and charateristics of the HVAC system (e.g. Passivehouse Institute, 2010). Energy demand for heating and cooling may differ from final energy consumption for heating and cooling depending on the heating and cooling sources. For example, for each kWh of final energy consumption of a heat pump, two to three kWh heat may be delivered to the building. Heating and cooling demand performance is a component of some exemplary building energy standards that may be applied to new buildings, referred to below.

For existing accommodation buildings, data on final energy consumption are more readily available than data on energy demand. Therefore, final energy consumption for heating and cooling, expressed in kWh per m^2 and per year, is the most practical and relevant environmental performance indicator for this technique. Where energy consumption specifically for heating and cooling cannot be isolated from other energy consumption (e.g. because electricity used to provide heating and/or cooling is not sub-metered), total final energy consumption per m^2 per year may be used instead.

Exemplary building energy standards

As described in the EMAS SRD for the construction sector (EC, 2012), two exemplary building energy standards stand out as particularly useful indicators of best practice with respect to building energy rating:

- PassiveHouse standard
- Minergie standard.

These standards are applicable to non-residential buildings (Table 7.6), although there is no specific derivation for accommodation buildings. There are examples of accommodation achieving these standards, including the following.

- Minergie existing non-residential building standard: 15 hotels and hostels in Switzerland, including YHA Valbella, YHA Scuol, YHA Zermatt (Hostelling International, 2011; Minergie, 2012);
- Minergie P standard new building: Monte Rosa Hut, Switzerland.
- PassiveHouse new non-residential buildings: Boutiquehotel Stadhalle in Vienna (HES, 2011).

Compliance with these standards is based on modelling of building heating and cooling demand (PassiveHouse standard), and total primary energy consumption considering heating and cooling sources (PassiveHouse, Minergie P).

Table 7.6: Two exemplary building energy standards

Standard	New non-residential buildings	Existing non-residential buildings
PassiveHouse (Passive-On, 2007)	Heating + cooling energy demand **≤15 kWh/m^{2}yr** Total primary energy demand **≤120 kWh/m^{2}yr**	Heating and cooling energy demand **≤25 kWh/m^{2}yr** Total primary energy demand **≤132 kWh/m^{2}yr**
Minergie	HVAC primary energy consumption: Public administration, schools, commercial **≤25 kWh/m^{2}yr** (Restaurants ≤40 kWh/m^{2}yr)	HVAC primary energy consumption: Public administration, schools, commercial **≤55 kWh/m^{2}yr** (Restaurants, ≤ 65 kWh/m^{2}yr)

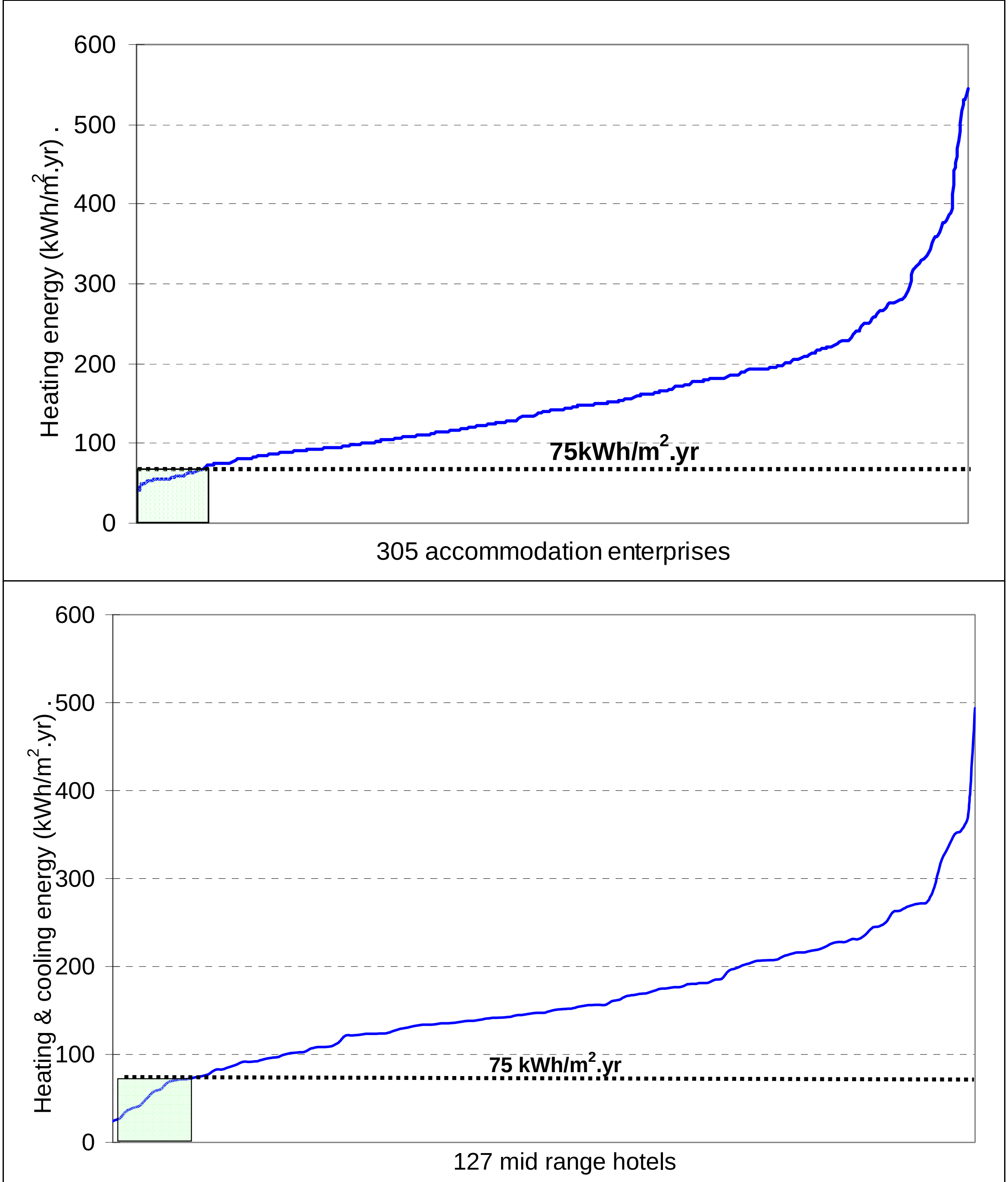
<u>Benchmarks of excellence</u>

Figure 7.14 presents frequency distribution curves for final energy consumption: (i) for heating across 305 German accommodation establishments, ranging from unstarred bed and breakfasts to five star hotels; (ii) for heating and cooling across 127 mid-range hotels. In both cases, the tenth percentile best performers achieve final energy consumption of 75 kWh/m2yr or less. On the basis of the above data, and Table 7.11 under 'Reference organisations', the following benchmark of excellence is proposed.

BM: for exiting buildings, final energy consumption for HVAC and water heating ≤75 kWh, or total final energy consumption ≤180 kWh, per m^2 heated and cooled area per year.

A second benchmark of excellence is proposed for new buildings, based on building energy performance equivalent to best practice standards.

BM: the rated energy performance of new buildings conforms with Minergie P or PassiveHouse standards.



NB: For both the above data sets, the ten percentile lowest consumption threshold is 75 kWh/m2yr.

Figure 7.14: Final energy consumption for heating (HVAC and hot water), expressed per m² heated and cooled floor area per year, across: (i) 305 German accommodation establishments (top figure); (ii) 127 mid-range hotels (bottom figure)

Cross-media effects

There are no significant cross-media effects of improved building envelopes. The energy consumption for producing insulating products is very low compared to the energy saved over their operational lifetimes.

Operational data

Detailed operational data on building design and retrofit options to minimise energy consumption are described in the SRD for the building and construction sector (EC, 2012). Some operational and technical performance data for the PassiveHouse standard are provided here. The three key components of the PassiveHouse standard are the heat consumption (<15 kWh/m^{2}yr), the total primary energy consumption (<120 kWh/m^{2}yr) and the air leakage rate at 50 Pa (<0.6 h^{-1}). For the design, some recommendations are given by the standard to fulfill the requirements. In Table 7.7, recommended and best practice examples from existing buildings are provided.

Table 7.7: Recommendations and best practices of elements for the PassiveHouse standard

Component	Recommended	Best practice
Insulation (envelope), U-value W/m^{2}K	<0.15	0.05
Thermal bridges	No thermal bridges	No thermal bridges
Glazing, U-value, W/m^{2}K	<0.8	0.5
Window framework without thermal bridge, U-value, W/m^{2}K	<0.8	0.75
Exhaust air heat recovery, efficiency, %	>75	92
Air leakage, %	<3	<1
Electricity demand for ventilation, W/(m^3/h)	<0.45	0.3
Source: Feist et al. (2005).		

The Austrian Ecolabel for tourism requires that the top floor ceiling of each building owned by and/or under the influence of the enterprise to achieve a U-value of 0.30 W/m^{2}K or less, and that, if this is not available, a plan of measures must be prepared in cooperation with an energy technician and implemented to minimise energy losses.

Applicability

Performance benchmarks

The refurbishment of an existing building to reduce final energy consumption to the benchmark level specified above for existing buildings is widely applicable. Achieving Passivehouse or Minergie standards is restricted to new buildings.

Building ownership

One barrier to implementation of building envelope improvements across accommodation is the low level of ownership of host buildings by large hotel and hostel chains (e.g. the Rezidor group does not own any of its hotel buildings: Rezidor, 2011). In such cases, it may or not be possible for the accommodation managers to make changes to the building envelope, depending on lease conditions, but there will be no economic incentives to make the necessary long payback investments.

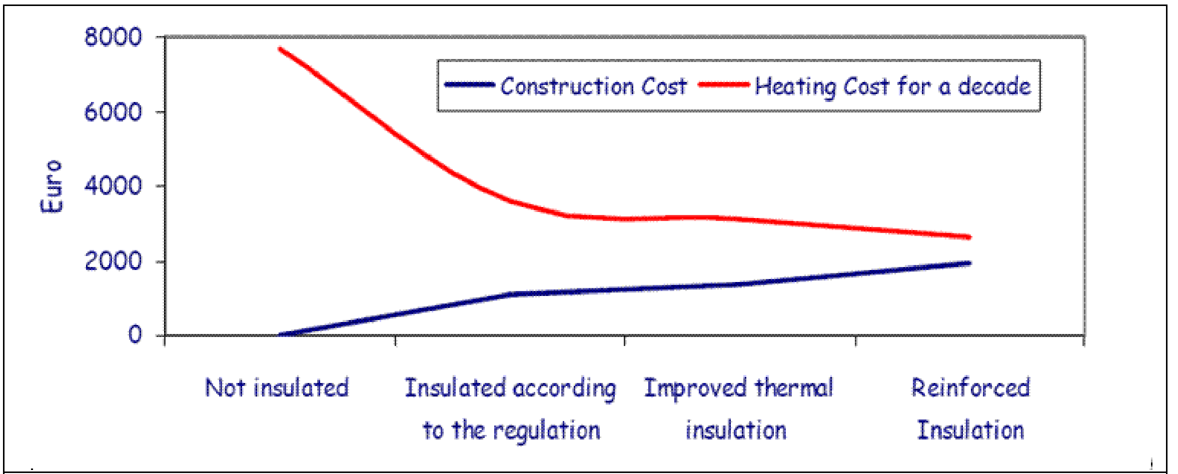
Building envelope improvement may be less important but still relevant for buildings not occupied during the main heating/cooling season (e.g. northern European campsites closed in winter).

Economics

New buildings

Specifying a high quality building envelope prior to initial construction is cost effective. Achieving the PassiveHouse standard for new buildings is associated with an additional building cost of approximately 10 %, and will typically be paid back within five to ten years

(Feist, 2012). Even in Mediterranean climates, reduced heating costs arising from additional insulation justify the higher initial investment (Figure 7.15).



Source: Farrou et al. (2009).

Figure 7.15: Increased construction costs compared with reduced heating costs over ten years for Mediterranean hotels

Retrofitting
Improving an existing building envelope is more expensive, and is only economically viable during planned refurbishments. Often, it is not economically viable to retrofit an existing building to the Passive standard in the absence of external support (e.g. government grants).

The costs for the refurbishment of the extension building of the Hotel Victoria are described in the 'Case Studies' section, below. According to those data, the insulation of the reinforced concrete layer is the most cost efficient aspect of building envelope improvement, followed by the insulation of the outer walls and the flat roof.

Driving forces for implementation

For new buildings, European and member state regulations on minimum energy efficiency levels are a major driving force for more energy efficient building envelopes.

Accommodation managers may specify beyond regulatory requirements in order to further reduce operating (HVAC) costs, and to reduce exposure to future energy price volatility (risk aversion).

Corporate social responsibility and green marketing are other driving forces (building envelope efficiency features may be highly visible to guests).

Case studies

Best Western Premier Hotel Victoria, DE-Freiburg
The refurbishment of an existing hotel can be used to improve the building envelope with regard to the thermal transmissivity of the walls, windows and doors, the roof and the basic ceiling. This approach is demonstrated by the refurbishment of an extension building of the Hotel Victoria in Freiburg, Germany (Figure 7.16). Building envelope upgrades implemented during this retrofit demonstrate best practice, and are close to recommendations to comply with the PassiveHouse standard. However, the overall retrofit project is not regarded as an example of best practice in its totality. A heat recovery ventilation system could not be fitted owing to

interior space restrictions, preventing full exploitation of the building envelope improvements. Consequently, final building energy performance falls far short of the PassiveHouse standard.

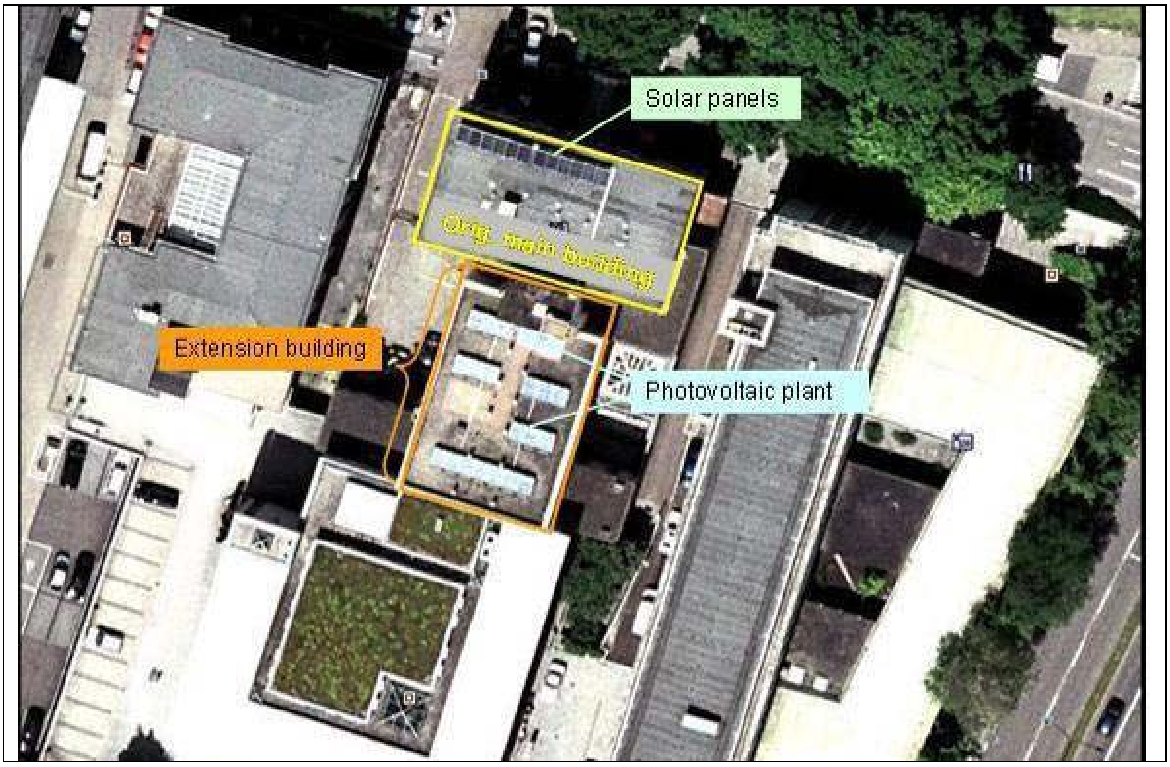


Figure 7.16: Bird's eye view of the Hotel Victoria in Freiburg; the original main building and the retorfitted extension building are indicated

Table 7.8 shows the conductivity, thickness and the calculated u-values of the outer walls, the basic ceiling and the flat roof. The hotel was retrofitted with triple-glazed windows having a u-value of 1.16 W/m^{2}K.

Table 7.8: Conductivity, thickness and the calculated u-values of the outer walls, the basic ceiling and the flat roof

Feature	Components	λ W/mK	Thickness mm	U-value W/m^{2}K
Outer walls	Interior plaster	0.700	15	0.153
	Masonry	0.890	300	
	Thermal insulation	0.040	240	
	Synthetic resin plaster	0.700	5	
Reinforced concrete plate (garage ceiling)	Floor covering	0.000	10	0.129
	Floated screed	1200	35	
	Thermal insulation	0.040	10	
	Impact sound insulation	0.040	10	
	Perlitte layer		20	
	Reinforced concrete layer	2300	300	
	Termal insulation	0.035	240	
Flat roof	Reinforced concrete layer	2	200	0.113
	Thermal insulation	0.035	300	
	Waterproofing	0.170	5	
	Covering		50	

Because of the small height of the corridors, it was not possible to install a controlled ventilation system with heat recovery. Instead, the ventilation system comprises a central ventilator that draws air from the bathrooms, fed by fresh air entering rooms via ventilation devices placed outside (Ufheil et al., 2009). This means that, during cold periods, incoming air is not pre-heated with exhaust air, and thus significantly increases heating requirements. The absence of controlled ventilation with heat recovery prevents the PassiveHouse standard from being achieved, despite the type and thickness of the insulation and the specification of the triple-glazed windows being close to the Passive Standard recommendations.

Figure 7.17 shows the windows and the ventilation devices integrated in the thermal insulation layer. The thermal insulation of the masonry (24 cm) is not installed yet.

Figure 7.17: Refurbishment of the facade by triple-glazed windows, ventilation devices and 24 cm-insulation layer

As a result of the described measures, the energy consumption for heating and hot water preparation for the entire hotel was reduced by 21 % in 2010 and 9 % in 2011, compared with the average heating-degree-day-normalised average over the period 2003 – 2008 before the refurbishment. As only the extension building has been refurbished and the heating system serves the original main building with 30 rooms (1 060 m^2) as well as the extension building with 36 rooms (1 140 m^2), the reduction is about 18 % and 40%, for 2011 and 2010, respectively, for the refurbished building (Hotel Victoria, 2011).

The costs for the refurbishment of the extension building of the Hotel Victoria are compiled in Table 7.9.

Table 7.9: Actual costs for the refurbishment of the extension building of the Hotel Victoria

	actual costs
Construction works	
Stairs	**16.000**
Windows and door	**48.720**
Garage doors and fire doors	**24.740**
Thermal insulation and plaster	**137.570**
Natural stone works	**23.244**
Shutters	**24.470**
Scaffolding	**20.930**
Roof sealing and flashing	**134.972**
Demolishing and construction works	**26.590**
Asbestos removal	**14.723**
Technical works	
HVAC	**204.133**
Chimney works	**18.538**
total	**694.630**

The approach of investment costs/benefit ratio (CBR) has been applied. This ratio is defined as follows:

CBR = additional investment costs / (savings of primary energy x use phase)

The additional costs are calculated in relation to minimum requirements according to the German Energy Efficiency Ordinance. For the different measures, the following CBRs have been calculated for component lifetimes (use phases) of between 18 and 30 years (Table 7.10). According to these numbers, the insulation of the reinforced concrete layer is the most cost efficient, followed by the insulation of the outer walls and the flat roof

Table 7.10: Cost-benefit ratio of different building envelope retrofit components

Components	CBR
Flat roof (300 mm insulation layer)	0.077
Outer walls (240 mm insulation layer)	0.053
Reinforced concrete layer (240 mm insulation	0.027
Windows (replacement of double- by triple-	0.196
Ventilation system	0.177

<u>Other examples</u>

In addition to accommodation enterprises referred to throughout the technique description, some examples of best practice enterprises achieving the applicable benchmarks of excellence are provided by the HES RE case studies for SME hotels (Table 7.11).

Table 7.11: Examples of SME hotels achieving 'excellent' performance

Accommodation	Year built (renovated)	Energy consumption (kWh/m^2yr)	Comments
Boutique-hotel Stadhalle, Vienna	2008	12.6	– 82 rooms – Continental climate – 38-room PassiveHouse extension – On-site solar PV and wind turbine electricity generation
Eco Ambient Hotel Elda, Italy	1949 (2007)	40	– 17 rooms – Mountain climate, 800 m altitude – Wooden building with 14 cm fibre Wood insulation – Window U-values 1.00 W/m^2K
Hotel Gela, Bulgaria	1956	162	– 15 rooms, 800 m^2 – Mountain climate
Seehotel Wissler, Germany	1970 (2009)	104	– 43 rooms, 6 900 m^2 – EMAS and Viabono labels
Source: HES (2011).			

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7.3 Optimised HVAC systems

Description

According to ITP (2008) 20 – 50 % of energy costs in hotels are attributable to heating, ventilation and air conditioning (HVAC) systems. The primary function of HVAC systems is to control indoor air quality and maintain comfortable temperatures. Humidty control is an important task for larger HVAC systems. The primary components of a basic HVAC system, illustrated in Figure 7.18, are:

- heat source
- cooling source
- heat/cold distribution system
- ventilation system
- control system.

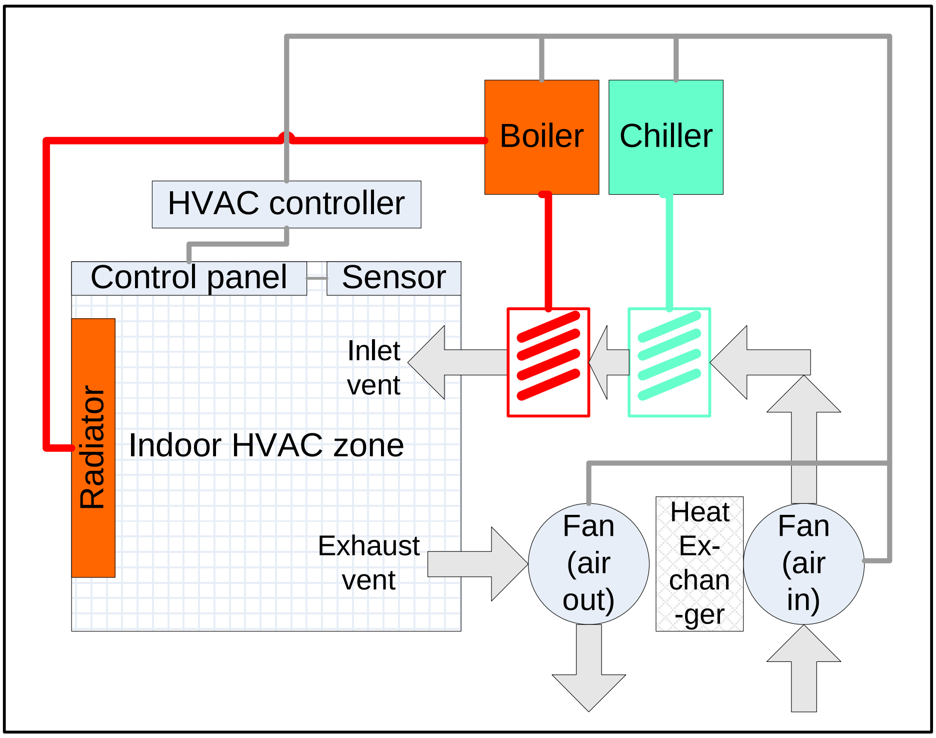


Figure 7.18: Schematic representation of a basic HVAC system

Best practice with respect to specific components of HVAC systems is referred to elsewhere in this chapter. Best practice in heating and cooling is described in section 7.4 and also section 7.6, and some aspects of HVAC control are described in section 7.1. Reducing the electrical load of lighting and appliances (section 7.5), and reducing waste heat in kitchens (section 8.4) and laundries (sections 5.4 and 5.5), can significantly reduce cooling demand and facilitate HVAC optimisation. The focus of this section is on measures to optimise the heat/cold distribution system and the ventilation system, with reference to technology and control options. Table 7.12 summarises best practice measures considered in this BEMP.

Table 7.12: Key measures to reduce the energy consumption of HVAC systems considered in this section

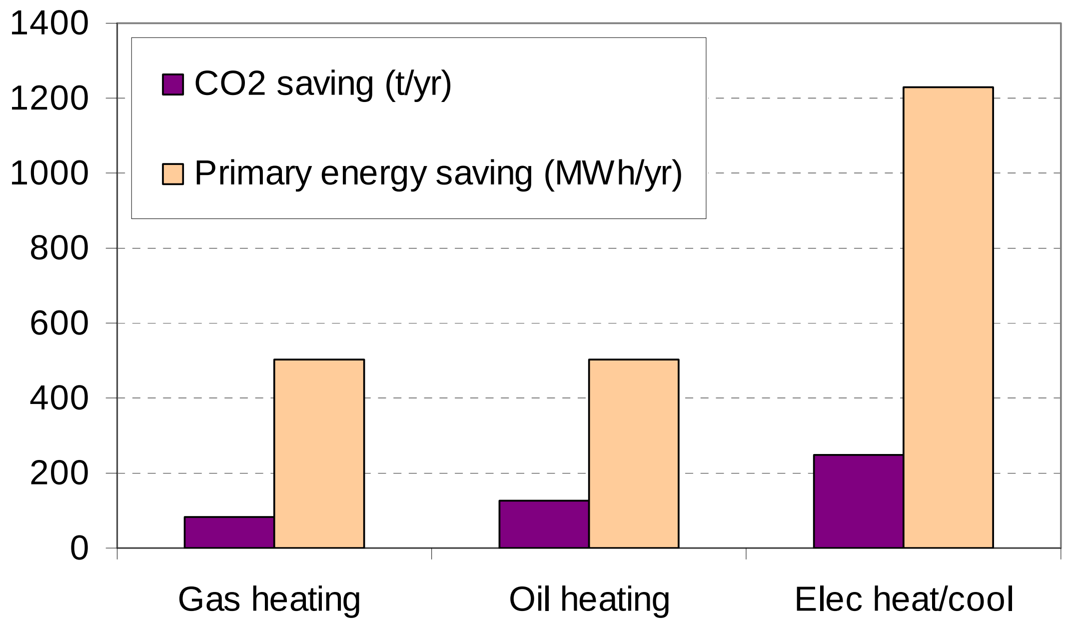
Measure	Description	Applicability
Integrated and optimised HVAC system design	HVAC optimisation requires integration with features of the building envelope and heating and cooling systems. The design and control of HVAC systems should aim to achieve comfortable and hygienic indoor conditions with minimal energy input according to the parameters determined by the aforementioned features. Key aspects of good system design are: – specification of an efficient and appropriately sized heating/cooling source in relation to demand determined by the building envelope, climate and internal heat gains; – heat/cold distribution system sized in accordance with the quantity of heating or cooling to be delivered, and the optimal delivery temperature (e.g. geothermal heating systems work most efficiently with lower distribution temperatures, necessitating large radiative surface areas); – ventilation system designed according to space usage, anticipated occupancy and contaminant generation; – ducting should be within the conditioned envelope, sealed, insulated and with a vapour barrier (above ceilings and outdoors), of sufficient capacity, and without sharp bends or other flow restrictions.	New buildings, major renovation
Ventilation control with heat recovery	As shown in Figure 7.13 in section 7.2, ventilation is responsible for 35 % of heat loss from a typical building. Best practice with respect to ventilation is to: – at least control ventilation rates according to occupancy profiles across different zones; – regulate ventilation according to demand based on monitoring of indoor CO_2 concentrations using sensors (within limits established by various national regulations regarding minimum air exchange rates in commercial buildings); – recover heat from exhaust ventilation by passing it through a heat exchanger with incoming ventilation air.	All buildings with centralised mechanical ventilation
Zoned HVAC control	Individual rooms and various areas within accommodation buildings have different heating and cooling requirements at different times. Every one degree in reduced heating or cooling can reduce HVAC energy consumption by 8 % (Carbon Trust, 2011). Various options exist to implement zoned control of HVAC depending on system complexity: – the HVAC system can be divided into separate zones, including individual guest rooms, that can be controlled remotely (e.g. through BMS) or manually, and zones can be shut off when not required using shut-off valves; – at a basic level, temperature and ventilation can be controlled manually, with timers, or via thermostatic radiator valves in each zone; – in buildings with a BMS, continuous and independent control of HAVC across all zones is possible, based on temperature, CO_2 and/or other air-quality sensors; – for rooms, control of HVAC according to occupancy and open windows is possible using key-card activation and window sensors (see also electrical appliance control: section 7.5).	All buildings

Use of free and evaporative cooling	Ventilation with outdoor air may be sufficient to maintain comfortable indoor air temperatures, and to increase daytime heat absorption by buildings in summer, whilst evaporative cooling can enhance the efficiency of compressors and can be used to cool incoming ventilation air. Key aspects include: – installation of openable windows so that natural ventilation with outdoor air may be used at appropriate times (with installation of sensors to deactivate HVAC when windows opened); – use of mechanical ventilation to distribute outdoor air when appropriate (e.g. night-time); – installation of a water spray evaporation system in the path of compressor cooling air in appropriate (warm, dry) climates; – installation of an indirect evaporative cooling system (with heat exchanger) in appropriate climates to cool incoming ventilation air without directly increasing humidity.	All buildings Systems with chiller units (evaporative cooling)
Efficient equipment	There are many individual components within an HVAC system for which efficient models can be selected. Apart from the main heating and cooling components described elsewhere (section 7.4 and 7.6), efficient HVAC components include the items listed below. – Gas- and oil-fired boilers and individual room air-conditioning units do not represent best practice with respect to heating and cooling sources. However, where they are installed, the highest seasonal energy efficiency ratio, for example reflected in an 'A' rated European Energy Label, should be sought for all new appliances. Information should be sought on full and **part load** efficiency. – Variable speed drive motors are electric motors whose speed is controlled via the power supply in accordance with demand, reducing energy consumption by up to 40 % compared with standard motors operating at one (full) speed. – Direct drive pumps and fans require less energy than belt-driven versions. – Pressure-independent control valves ensure the correct rate of flow through cooling and heating systems, irrespective of system pressure variations. Installing these valves at critical points in the HVAC system can reduce energy consumption by facilitating a more accurate control of HVAC systems. – Efficient compressors. Compressors are the main draw of energy for standard cooling systems. It is important to specify the most efficient compressors available. For example, variable speed compressors are more efficient than single-speed compressors for variable load applications. In addition, some newer compressor designs incorporate magnetic bearings instead of lubricating oil, with claimed energy-efficiency benefits of 35 – 50 % (Danfoss, 2012). – Heat recovery from compressors. A significant amount of heat is released by compressors used for cooling, and this can be recovered for DHW heating (see section 8.4).	All buildings
Maintenance	See section 7.1 (energy system) and section 5.1 (hot water system). Of particular importance for ventilation system efficiency is the regular replacement of filters, associated with the following best practice: installation of a filter differential pressure gauge, linked to a monitor and alarm that indicates when a predetermined pressure drop is exceeded.	All buildings
Source: ASHRAE (2009); Carbon Trust (2007; 2011); EC (2011).		

Achieved environmental benefit

As described throughout this BEMP section, many components and aspects of HVAC can be improved in isolation, but ideally in an integrated manner, to achieve energy savings. For example, heat exchangers between outgoing and incoming ventilation air can recover up to 80 % of the heat energy in exhaust air, whilst variable speed drives can typically reduce energy consumption for pumps and fans by 40 %. Reducing heating temperatures by 1 ºC can reduce energy demand for heating by up to 8 %.

When integrated into a fully optimised HVAC system, the sum of these improvements can be high. Figure 7.19 indicates the total primary energy and CO_2 emissions that could be avoided through HVAC optimisation for an average performing 100-room hotel, by reducing HVAC energy consumption from 161 to 75 kWh/m^{2}yr. Avoided primary energy ranges from 501 MWh for gas and oil heating systems, through to 1230 MWh for electric heating and/or cooling systems, whilst avoided CO_2 emissions range from 84 t per year for gas heating systems to 251 t per year for electric heating and/or cooling systems.



NB: Based on the difference between average and best performance levels, for a 100-room 5 300 m^2 hotel (see Figure 7.5, section 7.1).

Figure 7.19: Annual primary energy and CO_2 savings achievable through the implementation of best practice levels of HVAC energy consumption, according to HVAC energy source

Appropriate environmental indicator

<u>Management indicators</u>

The most appropriate environmental indicators relate to actual building energy performance (below), but the following management indicators may also be used to indicate best practice where data are missing.

- Integration of HVAC and building envelope design to optimise building energy performance based on a profile of predicted use and climatic data.
- Implementation of demand-based ventilation control with heat recovery, HVAC zoning, free-cooling and evaporative cooling where appropriate and feasible.
- Selection of energy-efficient HVAC equipment, for example based on EU Energy Label ratings and expert advice.

Performance indicators
Final energy consumption per m^2 and per year for HVAC is the most appropriate performance indicator, applying relevant conversion factors to fuel consumption data such as those proposed in Table 7.4 (section 7.1). High performance may be indicated by compliance (certification) with strict building energy-performance standards such as the PassiveHouse and Minergie standards.

Benchmark of excellence
The same benchmarks of excellence proposed for best practice in insulating the building envelope (section 7.2) also apply here, i.e.:

BM: for exiting buildings, final energy consumption for HVAC and water heating ≤75 kWh, or total final energy consumption ≤180 kWh, per m^2 heated and cooled area per year.

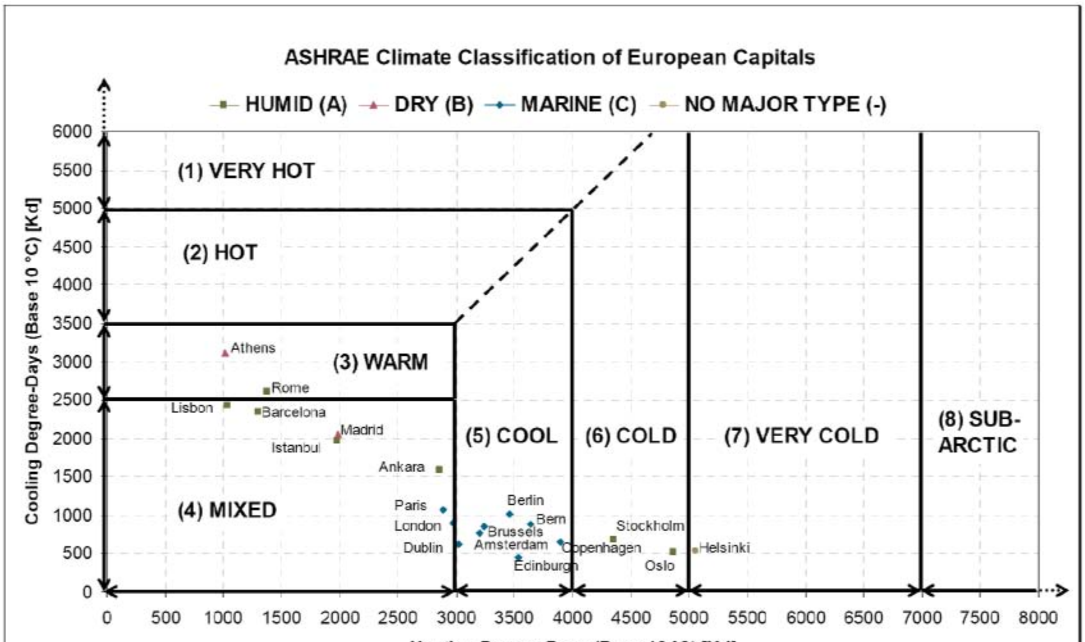
A second benchmark of excellence is proposed for new buildings, based on building energy performance equivalent to best practice standards.

BM: the rated energy performance of new buildings conforms with Minergie P or PassiveHouse standards.

Cross-media effects
Optimisation of HVAC systems is associated with few significant cross-media effects. Appropriate ventilation control should avoid any indoor air-quality problems potentially arising from lower air exchange rates. Evaporative cooling can require large quantities of water.

Operational data
System design
In the first instance, features of the climate and building envelope should be used to determine basic HVAC system requirements, and features such as the types and capacities of heating and cooling systems and the type of ventilation system. Optimum building design differs across Europe according to climate, although high levels of insulation and air-tightness are important to minimise HVAC energy requirements everywhere. However, the balance between heating and cooling energy demand varies considerably depending on climate, which can be classified into zones across Europe according to the average number of HDD and CDD (Figure 7.20).

The moisture content of outdoor air is an important consideration for HVAC specifications, and indoor relative humidity should not exceed 60 %. For cooling requirements, the sensible and latent loads required to cool outdoor air to specified indoor dry-bulb and dew-point temperature should be included in load calculations (ASHRAE, 2009). When calculating heating and cooling demand, safety factors should be applied cautiously to avoid excess capacities.



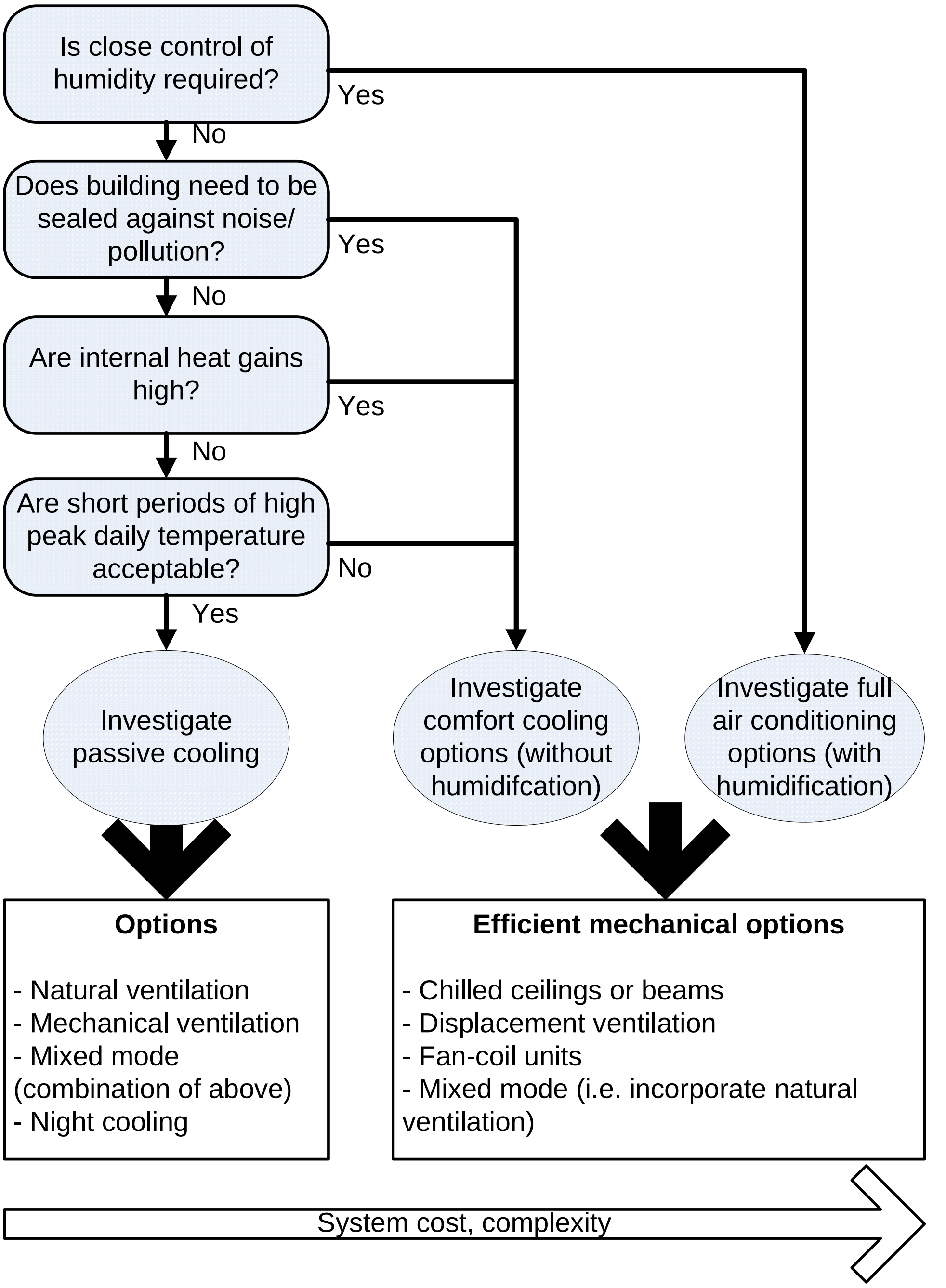
Source: (Schlenger, 2009)

Figure 7.20: Climate classification of European capitals

Figure 7.21 provides an example of factors used to decide on the type of ventilation and cooling system to install. In addition to climatic factors, additional important considerations are whether the building envelope is sealed, the quantity of heat gains from solar radiation through glazed areas and internal devices, and the acceptable peak temperature. Overall internal heat gain can be high in accommodation buildings owing to a typically high occupancy rate, a large number of electrical appliances such as televisions, and the presence of specific equipment with very high heat output in kitchens and laundry areas. It is essential that internal heat gain be considered in HVAC design, to ensure adequate ventilation and cooling rates, and to avoid excessive heating capacity. Heating system capacities should be calculated carefully based on building and climate factors, but Table 7.13 provides some indicative values for a selection of building types.

Table 7.13: Typical specific heating demand across a selection of building types

Building	Heating demand (W/m^2)
Old building with standard (at the time) insulation	75 – 100
New building with good insulation	50
Low energy house, new building	40
PassiveHouse	10
Source: Ochsner (2008).	



Source: Derived from Carbon Trust (2011).

Figure 7.21: Important factors to consider when designing the ventilation and cooling system

Heat and cold distribution

When deciding on the distribution system one key decision is whether the system should be air- or water- based. Hydronic systems are more efficient, but air-based systems may utilise existing ductwork and air handlers, and may thus be the preferred option for retrofits. For air-based systems, supply temperatures of 10 – 15 °C for cooling and 30 – 50 °C for heating are required. For water-based systems, there is a wide range of options (Table 7.14), with supply temperatures ranging from 35 °C or lower for heating and up to 18 °C for cooling if the building envelope is good (maintaining room temperatures at 22 – 26 °C with outdoor temperatures of 32 °C) (Ochsner, 2008). Whichever media is used for distribution, the installation of variable speed motors controlled by frequency converters in relation to demand can significantly reduce energy consumption by distribution pumps and fans.

When using air-source heat pumps, air-based systems can be centralised or decentralised (i.e. operate at the level of the entire hotel or at room level). Centralised systems have the advantage of being more efficient (if appropriate zoned control is implemented), emitting less noise near guests, offering greater control to accommodation operators (e.g. integration with BMS), and having lower rates of refrigerant leakage.

Decisions regarding the distribution system relate directly to the heating and cooling sources, as there is a wide variation in the operating temperature of different distribution systems (Table 7.14), with implications for the suitability and operating efficiency of different heating and cooling systems. Distribution systems with a large surface area, such as under-floor heating or low-temperature radiators, enable lower heating temperatures and higher cooling temperatures, which in general favour more efficient operation of heating and cooling sources. This is particularly the case for heat pumps that work most efficiently when the temperature differential between the source and destination is low (section 7.4). There are also benefits for wood boilers that may be operated continuously at low temperature, reducing start-up emissions (section 7.6).

Table 7.14: Delivery temperatures for different types of heat distribution system

Distribution system	Delivery temp. (°C)
Space cooling (chilled water)	5 – 8
Space cooling (cooled air)	10 – 15
Warm air heating	30 – 50
Warm water floor heating	30 – 50
Warm water radiators (low temperature)	45 – 55
Warm water radiators (forced convection)	55 – 70
Warm water radiators (free convection)	60 – 90
Source: Heat Pump Centre (2012).	

Temperature control

Careful temperature control to avoid excessive heating or cooling can save a considerable amount of energy (8 % per 1 ºC avoided temperature change). Zoning of the building and HVAC system facilitates precise temperature control for the different demands of different zones (Table 7.15).

Table 7.15: Recommended temperature settings for accommodation zones in a cool climate

Zone	Temperature (ºC)
Bars, lounge areas	20 – 22
Guest bedrooms	19 – 21
Guest bathrooms	26 – 27
Restaurants and dining areas	22 – 24
Corridors	19 – 21
Kitchens	16 – 18
Laundries	16 – 19
Source: Carbon Trust (2007).	

In addition, setting temperature controls with a gap of around 4 – 5 ºC between the heating and cooling thermostat set points to create a comfortable 'dead band', avoiding simultaneous operation of heating and cooling systems, can save a significant amount of energy (Carbon

Trust, 2011). Temperature sensors should be located in representative positions within each zone, trying to avoid exterior walls.

Ideally, continuous monitoring and control of temperature and ventilation rates across zones can be provided by a BMS, as described in section 7.1. With respect to heating and cooling, BMS can be programmed to manage individual guest room temperature according to a number of modes related to occupancy and rental status. Guests may have full control of temperature when the room is occupied (within system heating and cooling capabilities at the time of operation), whilst the heating and cooling may be shut off for unrented rooms (periodic activation may be desirable to control humidity). Some luxury hotels prefer to maintain the temperature of unoccupied rooms within a narrow range so that the guest's desired temperature may be rapidly reached upon re-entry (The Savoy, 2011).

Ventilation control and heat recovery

For hotels, ASHRAE (2009) recommend minimum air flow rates of 1.1 m^3 per hour per m^2 plus 8.5 – 12.7 m^3 per hour per person. Accordingly, the occupancy profile of the building is a determining factor that must be estimated in advance when designing ventilation systems. However, the occupancy profile of a building varies throughout the day and depend on business patterns, etc. Therefore, the preferred solution to optimise ventilation rates is the installation of a demand control unit that controls the ventilation rate according to sensor readings of CO_2. Sensors should be placed in every major HVAC zone (but not in every room), and may be located in an accessible position within the return air duct to provide a representative reading. It is important to ensure sensors are always calibrated, and certified by the manufacturer to have an error less than 75 ppm (ASHRAE, 2009).

With centralised mechanical ventilation systems, air may be drawn from the building and expelled via one exhaust point, making application of heat recovery through a heat exchanger straightforward. However, some areas within accommodation premises require special attention for ventilation, and may have separate exhaust points. According to hygiene regulations bathrooms require a separate ventilation system that may operate continuously. Exhaust ducting may be diverted to pass through a heat exchanger with incoming ventilation air to minimise energy loss.

Kitchens require high air exchange rates of 15 – 60 changes per hour, and also require separate ventilation systems. Laundries require an air exchange rate of 10 – 15 changes per hour, and produce moist, warm exhaust air with a high energy content that may not pass through the central ventilation systems. Similarly for pool areas, with air exchange rates of 4 – 6 changes per hour. Demand control of ventilation in these areas is important, and there are options to recover this heat to warm incoming ventilation air without the exhaust air passing through the central mechanical ventilation system (see sections 5.4, 5.6 and 8.4).

As for the heat and cold distribution systems, the use of variable speed motors for pumps and fans can significantly reduce energy consumption. The installation of centralised mechanical ventilation systems may not be feasible in existing buildings without such systems.

Maintenance

Details on general maintenance of energy related equipment are provided in section 7.1. In addition, blockages in HVAC systems are common and reduce efficiency. Regular checking and cleaning of filters, fans and air ducts can improve efficiency by up to 60 %. Pressure gauges may be fitted at strategic points within the HVAC system to indicate blockages or dirty filters (Carbon Trust, 2011), including filter differential pressure gauges.

Checklist for HVAC systems

A best practice checklist with respect to HVAC installation and maintenance was compiled for the EMAS SRD for the building and construction sector (EC, 2012). This is repeated in Table 7.25, and readers are referred to EC (2012) for further technical detail on HVAC systems.

Table 7.16: Checklist for aspects and associated improvement actions

Observation	Potential retrofit action
Duct leakage	Add seal ducts: aeroseal/tape/mastic
Bad duct insulation	Add insulation to ducts
Air-flows at registers	Replace registers, open/close dampers, reduce system flow resistance by straightening existing ducts or replacing them with straight runs of new ducts
Low air handler flow	Replace filters, fix duct restrictions, change fan speed, replace fan with a high-efficiency unit, add extra returns in return-restricted systems
Bad filter condition	Replace filter
Incorrect thermostat setting	Raise thermostat in summer and lower it in winter to account for better distribution, mixing and envelope improvements
Spot ventilation	Replace fans if necessary. If possible, remove spot ventilation and use ducts and central ventilation
Spot ventilation: high power consumption	Replace with a higher efficiency unit, remove/reduce duct flow restrictions, clean fan and ducting
Equipment capacity	Replace with correct size
Refrigerant charge	Add/subtract refrigerant
Age and condition of HVAC system	Clean the system and repair damage or replace the system if >15 years old
Location of HVAC system equipment and ducts	Seal and insulate duct locations. If applicable, move system location
Window A/C units	Replace with central unit or improved distribution
Multiple systems/zoning	Ensure correct damper operation, check capacity of each system/zone load calculation
Moisture testing	Improve source control — better venting in sensitive zones, fix flashing/detailing, seal crawlspaces in high humidity climates, replace windows, add insulation to walls, floors and ceiling
Occupant survey – asking customers to report problems	Create moisture-removal strategies; install new windows, change register type, airflow and location to improve mixing/remove drafts, add envelope insulation, etc.
Source: EC (2012).	

Applicability

Building ownership
As with improvements to the building envelope, one major barrier to installation of optimised HVAC systems across accommodation buildings is the low level of ownership of host buildings by large hotel and hostel chains. In such cases, the scope for modification of the HVAC system is limited by lease conditions, and there is no opportunity for accommodation managers to specify fully optimised HVAC systems integrated with the building envelope. However, accommodation managers may consider efficient HVAC characteristics when selecting buildings to rent, and when liaising with building owners over renovations.

Ventilation system control
Based on the case study of the Hotel Victoria retrofit (section 7.2), the retrofitting of a centralised mechanical ventilation system with heat recovery can be difficult in old buildings owing to space restrictions and fire regulations, but such retrofitting is essential to realize benefits associated with building envelope improvements. Regulations stipulating minimum air-exchange rates in some member states may constrain the optimisation of ventilation rates.

Economics

Efficient equipment

Each kWh per day of reduced electricity consumption leads to an annual saving of between EUR 37 and EUR 73. Any price premiums arising from the specification of more energy-efficient equipment at the procurement stage are likely to be paid back relatively quickly.

Replacing older equipment with new efficient equipment during renovation works also leads to short payback times. Danfoss (2012) claim that investment in variable speed drives pays back within one to two years for building applications, whilst investment in pressure independent control valves pays back within six months.

Government incentives

Government schemes may provide subsidies for the installation of energy-efficient equipment. For example, under the UK Enhanced Capital Allowance scheme, companies may deduct the capital cost of energy saving equipment from taxable profit in the year of purchase (http://etl.decc.gov.uk/). Equipment covered by the scheme relevant to this technique includes:

- air to air energy recovery
- automatic monitoring and targeting
- compact heat exchangers
- HVAC zone controls
- motors
- pipe-work insulation
- thermal screens
- variable speed drives
- warm air and radiant heaters.

System optimisation

In 1997 – 2000, the 465-room, 31 500 m^2 Scandic Copenhagen hotel replaced the existing undersized air conditioning system that used the environmentally damaging Freon 12 refrigerant with a new correctly sized system that used the natural refrigerant ammonia (Horesta, 2000). The old system was unable to service the whole hotel during periods of peak demand, and it was estimated that a 30 % increase in system capacity would lead to energy savings of 15 000 kWh per year by enabling optimisation of system loading. All refrigeration and freezing needs in the hotel were integrated into the new central system, and the hotel building envelope was simultaneously upgraded during renovation work. Overall energy savings were calculated as 409 000 kWh per year, translating into annual cost savings of almost EUR 41 000 at current electricity prices, and a payback time of only 6 years.

Overall potential cost savings

Figure 7.12 in section 7.1 presents estimated costs of HVAC energy consumption for a 100-room hotel (5 300 m^2), based on average and best practice. Depending on the electricity price and fuel source for HVAC, total savings of between EUR 27 000 and EUR 91 000 per year are possible by optimising HVAC systems to achieve best practice levels of performance in an average 100-room hotel.

Driving force for implementation

The main driving force to optimise HVAC systems is to reduce energy costs and exposure to energy price volatility. In addition, optimised HVAC systems improve guest and staff comfort levels.

Case studies

Scandic Copenhagen

See description under 'Economics', above.

NH Laguna Palace Hotel, Italy

NH Laguna Palace Hotel comprises 384 hotel rooms and a convention centre, and has a total cooling capacity of 3 200 kW provided by decentralised water-to-water compact heat pump units and packaged water-to-air rooftop units (described in section 7.4). A number of best practice measures are incorporated in this HVAC system (Carano, 2010):

- the hotel is divided into separate HVAC zones according to variation in HVAC demand, and zones are served by independent modular water- and air- sourced heat pumps;
- the indoor quality control system is managed by the 'pulsing-activation' of ventilation and heat recovery across separate zones according to CO_2 values detected by the relevant probe;
- heat pump units include built-in heat recovery that increases system efficiency by avoiding the efficiency losses associated with pressure drops arising in separate plate heat exchangers;
- Ventilation is powered by low consumption fans running on direct current motors, with variable electronic control.

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7.4 Efficient application of heat pumps and geothermal heating/cooling

Description

Heat pumps harness RE, but require significant amounts of electricity to operate, and often involve the use of refrigerants with a high GWP. Therefore, they are considered an option to reduce energy demand, and described in this section separately from section 7.6 where RE options are described. Geothermal cooling is a renewable cooling source that requires small amounts of electricity to operate, but owing to its operational similarity with heat pump applications, it is described in this section.

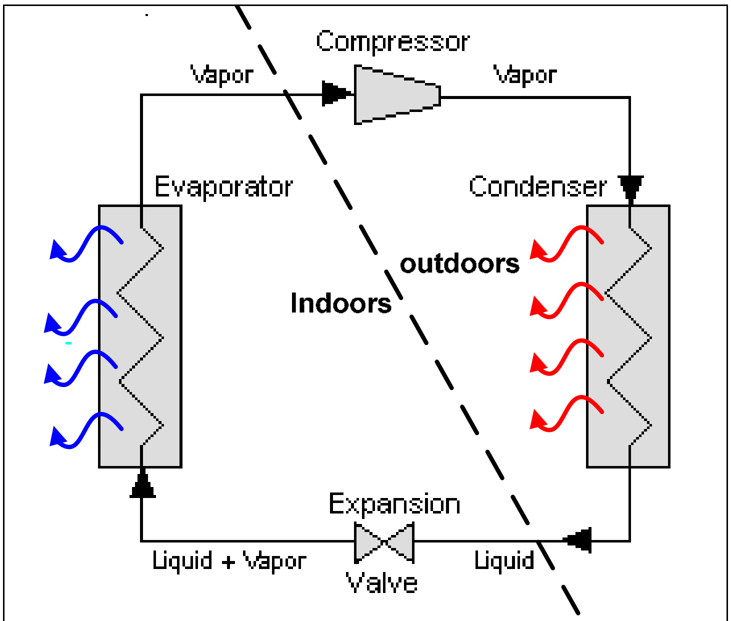
Ecolabel criteria for heat pumps, such as those contained in Commission Decision 2007/742/EC for the award of the EU Flower to heat pump devices, provide useful guidance on characteristics of well performing heat pumps. Selection of equipment awarded the EU Flower (or alternative efficiency labels such as Energy Star) can make an important contribution towards best practice. Reverse heat pumps represent basic air conditioning technology commonly used in accommodation buildings, and in themselves do not represent best practice (although selection of efficient air conditioning units, for example based on the aforementioned labels, represents good practice). Best practice measures for this technique are summarised in Table 7.17, and elaborated using relevant case studies.

Table 7.17: Main heat pump and geothermal energy applications

Measure	Description	Applicability	Best practice example
Geothermal or ground-source heat pumps	Groundwater, or water circulating in buried pipes, is passed through a heat exchanger, then heat upgraded with a heat pump is exchanged to the building HVAC and DHW systems	Winter months, all climates. Sufficient outdoor or suitable geology	Hotel Victoria (retrofit); Crowne Plaza Copenhagen Towers (new)
Geothermal cooling	Cool water pumped from underground is circulated within building HVAC systems in summer	Summer months, moderate and warm climates. Sufficient outdoor or suitable geology	Hotel Victoria (retrofit); Crowne Plaza Copenhagen Towers (water, new)
Use of low GWP coolants	Commission Decision 2007/742/EC for award of the EU Flower to heat pumps prohibits use of coolants with a GWP >1000. Natural refrigerants such as CO_2 and ammonia are increasingly being used, with GWPs 0 – 3 (see section 8.4)	May be specified for any new system	Scandic Copenhagen
Efficient air source heat pumps	Use of efficient air-source heat pumps for HVAC heating and/or cooling, and for DHW. Equipment certified according to, or complying with, Commission Decision 2007/742/EC	Winter months, excluding coldest climates	Where water-source heat pumps impractical or too expensive.

<u>Heat pumps</u>

Heat pumps extract and upgrade low grade renewable heat stored in surrounding air, water, ground, etc., so that it can be circulated within HVAC systems to provide space and water heating. They also work in reverse to extract heat from building HVAC systems and expel it to the surrounduing environment. Heat pumps function according to thermodynamic principles underpinning the basic refrigeration cycle (Figure 7.22). The external energy required by heat pumps to transport and upgrade heat from a heat source to the point of heating, and vice versa for cooling, is lower than the amount of heating or cooling energy provided by the heat pump, potentially resulting in significant energy savings compared with conventional heating or cooling systems.



Source: Derived from Wikipedia (2012).

Figure 7.22: Basic heat pump refrigeration cycle used to provide indoor cooling

The efficiency of heat pumps, expressed as a coefficient of performance (COP) for heating or Energy Efficiency Ratio (EER) for cooling, depends on the following critical factors:

- heat exchange media
- heat differential between source and destination
- system design and installation.

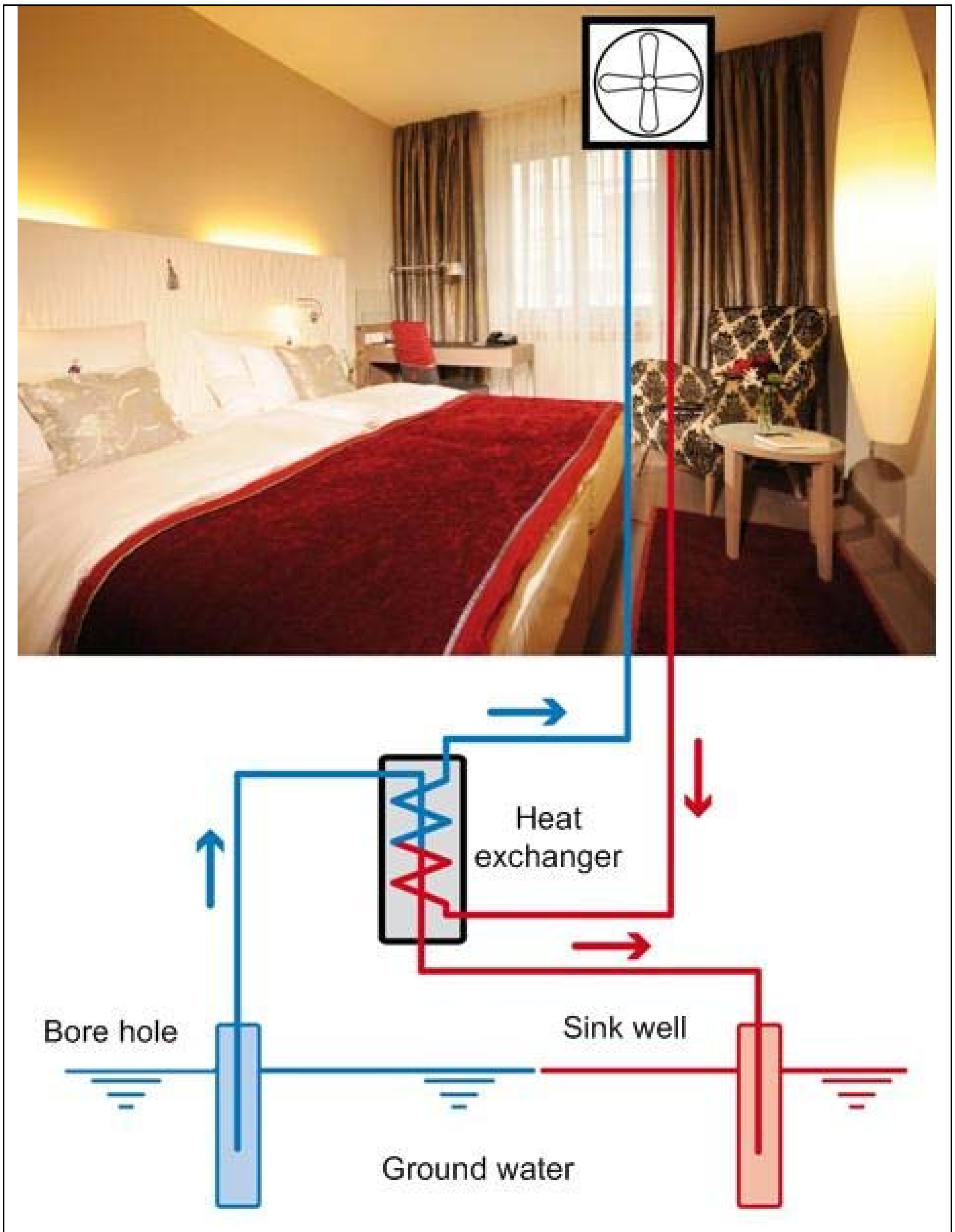
Heat exchange media may be: (i) ambient air (air-source heat pumps); (ii) water, including groundwater (water-source heat pumps); (iii) the ground, close to the surface or at depth (ground-source heat pump). Ground-source heat pumps typically use a heat medium such as brine or a water-glycol mixture, that may either be circulated down through a deep borehole or horizontally through piping installed at shallow depth (1 – 2 m), to exchange heat with the ground. As a rule of thumb the outdoor area required for the latter system is twice the area that requires heating, restricting applicability to smaller accommodation premises.

Typical water-source heat pumps achieve COPs of 4 to 5, compared with COPs of 2 to 3 for typical air-source heat pumps, although performance varies widely from less to more efficient designs and according to operating conditions. The lower the heat differential between the source and destination, the higher the efficiency, and the efficiency of air-source heat pumps decreases dramatically when outdoor temperatures drop below 0 ºC. Seasonal temperature variations are further below ground and in water bodies, making water- or ground-source heat pumps more efficient throughout the year.

Thus, one important aspect of best practice is to utilise ground- or water-source heat pumps where feasible according to space, geological and economic considerations (more expensive than air-source heat pumps). Another important aspect of best practice with respect to heat pump application is installation of a low temperature distribution (HVAC) system, which in turn is most effective where relatively low heat demands have been achieved through a good quality building envelope. Thus, optimised heat pump applications depend on an integrated approach to building design that incorporates a high-quality building envelope (section 7.2) with an HVAC system designed to optimise the efficiency of the heating and cooling source (section 7.3).

Geothermal cooling

Deep groundwater maintains a relatively constant temperature of 4 – 10 ºC throughout the year (IEA, 2012), and provides a useful source of cooling for building HVAC systems. Geothermal cooling is simple to implement, comprising a borehole sufficiently deep to extract cool groundwater, a pumping system and a heat exchanger, as represented in Figure 7.23. Extraction of cool water during summer is sufficient to provide 100 % of cooling demand, and the return of warmed water through a sink well results in localised warming of the groundwater during the summer. This slightly warmer water may then be pumped up in winter to provide heat to the HVAC system via a heat-pump. Examples of this system include the Hotel Victoria in Freiburg, Germany, and the Crowne Plaza Copenhagen Towers hotel in Denmark. In the latter hotel, the system returns four kWh of heating per kWh of electricity consumed to drive the system in heating mode, and eight kWh of cooling per kWh of electricity used to drive the system in cooling mode. Geothermal cooling may also be used to cool water supplied to accommodation via district cooling systems, especially in northern and eastern Europe where such systems are more common.



Source: Hotel Victoria (2011).

Figure 7.23: Schematic presentation of a groundwater cooling system

Ground cooling tubes are an alternative approach for summer cooling that may be suitable in some circumstances, for low-rise premises with sufficient outdoor space and where the earth is easy to excavate. Tubes typically 15 – 50 cm in diameter and tens of metres in length are buried approximately two metres below the ground. Incoming air, or recirculating indoor air in closed loop systems, passes through these tubes, dissipating heat to the surrounding ground (usually a few degrees cooler than the air during summer months, on average). One example of the use of such tubes is the Alma Verde holiday villas in Portugal, where the Coolhouse project (Faber Maunsell, 2004) measured cooling-energy savings of over 95 % for a ground cooling tube system compared with use of conventional air conditioning units (although indoor air temperatures were slightly higher). The main benefit of such systems is a significant reduction in peak daytime indoor temperature, potentially avoiding the need for air-conditioning, but applicability is restricted to specific conditions and such systems are not practical for large buildings.

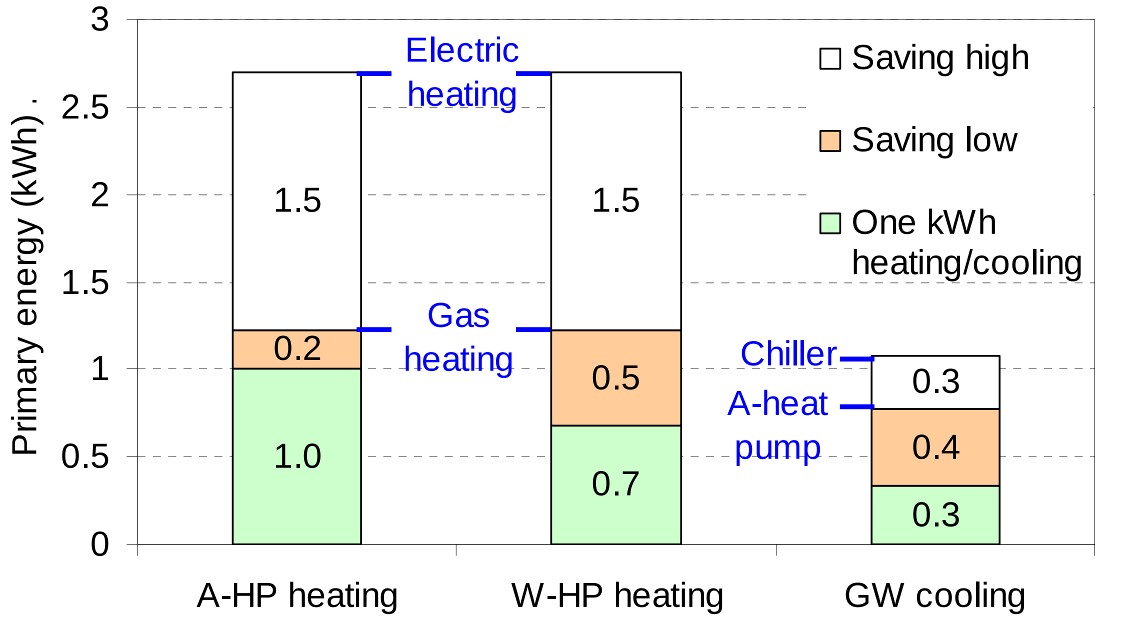
Low GWP refrigerants

Heat pump systems traditionally incorporated refrigerants such as hydrofluorocarbons and other inert compounds with high GWPs many thousands of times higher than CO_2 on a mass basis, and in some cases also high potentials to destroy stratospheric ozone. In recent years, various low GWP refrigerants such as the hydrocarbons R1270, R290, R600A, or the natural refrigerants CO_2 and NH_3, have begun to replace traditional refrigerants. These new refrigerants do not damage the ozone layer and have much lower GWPs. A detailed overview of the use of hydrocarbon and natural refrigerants is presented in the EMAS SRD for the retail trade sector (EC, 2011), with respect to retail refrigeration systems.

Achieved environmental benefit

The main environmental benefit of heat pumps and groundwater cooling is a significant reduction in primary energy demand. The extent of this reduction is heavily dependent upon the reference system compared (Figure 7.24), and is determined by the system efficiency (e.g. heat pump COP) and by the primary energy factor of the energy carrier (e.g. 2.7 for electricity: Table 7.4 in section 7.1). The primary energy saving potential of heat pumps and groundwater cooling range from 0.2 to 2.0 kWh per kWh heating or cooling delivered. Despite the high COP of groundwater cooling, the primary energy savings are higher for heat-pump heating owing to the lower efficiency of conventional heating systems.

Primary energy savings for heat pumps and groundwater cooling are reduced owing to their dependence on electricity, which has a high primary energy factor. However, the primary energy factor of electricity varies considerably depending on generating sources, so that primary energy savings arising from heat pumps and groundwater cooling can be close to 100 % if renewable electricity is used to drive the systems.



NB: Assumes A-HP heating and cooling COP values of 2.5 and 3.5, respectively, W-HP heating COP of 4, GW-C and chiller cooling COP values of 8 and 2.5, respectively, gas conversion efficiency of 0.9, and gas and electricity primary energy ratios of 1.1 and 2.7, respectively.

Figure 7.24: Primary energy requirements for 1 kWh heating or cooling delivered by air- and water-source heat pumps (A-HP and W-HP) and groundwater cooling (GW-C), and savings compared with conventional heating and cooling sources

Application of groundwater heating and cooling, with COP and EER values of 4 and 8, respectively, is claimed to result in total final energy consumption of less than 43 kWh per m^2 per year for the Crowne Plaza Copenhagen Towers hotel (CP Copenhagen, 2012).

Appropriate environmental indicator

Currently, there remains a lack of standardisation with regard to measuring the overall system efficiency of heat pump applications at the building level. The project 'SEasonal PErformance factor and Monitoring for heat pump systems in the building sector (SEPEMO-Build)' is intended to develop a common methodology for field measurement of heat pump systems and calculation of SPF in the building sector. However, the efficiency of heat pump units can be measured with respect to energy inputs and outputs.

Heat pump energy efficiency

Heat pump efficiency is calculated as the ratio between the total heat output and the primary energy input. A standardised methodology to calculate heat pump efficiency is provided by EN14511: 2004. The most common way to express the heating efficiency of a heat pump is the COP:

$COP = Q_H/W$
Q_H is the delivered heating energy, expressed in kWh; W is the work energy used to drive the system (usually electricity), expressed in kWh, and including all circulating pumps

The same equation applies for calculating cooling EER, replacing Q_H with with Q_C.

Heat pumps and geothermal cooling usually rely on electricity, with high upstream energy consumption and loss. For comparison with alternative direct heating sources, such as on-site gas boilers, primary energy efficiency (PPE) is a useful indicator. Primary energy efficiency can be calculated accordingly.

$PEE = Q_H / Q_P$
Q_H is the delivered heating energy, kWh; Q_P is the primary energy consumption, in kWh, calculated by multiplying the final energy consumption by the primary energy factor for the relevant energy carrier (see Table 7.4).

COP and EER values may also be expressed as Heating Seasonal Performance Factor (HSPF) and Seasonal Energy Efficiency Ratio (SEER), respectively, specifically representing operational performance averaged over a heating or cooling season.

System global warming potential

Refrigerant leakage makes a significant contribution to the environmental impact of heat pump systems owing to the high global warming potential (GWP) of traditional CHFC refrigerant gases (see Figure 8.27 in section 8.4). Leakage (top-up) rates of refrigerants can be multiplied by their GWP, and added to the carbon footprint of electricity consumed by the heat pump where these data are available, to calculate the annual carbon footprint of the cooling or heating system.

Building energy performance
Ultimately, the efficiency of the heating and cooling system is reflected in the indicators for building total energy consumption, and more specifically where available heating and cooling energy consumption (sections 7.2 and 7.3), expressed as kWh per m^2 heated and cooled area per year.

Benchmark of excellence
German DENA standards define a heat pump to be 'efficient' if it has a HSPF above 3.0 and 'very efficient' if it is above 3.5. A more detailed breakdown of reference performance COP, EER and PER values for different types of heat pumps is provided in the EU Flower criteria for heat pumps (Table 7.18 and Table 7.19). These values are proposed as benchmarks of excellence for specific heat pump types under specified conditions, according to the methodology of EN14511: 2004.

In relation to an EER benchmark for geothermal cooling, in the absence of detailed information, a value of 8 is initially proposed.

In addition, best practice in this technique is to install water-source heat pumps and/or geothermal cooling systems wherever feasible, and to optimise their operation through an HVAC system design that minimises the heat differential between the heat/cool source and delivery temperature (see section 7.3).

BM: water-source heat pumps and/or geothermal heating/cooling is used in preference to conventional heating and cooling systems wherever feasible, and heat pumps comply with EU Flower criteria.

Table 7.18: Minimum heating efficiency requirements for heat pumps according to the EU Flower ecolabel criteria under various operating conditions

Heat pump type	Min. COP (elec.)	Min. COP (gas)	Min. PER	Outdoor unit (temp., ºC)	Indoor unit (temp, ºC)
Air/air	2.9	1.27	1.16	Inlet DB: 2 Inlet WB: 1	Inlet DB: 20 Inlet WB: 15
Air/water	3.1	1.36	1.24	Inlet DB: 2 Inlet WB: 1	Inlet DB: 30 Inlet WB: 35
Brine/air	3.4	1.49	1.36	Inlet: 0 Outlet: –3	Inlet DB: 20 Inlet WB: 15
Brine/water	4.3	1.89	1.72	Inlet: 0 Outlet: –3	Inlet DB: 30 Inlet WB: 35
Water/water	5.1	2.24	2.04	Inlet: 10 Outlet: 7	Inlet DB: 30 Inlet WB: 35
Water/air	4.7	2.07	1.88	Inlet: 15 Outlet: 12	Inlet DB: 20 Inlet WB: 15

NB: Additional lower COP and PER values are indicated in EU Flower criteria based on higher output temperatures.
DB = dry bulb thermometer, WB = wet bulb thermometer.

Source: EC (2007).

Table 7.19: Minimum cooling efficiency requirements for heat pumps according to the EU Flower ecolabel criteria under various operating conditions

Heat pump type	Min. EER (elec.)	Min. EER (gas)	Min. PER	Outdoor unit (temp., ºC)	Indoor unit (temp, ºC)
Air/air	3.2	1.4	1.3	Inlet DB: 35 Inlet WB: 24	Inlet DB: 27 Inlet WB: 19
Air/water	2.2	0.97	0.9	Inlet DB: 35 Inlet WB: 24	Inlet DB: 23 Inlet WB: 18
Brine/air	3.3	1.45	1.3	Inlet: 30 Outlet: 35	Inlet DB: 23 Inlet WB: 18
Brine/water	3	1.32	1.2	Inlet: 30 Outlet: 35	Inlet DB: 23 Inlet WB: 18
Water/water	3.2	1.41	1.3	Inlet: 30 Outlet: 35	Inlet DB: 23 Inlet WB: 18
Water/air	4.4	1.93	1.8	Inlet: 30 Outlet: 35	Inlet DB: 27 Inlet WB: 19

NB: Additional lower EER and PER values are indicated in EU Flower criteria based on lower output temperatures.
DB = dry bulb thermometer, WB = wet bulb thermometer.

Source: EC (2007).

The benchmarks of excellence proposed for HVAC and total final energy consumption in sections 7.2 and 7.3 in relation to overall building energy performance for existing hotels are based on data for hotels that mostly do not use heat pumps for heating or cooling. Therefore, application of efficient heat pumps and geothermal cooling should enable enterprises to perform considerably better than those benchmarks.

Cross-media effects

Operation of heat pumps containing hydrofluorocarbon refrigerants contributes to global warming via refrigerant leakage which can somewhat offset GHG emission savings attributable to lower energy consumption. The EU Flower for heat pumps requires use of refrigerants with a GWP of ≤2000, and allows a 15 % reduction in minimum COP, EER and PER values for heat pumps using refrigerants with a GWP of less than 150. Air-source heat pumps also generate some noise.

Operational data

Basic good practice in heat pump system design is provided in EU standard EN *15450 'Heating systems in buildings – Design of heat pump heating systems'*.

<u>Efficient heat pump system design</u>

The decision to install a heat pump, the selection of the preferred type of heat pump, and the specific application of the heat pump will depend largely on local factors and the alternative heating and cooling options available. As referred to under 'Applicability', climate is a critical factor when deciding whether to install air-source heat pumps, but can affect all types of heat pump through its influence on the heating and cooling demand. The key questions that follow are relevant.

- What are the heating and the cooling demands (see section 7.3)?
- What alternative heating and cooling options are available?
- What supply temperatures are required for the existing or planned distribution system (section 7.3)?
- What is the seasonal capacity and temperature of available heat sources/sinks?

Heating and cooling demand should be determined in accordance with relevant national standards, based on modelled data for new or newly renovated buildings or recent data for existing buildings. The concurrency between heating and cooling demands and heat source/sink is an important factor that should be ascertained by using an expert based on a site survey, considering yearly and daily variations that can have a large effect on the exploitability of a heat source/sink. Concurrency is important in relation to the selection of heat source and distribution system, and the installation of a buffer system. Buffer systems can be more easily integrated into water- and ground- source heat pumps operating with water-based distribution systems. Buffer systems enable loads to be balanced and the operating cycles length to be extended.

Calculation of theoretical and estimated actual (e.g. approximately half theoretical) efficiencies for different heat pump types using different heat sources or sinks locally available at specific temperature ranges (see below) can be used to indicate the relative energy and economic performance of different types of heat pump. When comparing alternative heating and cooling options, key aspects include energy consumption and costs as well as lifetime of the existing system (if an existing system is being replaced). The availability of alternative heating and cooling options is a critical and highly site-specific factor. For example, accommodation may be located in an area where district heating and/or district cooling is available, which could significantly reduce the energy and cost benefits of heat pump systems. Table 7.20 lists advantages and disadvantages associated with different types of heat pump.

A critical factor involved in ensuring that the heat pump systems are operating efficiently at high capacity is to install a centralised heat pump system, rather than a decentral system. The highest overall system efficiencies are achieved by installing a heat pump with a capacity slightly below the peak load, combined with a buffer system to regulate peaks and troughs in demand. This is easier to achieve with water-based, rather than air-based, distribution systems given the high heat capacity of water.

Table 7.20: Main advantages and disadvantages of different heat sources

Heat Source	Advantages	Disadvantages
Air	– Readily available and easy to establish – Decentralised systems – Relatively low establishment cost – An auxiliary heating system may function as a backup heating system	– May require auxiliary heating system in winter – High temperature variations and low temperatures in winter – Lower HSPF due to temperature conditions – May require defrosting of evaporation coils – Potential noise emissions (decentral systems)
Water	– Stable and relatively high temperature – Relatively low temperature difference between source and sink over the year – Higher HSPF due to the temperature conditions	– For groundwater systems: risks of water quality issues, water table issues, risk of polluting or deteriorating the water source – Corrosion due to salts/saline sea water – Relatively high establishment costs – Freezing of evaporation coils (mainly for surface waters or low saline sea water) – Less accessible as heat source, especially in urban areas
Ground and	– Stable and relatively high temperature	– Large outdoor space requirements for horizontal systems + reestablishment

Heat Source	Advantages	Disadvantages
soil	– Relatively low temperature difference between source and sink over the year – Higher HSPF due to the temperature conditions	of outdoor areas, e.g. gardens – Relatively high establishment costs and high costs of vertical systems (but low as percentage of Life-Cycle Costs) – Unknown geological structures or soil thermal properties – Risk of leakage from evaporation coils and soil pollution – Lowering of soil temperature during heating season and prolonged lowering of temperature at the end of the heating season
Source: Dinçer and Kanoglu (2003).		

Temperature differential

The heat pump cycle follows a Carnot Cycle and the theoretical COP_{max} can therefore be calculated by using the temperature difference between the heat source (evaporator) and the heat output (condenser). Thus, the theoretical system efficiency can be calculated based on the input temperature and the output temperature, as presented below for a heating system.

$COP_{max} = T/\Delta T$
T is the temperature of the heat sink (condenser temperature) in degrees Kelvin; ΔT is the temperature difference between the warm and the cool side (evaporator and condenser) in degrees Kelvin .

From the formula it is clear that COP_{max} is inversely proportional to the temperature difference between the heat source/sink and the HVAC supply system operating temperature.

To illustrate the calculation of the COP_{max} we can take two examples where the heat source is groundwater at 10 °C (283 K), the heat distribution system is either a low temperature underfloor heating system requiring supply water at 35 °C (308 K) or a high temperature radiator system requiring supply water at 70 °C (343 K).

Table 7.21: Examples of theoretical COP_{max} values for a low and high temperature distribution system

Low temperature underfloor heating	High temperature radiators
$\Delta T = 308 – 283$ $= 25$ K	$\Delta T = 343 – 283$ $= 60$ K
$COP_{max} = 308$ K / 25 K = 12.3	$COP_{max} = 343$ K / 60 K = 5.7

The COP_{max} as calculated above is a theoretical value for an ideal process. In reality thermal, mechanical, and electrical losses will impact the COP. The achieved COP can, as a rule of thumb, be taken as half of the Carnot Efficiency.

For DHW heating in summer, the COP is likely to be lower than for HVAC heating in winter because of the higher temperatures required for hot water. Studies of selected heat pumps across

Germany showed average HSPFs of just above 3.0 for the summer and around 4.0 between October and March (EC, 2012).

Applicability

Building ownership

As with building envelope improvement and HVAC optimisation, the installation of heat pump and geothermal systems may not be under direct control of accommodation management owing to the ownership structure of accommodation buildings, in particular for hotel chains. In such cases, this technique may be more applicable to building owners and management companies who decide on heating system installations, although accommodation managers may use information here as a guide for selection of appropriate premises, and to encourage building owners to upgrade the heating and cooling systems.

Air-source heat pumps

Air-source heat pumps are applicable in most conditions, but the heating efficiency of such systems may be limited and require backup when outdoor air temperatures fall significantly below freezing. Thus, applicability may be limited in very cold and sub-arctic climate zones, as displayed in Figure 7.20 (section 7.3).

Ground- and water-source heat pumps

Ground-source heat pumps require either: (i) sufficient outdoor area where extensive digging is possible adjacent to the premises; (ii) appropriate geology below the premises to enable economic drilling of boreholes.

Geothermal cooling with groundwater depends on the presence of suitable hydrogeology (groundwater must be present at an accessible depth) and geology directly below the premises.

Ground cooling tubes

The applicability of ground cooling tubes is limited by a number of factors, including the availability of outdoor space and easy-to-excavate ground. The average daily ground temperature must also be at least a few degress cooler than the average daily air temperature during summer months, and the system may not work well with very warm humid air that requires dehumidification.

Economics

Installation costs

The costs of installing heat pump systems vary significantly with the type of heat pump, the location, and the selected collection and distribution system, but are typically around twice those of installing conventional heating systems (Geosystems, 2012). Consulted HVAC specialists have provided approximate installation costs of EUR 150 – 300 per kW capacity for the heat pump, and EUR 200 per kW installed capacity for the collection and distribution system (GMCB, 2010).

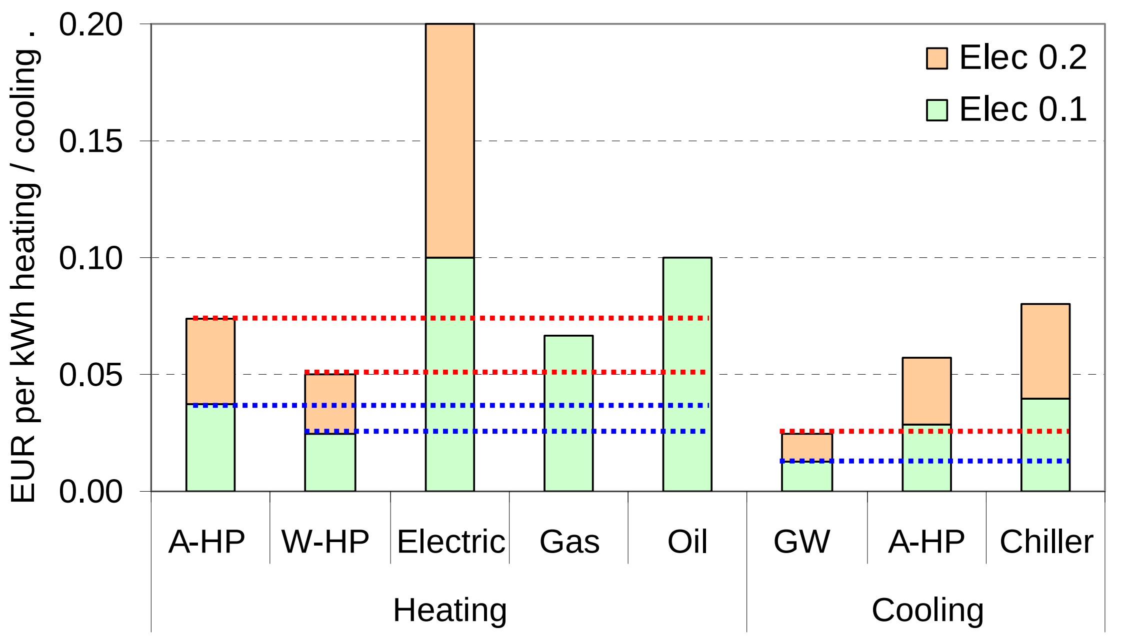
As an example, for a 5 300 m^2 100-room hotel, installing a heat-pump heating system may involve total costs of EUR 106 000, assuming a cost of EUR 400 per kW installed (including distribution system) and installation of 50 W per m^2 (Ochsner, 2008).

Even for more expensive heat pump applications, installation costs represent 10 – 20 % of lifecycle costs. For example, the comprehensive geothermal heating and cooling systems installed at the Crowne Plaza Copenhagen Towers (described below) are estimated to pay back within 6 years.

Government energy efficiency schemes may provide economic incentives for installing heat pumps. Equipment for which purchase costs may be offset against tax under the UK Enhanced Capital Allowance scheme includes heat pumps for space heating.

Operating cost savings

As for previous sections, country- and contract-specific energy prices determine the cost competitiveness and payback times for heat pump applications. Figure 7.25 shows energy costs per kWh of heating and cooling delivered for different systems, and shows the cost advantages of heat pump systems compared with conventional electric resistance, gas and oil heating systems (apart from air-source heat pumps compared with gas when the electricity price is EUR 0.20 per kWh).



NB: Based on efficiency assumptions applied in Figure 7.24, and energy costs of EUR 0.1 – 0.2 per kWh for electricity, EUR 0.06 per kWh for natural gas, and EUR 0.09 per kWh for oil.

Figure 7.25: Energy costs for every kWh of heating and cooling delivered by different systems

The relative differences in energy costs for one kWh of heating or cooling across the different systems are summarised in Table 7.22 and Table 7.23, respectively. Water-sourced heat pumps (i.e. using ground or groundwater) offer the lowest heating cost per kWh, and reduce heating energy costs by 63 % compared with gas and 75 % compared with electric resistance and oil heating (Table 7.22).

Table 7.22: Comparison of input energy costs per unit heat output for different heat sources

	A-HP	W-HP	Electric	Gas	Oil
A-HP	0 %	48 %	-63 %	-44 %	-63 %
W-HP	-33 %	0 %	-75 %	-63 %	-75 %
Electric	170 %	300 %	0 %	50 %	0 %
Gas	80 %	167 %	-33 %	0 %	-33 %
Oil	170 %	300 %	0 %	50 %	0 %

Groundwater cooling systems offer the lowest cooling costs per kWh, and save between 56 % compared with air-source heat pumps and 69 % compared with chiller systems (Table 7.23).

Table 7.23: Comparison of input energy costs per unit cooling output for different cooling sources

	GW	A-HP	Chiller
GW	0 %	-56 %	-69 %
A-HP	129 %	0 %	-29 %
Chiller	220 %	40 %	0 %

Payback times

Payback times are highly dependent on the type of system installed, contract energy prices, and the reference system compared, and should therefore be calculated for specific applications. To develop the example of a geothermal heat pump installed in a 5 300 m^2 100-room hotel described above, annual heating energy costs could be reduced by between EUR 16 563 and EUR 35 554 compared with gas heating, assuming average and best practice heating demand of 161 and 75 kWh/m^{2}yr, respectively. This compares with an investment cost of EUR 106 000 (see above), of which half may be additional for the geothermal system (Geosystems, 2012), indicating a simple payback period in the region of 1.5 to 3.2 years.

Meanwhile, the same sized hotel in a warm climate with a cooling demand of 75 kWh/m^{2}yr could reduce annual cooling energy costs by EUR 10 931 by installing a groundwater cooling system in place of a chiller. This would be associated with a simple payback of 4.8 years, assuming the geothermal system costs twice as much as the chiller system to install.

In fact, consideration of payback times can be complex for heat pumps, because they can provide both heating and cooling, and may in some cases be considered an upgrade of cooling system heat pumps that would be required anyway. In this context, the application of heat pumps for heating may be most cost effective in the 'mixed' and 'warm' climate zone of Figure 7.20 (section 7.3) where the heat pumps can also be used in reverse to provide summer cooling, thereby avoiding the costs associated with installing separate heating and cooling systems. In such cases, installation of an efficient air-source heat pump system may pay back immediately, and installation of the most efficient groundwater-based systems may pay back over a number of years before realising large annual energy cost savings.

Online calculation tool

The EU funded project ProHeatPump has developed a basic online calculation tool that can be used to evaluate and compare the following heating options in terms of capital and annual costs:

- ground-source heat pump
- oil boiler
- gas boiler
- direct electric
- electric boiler
- wood boiler
- pellet boiler
- district heat.

Based on information on investment costs, fuel costs, and efficiency the online tool calculates the primary energy demand, annual fuel quantities and costs, annualised capital cost (annuity factor of 0.096 and interest rate of 5 %), and total annual heating cost for the different options. The online tool is available at: http://proheatpump.syneriax.com/calculator.htm?lang=GB

Driving force for implementation

Potentially large reductions in annual energy costs, as described above, represent a major driving force for installing heat pump and geothermal cooling systems. Such systems can also significantly reduce the carbon footprint of accommodation, and facilitate 'carbon neutral' operations as claimed by some accommodation managers in sustainability reporting (e.g. Crowne Plaza, 2011).

With respect to use of low GWP refrigerants, the use of conventional refrigerants with high GWP must be phased out under current regulations.

Case studies

NH Laguna Palace Hotel, Italy

NH Laguna Palace Hotel comprises 384 hotel rooms and a convention centre, and has a total cooling capacity of 3 200 kW provided by decentralised water-to-water compact heat pump units and packaged water-to-air roof-top units (Curano, 2007). These units also provide heating for the hotel, and use river water extracted via a pre-existing underground duct as a stable heat source/sink. The installed system avoids the need for boiler heating of the HVAC system in winter and cooling tower cooling in summer.

High-efficiency water-source heat pumps use refrigeration circuits that include rotary/scroll compressors, 4-way valves, heat exchangers on the demand and source sides (finned coil and plate types), an expansion device (electronic thermostatic valves on larger models), variable flow pumps to reduce energy consumption, electronic controls and automatic safety devices.

A modular decentralised system was chosen because the different zones of the hotel have different needs, in particular the conference centre, rooms and large suites. For example, individual compact water-to-water heat pumps the size of a washing machine are used for each suite. Packaged water-to-air rooftop units supply conditioned air to high attendance zones including the restaurants, meeting rooms and conference centre. The system in this hotel also incorporates aspects of best practice for HVAC optimisation (see section 7.3).

Crowne Plaza Copenhagen Towers, Denmark

Crowne Plaza Copenhagen Towers was built in 2009, has a floor area of 58 000 m^2, and incorporates 366 rooms, a conference room section, kitchen, restaurant and ancillary office building. Geothermal heat pumps were installed based on the aquifer thermal energy storage (ATES) technique that utilise groundwater as a heat source and heat sink. Cold groundwater is pumped up during the summer and directed to the hotel's basement where it cools down the water in the internal HVAC system. The groundwater is then returned into the ground, where the water accumulates heat during the summer for use in the winter. During winter, the water which was heated during the summer is pumped up again and heat energy is sent through two heat pumps which raise the temperature to heat the hotel HVAC system. Table 7.24 summarises some technical characteristics of the system. Frequency converters regulate the speed of heat pumps and HVAC system circulation to optimise energy efficiency (Danfoss, 2010; CP Copenhagen, 2012).

Table 7.24: Key characteristics of the geothermal heating and cooling systems in the Crown Plaza Copenhagen Towers

Function	Heat pump capacity	Peak demand	COP	Supply temp.
Heating	1 183 kW	2 900	4.0	30 – 60 °C
Cooling	1 100 kW	4 100	8.3	12 – 18 °C

The technology realises energy savings of up to 90 % compared with mechanical cooling and up to 60 % compared with traditional heating, and enables the Crowne Plaza Copenhagen Towers to achieve the Danish Low Energy Class 2 standard, i.e. energy consumption <42.6 kWh per m^2 per year. The payback time for such systems is typically between 0 and 6 years.

<u>The Zetter Hotel, Clerkenwell, London</u>
The 59-room Zetter Hotel in Clerkenwell, London, installed seven heat recovery air conditioning units that use groundwater from a 130 m borehole sunk below the hotel. The selection of groundwater cooling not only maximised energy efficiency, but avoided losing valuable roof space to conventional air-source air conditioning units, thus enabling the provision of an additional penthouse suite. The main 5-story atrium provides natural ventilation, whilst each of the condensing units can supply simultaneous cooling and heating for up to 16 individual indoor units. Condensing units are interlinked via the building's water loop, enabling heat recovery from indoor units on the same refrigerant circuit in addition to transfering energy between circuits.

<u>Others</u>
Other examples of geothermal heating and cooling applied in accommodation buildings include:

- Brigittenau Youth Palace, Vienna
- Boutique-hotel Stadhalle, Vienna
- Decoy Country Cottages, Ireland
- Hotel A Quinta da Auga, Spain.

Other best practice examples of heat pump heating in accommodation buildings include:

- Kühlungsborn campsite, Germany (upgrades heat from wastewater: section 9.2)
- Krägga Herrgard hotel in Sweden (ground-source heat pumps)
- Alle Ginestre Capri, Italy (air-water heat pump for hot water, and air-air heat pump for HVAC).

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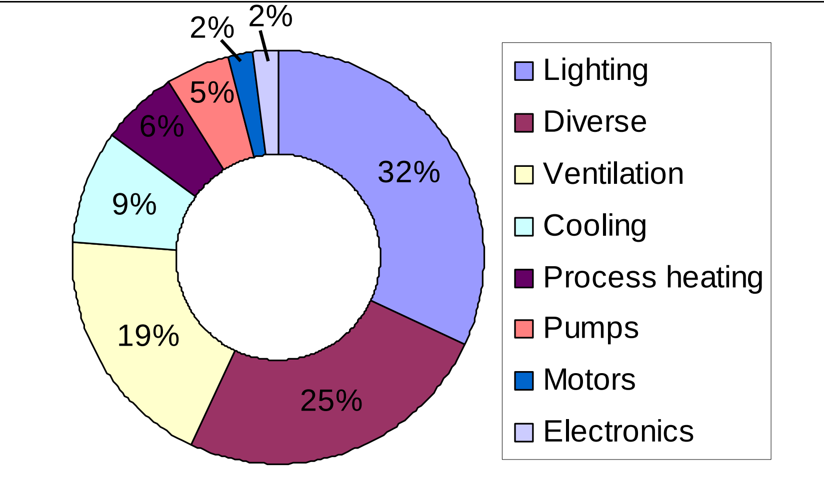
7.5 Efficient lighting and electrical equipment

Description

Lighting is the greatest single source of electricity consumption in accommodations, accounting for between 15 % and 45 % of hotel electricity consumption (Horesta, 2000; ITP, 2008; Leonardo Energy, 2008) (Figure 7.26). Typically, hotels can achieve substantial electricity and financial savings through the installation of modern lighting technology, good building design, and the implementation of intelligent lighting control. Inefficient lighting emits significant quantities of heat which can add significantly to building cooling demand in summer.



Source: Horesta (2000).

Figure 7.26: Electricity consumption in Danish hotels

Figure 7.27 presents modelled data for lighting electricity consumption across different areas of a 65-room luxury hotel using an inefficient traditional lighting system comprising incandescent, halogen and metal halide lamps and without intelligent lighting control. Electricity consumption for lighting in this case would equate to 831 216 kWh per year. Daily consumption is dominated by corridor lighting owing to 24-hour per day operation and high installed capacity of over 100 W/m^2 (representative of some luxury hotels). Permanent lighting in the small lobby area is the second largest draw of electricity, again owing to 24-hour operation and high installed capacity. Meanwhile, room space accounts for most of the heated and cooled areas in hotels, but are the third largest draw on electricity consumption for lighting owing to average use of approximately four hours per day in occupied rooms and an assumed occupancy rate of 80 %. Restaurant and outdoor areas account for significant portions of lighting demand. Outdoor lighting is described in more detail in section 9.2. Data for this hotel following installation of an optimised lighting system are presented in Figure 7.30 under 'Appropriate environmental indicators'.

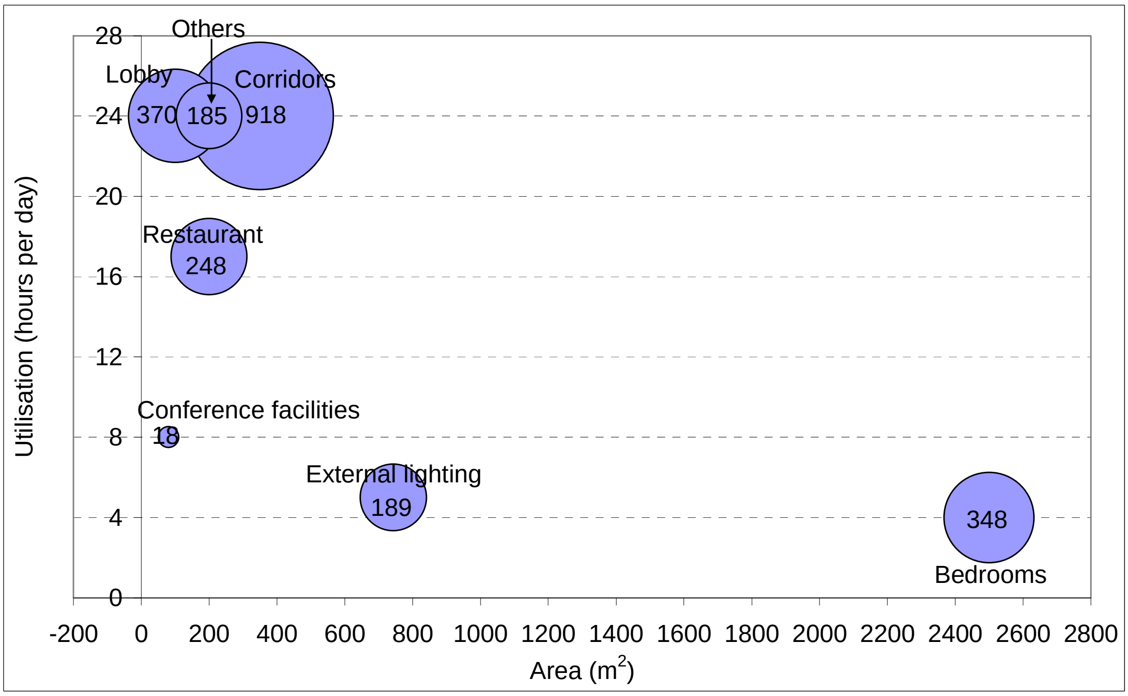


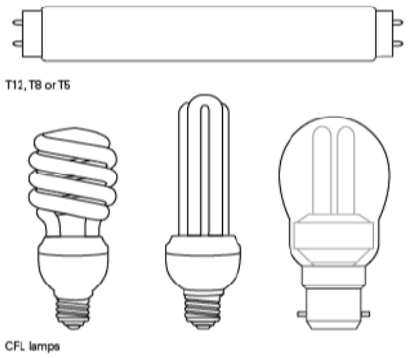
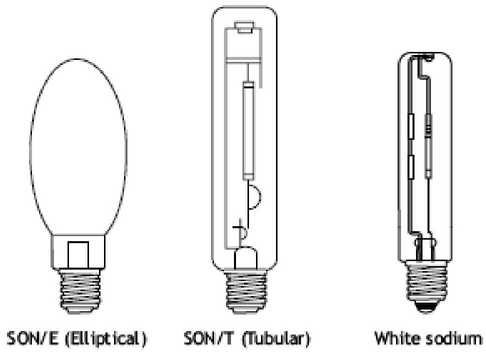
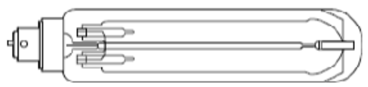
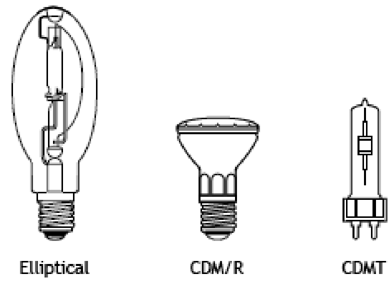
Figure 7.27: The total area, average utilisation rate (hours per day), and energy consumption in kWh per day (bubble size) for different areas in a 65 room hotel using traditional lighting

<u>Lamp types</u>
Incandescent lamps have a short lamp lifetime and poor energy efficiency owing to heat radiation in the infrared spectrum, and are consequently being phased out in the EU for most uses, to be replaced by more efficient lamps such as fluorescent lamps, high intensity discharge lamps and light-emitting diodes (LEDs). The main types of lamp suitable for replacing low efficiency incandescent lamps in accommodation are shown in Table 7.25 and Table 7.26, and are summarised below.

- **Gas discharge lamps** include a range of types, of which fluorescent tubes and compact fluorescent lamps (CFL) are the most common. CFLs can replace incandescent lamps directly. Fluorescent tubes that require specific luminaires containing the ballast and control gear. Advantages are that they are energy efficient, have a long lamp lifetime (approximately 8000 hours) and they are a mature technology. Disadvantages are that they make take awhile to warm up and produce maximum light output, they are difficult to dim, they have a low Colour Rendering Index (CRI) (see Table 7.27) compared with incandescent lighting, comparatively high production costs, ultraviolet light emissions and they contain hazardous materials (e.g. mercury).

- **Light-emitting diodes (LEDs)** are semiconductor diodes which convert electricity into light. Modern LEDs use a coating which creates a wave shift that enables white light from a single diode, and can be produced relatively cheaply compared with older LEDs. Advantages of LEDs are that they are energy efficient with low heat radiation, have a very long lamp lifetime, start instantly, produce directional light, they can be dimmed, they are safe to dispose of, and they do not produce ultraviolet or infrared emissions. Disadvantages of LEDs are that production costs are high, the technology is still under development, the CRI is lower CRI than incandescent lamps, and the directional light they produce is not always appropriate for ambient lighting.

Table 7.25: Appearance of different types of lamps

Compact fluorescent lamps	**High-pressure sodium lamps**
	
Low pressure sodium lamp	**Metal halide lamps**
	
Source: Carbon Trust (2010).	

Fluorescent lamps have both significantly higher lighting efficiencies and significantly longer lifetimes compared with incandescent lamps. LED technology ise developing rapidly, with high lighting efficiency, long lifetime and greater potential flexibility in colour temperatures. LEDs are already economical despite higher initial costs, and are expected to become the dominant lighting technology for buildings (EC, 2007).

Table 7.26: Specific properties of different types of lighting

Type	Optical spectrum	Nominal efficiency (lumen/W)	Lifetime (hours)	Colour temperature (Kelvin)	Colour	CRI
Incandescent	Continuous	12 – 17	1 000 – 2 500	2700	Warm white	100
Halogen	Continuous	16 – 23	3 000 – 6 000	3200	Warm white	100
Fluorescent	Mercury line + phosphor	52 – 100	8 000 – 20 000	2700 – 5000	White (tinge of green)	15 – 85
Metal halide	Quasi-continuous	50 – 115	6 000 – 20 000	3000 – 4500	Cold white	65 – 93
High-pressure sodium	Broadband	55 – 140	10 000 – 40 000	1800 – 2200	Pinkish orange	0 – 70
Low-pressure sodium	Narrow line	100 – 200	18 000 – 20 000	1800	Yellow, virtually no colour rendering	0
Sulphur	Continuous	80 – 110	15 000 – 20 000	6000	Pale green	79
LED (white)		40 – 100	>35 000 – >50 000	–	White, warm white	75 – 94
Source: Adapted from EC (2009).						

Building design

Optimised building design for lighting goes beyond the installation of energy efficient lamps. Glazed areas with appropriate shading devices may be used to minimise the need for artificial lighting during the daytime in rooms and many public areas. Sky lights may be installed where the climate is suitable, although care must be taken to ensure that energy consumed to compensate for additional heat loss does not exceed the electricity saved for lighting. Sky lights or similar horizontal glazing is not suitable for cold climates. See section 7.2 for more details on glazing within the building envelope. Careful positioning of indoor partitions can also optimise the penetration depth of natural light into the building.

The use of light materials and matt finishes in day-lit areas improves visual comfort, whilst the use of paints and finishes with high surface reflectance in all areas will maximise lighting effectiveness (ASRAE, 2009).

Intelligent lighting system

Design and implementation of an optimised lighting system incorporating intelligent control should include the following elements:

- identification of the specific lighting requirements according to the type of use for the particular space (i.e. zoning);
- selection of the most efficient lamps to deliver the lighting requirements for each zone;
- installation of lighting management control systems, including occupancy sensors, timers, photo sensors, to switch lighting off when not required;
- implementation of a maintenance programme that includes lamp cleaning and sensor testing to ensure optimum performance.

Efficient electrical equipment

The procurement of efficient electrical equipment, especially mini-bar refrigerated cabinets and television sets, can significantly reduce electricity demand. The highest 'A' rated appliances according to the EU Energy Label, or Energy Star labelled appliances, should be selected.

Anther important best practice measure with regard to lighting and room electrical equipment such as televisions is the installation of key-card controllers that cut off the electricity supply to all lighting and equipment when guests are not in the room.

Achieved environmental benefits

Reduced electricity consumption

Installation of low-energy lighting and efficient control systems can lead to considerable reductions in electricity consumption and associated upstream impacts associated with electricity generation – in particular air pollution, climate change and resource depletion. Typically, for every kWh of electricity saved, between 2 and 3 kWh of primary energy and over 0.5 kg CO_2 eq. is saved (DEFRA, 2011). Section 7.1 summarises the magnitiude of electricity savings achievable for a typical 100-room hotel.

Efficient lighting

The magnitude of electricity reductions from efficient lighting is demonstrated by three case studies.

One 65-room luxury hotel saves over 700 000 kWh per year through an efficient lighting system almost entirely comprised of LED and CFL lamps, compared with a reference scenario of traditional lighting (Figure 7.28).

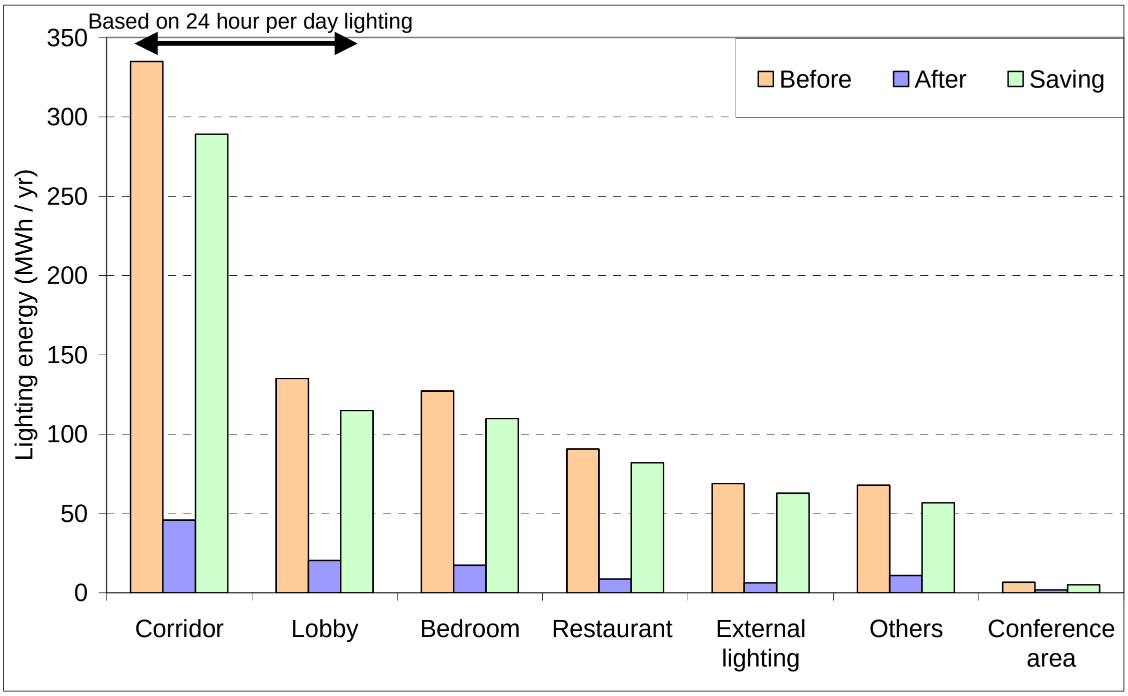
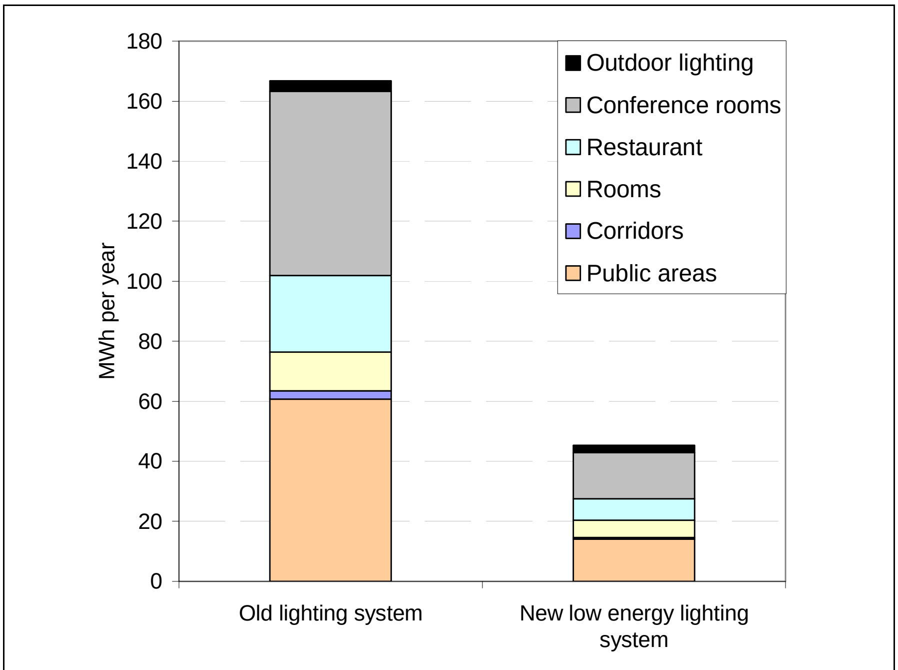


Figure 7.28: Electricity reductions achieved by installation of almost universal LED and CFL lighting in a 65-room hotel, compared with a reference scenario of incandescent, halogen and CFL lighting

Hotel Tomo is a three-star conference hotel in Riga, Latvia, with 170 rooms, 6 conference rooms, restaurant and bar services, with a serviced floor area of 6 911 m^2. A comprehensive light replacement programme reduced electricity use by 121 500 kWh per year, equivalent to 18 kWh/m^2yr. The greatest savings were made in the public areas, conference rooms, restaurant, and guest rooms (Figure 7.29).



Source: Based on data in Ekodoma (2007).

Figure 7.29: Estimated light energy use in different areas of the 170-room Tomo conference hotel in Riga, Latvia, before and after a comprehensive low-energy lighting retrofit

Extensive replacement of incandescent and halogen lamps with LED, CFL and E27 halogen lamps in the 293-room Prague Marriott Hotel resulted in an electricity saving of 404 MWh per year (58 % of lighting electricity), equivalent to approximately EUR 40 400 per year.

Intelligent control systems

Intelligent lighting control systems can considerably reduce lighting electricity demand. In the 65-room luxury hotel referred to above, corridor lighting still dominates lighting electricity demand after installation of low energy bulbs owing to 24-hour per day operation (Figure 7.28). Installation of sensor controls in corridors could reduce corridor lighting demand by 70 % and total lighting electricity demand by a further 33 %.

Installation of a key-card control system for room lighting in the Mövenpick Resort in Petra, Jordan, reduced total electricity consumption by 20 % (ITP, 2008).

Appropriate environmental indicators

Installed lighting type and capacity

For lighting, various technical performance indicators are relevant. For lamps, the appropriate indicator is lumens per watt energy input. To optimise installed lighting capacity and ensure that lighting is appropriate for the purpose, the illuminance measured in lux or lm/m^2 along with upper glare limit, UGR_L and the colour rendering index limit, R_a (Table 7.26) are relevant indicators.

Installed capacity, expressed in W/m^2, is an important indicator for design and the most easily measured indicator of potential lighting energy consumption. The lighting standard EN15193 provides reference values for a lower level of installed lighting capacity in hotels of 10 – 30 W/m^2.

Lighting control

Intelligent lighting control is reflected by the following indicators:

- percentage of public rooms with outdoor glazing with photo-sensor control of lighting
- percentage of guest rooms with occupation-controlled lighting (e.g. key-card control)
- installation of motion-sensor-activated, or timed push-button, lighting in corridors.

Best practice is for all rooms and corridor areas to have intelligent lighting control. For small enterprises where automatic lighting control in rooms may not be practical, the best practice is to install appropriately positioned signs reminding guests to switch off lights (as required in EU Flower criteria for accommodation: EC, 2009).

Lighting electricity consumption

The ideal final indicator of efficient lighting is electricity use (kWh) for lighting, expressed per m^2 serviced area per year. In many cases it will not be possible to calculate this indicator because lighting electricity consumption is not sub-metered. EN 15193 standard provides guidance for the calculation of annual energy consumption for lighting in individual zones based on installed capacity, average use frequency and time, and parasitic energy for standby lighting and lighting control systems. However, lighting energy efficiency will be reflected in total electricity consumption (below).

Figure 7.30 presents daily energy consumption across different hotel areas for a luxury 65-room hotel fitted with low energy LED and CFL lighting throughout. This translates into annual electricity consumption for lighting of 127 457 kWh per year, equivalent to 34 kWh/m^{2}yr throughout the hotel, and consistent with the proposed benchmark for total electricity consumption below. Installation of sensor-controlled lighting in the corridors could reduce lighting energy consumption further, to an average of 22 kWh/m^{2}yr. Assuming a gross floor area equivalent to 50 m^2 per room, lighting consumption in the Prague Marriott Hotel referred to above would equal less than 20 kWh/m^2yr.

Figure 7.30: Installed capacity and daily consumption (kWh, bubble size) of lighting in different areas of a 65-room five-star hotel implementing good practice

<u>Benchmark of excellence</u>

The data above support the following benchmark of excellence where specific lighting electricity consumption data are available:

BM: installed lighting capacity <10 W per m^2 or lighting electricity consumption <25 kWh/m^2yr (heated and cooled floor area).

However, the most comprehensive and easily calculated benchmark for lighting and electrical device efficiency is total annual electricity consumption expressed per area. Figure 7.31 displays electricity consumption per m^2 across a well performing mid-range hotel chain. Based on the tenth percentile of best performing hotels within this group, the following benchmark of excellence for electricity consumption is proposed:

BM: total electricity consumption ≤80 kWh m^2yr (heated and cooled floor area).

This benchmark is widely applicable to accommodation of different types and sizes, and is consistent with achievable electrical demand for lighting in a luxury hotel, as described above. However, this benchmark may not be achievable by accommodation with a high electricity demand for heating and cooling. For example, accommodation located in warm climates with a high (electrical) cooling demand will not be able to achieve this benchmark without also having a high quality building envelope (section 7.2) and optimised HVAC system (section 7.3). For such hotels, the benchmark of final energy consumption applies (section 7.1).

Both the benchmarks above are expressed per m^2 indoor heated and cooled area, but include electricity consumption for all processes, including lighting, in outdoor areas.

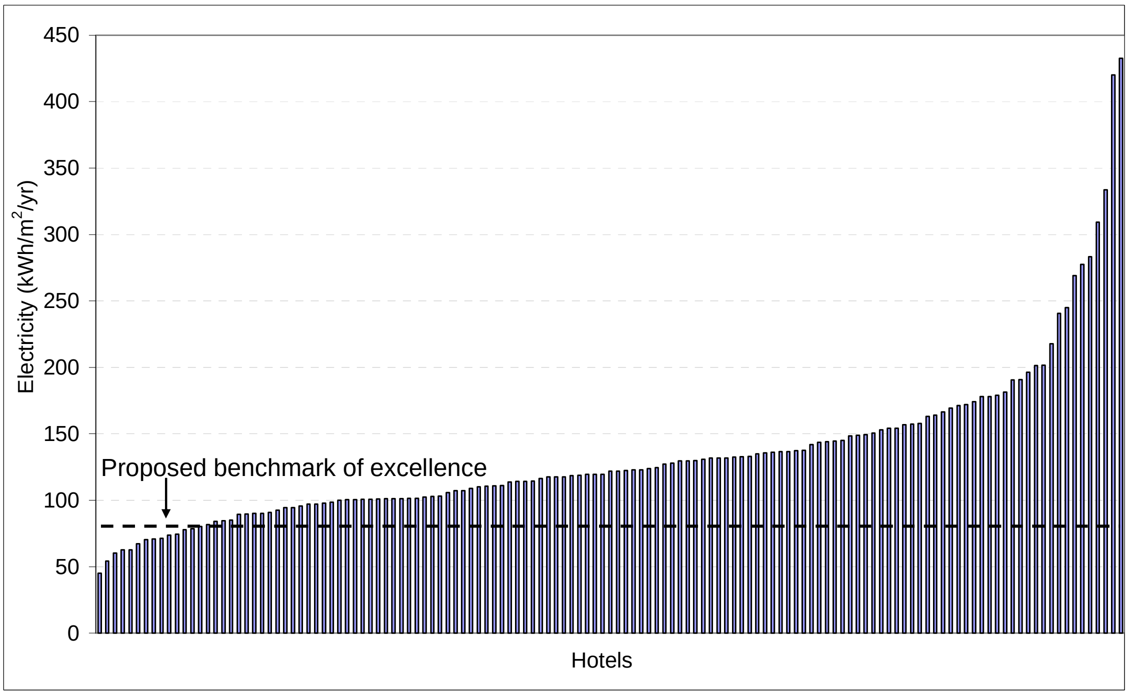


Figure 7.31: Electricity consumption per m^2 across a mid-range hotel chain, and proposed benchmark of excellence

Cross-media effects

Use of day-lighting should be considered carefully as it may have a significant impact on heating and cooling demand that can outweigh the benefits of reduced lighting energy. This must be considered at the design phase. Specifically, windows and skylights should be appropriately orientated and specified with low U-values and heat-reflective coatings (see section 7.2).

Efficient lighting generates less heat, which can increase the demand for heating in winter but reduce the demand for cooling in summer, and reduce the demand for cooling throughout the year for some rooms such as kitchens, storage rooms and busy conference rooms. Overall, energy savings from efficient lighting more than offset any additional winter heating requirements.

The major cross-media effect arising from the installation of low-energy lighting is the generation of hazardous waste arising from low-energy lamps, especially mercury-containing CFL lamps. Mercury content in fluorescent lamps can be reused, and the European Waste Electrical and Electronic Equipment (WEEE) Directive (EC, 2012) requires the collection and recycling of fluorescent lamps.

Lighting control systems that result in the frequent switching on and off of lamps may reduce lamp lifetime, especially for CFLs. For this reason, controlled halogen, and ideally LED, lamps may be better suited to areas such as corridors where lighting is required only intermittently.

Operational data

<u>Use of natural light</u>

Daylighting refers to the use of windows and skylights to bring sunlight into a building, reducing the need for artificial light, and depends on structural design features integrated during initial construction or during major renovation works. Glazing has a high heat-transfer coefficient (high U-values), and may result in excessive passive solar heating of indoor areas in sunny climates. Therefore, use of natural light should be considered carefully and integrated with optimisation of building envelope (section 7.2) and optimised HVAC systems (section 7.3). Further information on use of daylight is provided in the SRD for the building and construction sector (EC, 2012). Some main points are highlighted here.

The sizing and positioning of glazed areas should consider the cardinal directions, as referred to below.

- South-facing windows are advantageous for daylighting in cooler climates as they enable solar gain in winter, whilst solar gain in summer can be minimised through appropriate shading.
- North-facing windows provide relatively even, natural light, produce little glare, and almost no unwanted summer heat gain. They are therefore also advantageous for daylighting.
- East- and west-facing windows cause glare, admit a lot of heat during summer, and contribute little to solar heating during winter.

To realise the full advantage of natural light, it is important to account for natural lighting in system design and control. For example, lighting should be installed in separate circuits running parallel to natural light sources (e.g. windows), and these light circuits should be controlled separately according to natural lighting using photo-sensors and on-off or dimmer controls. The objective of the control is to minimise the utilisation of artificial lighting without dropping below the design levels or lighting requirements for the specific space.

<u>Lighting type and quantity</u>

Table 7.27 describes some important terminology and features of lighting. Some features of lighting, such as CRI and CT, have important implications for functionality and should be matched according to use. This may affect the choice of lighting technology. In accommodation buildings, such as hotels, lighting may be classified according to three primary purposes:

- ambient lighting provides general lighting for daily indoor activities and outdoors for safety and security;
- task lighting provides the lighting required for particular tasks that require more than ambient lighting, including in the kitchen, bed-side lamps, bathroom mirror lamps, etc.;
- accent lighting draws attention to specific features and enhances aesthetic qualities of an indoor or outdoor environment.

Table 7.27: Description of terms relating to important features of lighting

Term	Description
Colour Rendering Index (CRI)	The CRI refers to the colour rendering properties of the light in relation to sunlight (set to a value of 100). Lamps with a CRI above 80 are considered acceptable for most indoor applications. The CRI is particularly important where food is prepared and served.
Colour Temperature (CT)	The warmth (yellow-red) or coolness (blue-green) of a light source. Colour temperatures are measured in Kelvin, where higher Kelvin temperatures (3600 – 5500 K) are considered cool and lower colour temperatures (2700 – 3000 K) are considered warm. Cool light produces higher contrasts than warm light. Lamps with a high CT are preferred for visual tasks. Lamps with low CT are used in bathrooms.
Efficacy	The ratio of light produced to energy consumed measured in the lumens divided by the electrical consumption (lumens per watt).
Illuminance	The illuminance (E) indicates how much light – the luminous flux measured in lumens – from a light source falls on a given surface. It does not include reflectance and does therefore not give a precise measure of the brightness of the room.
Lumens	The luminosity provided by a light source.
Luminance	The brightness of a luminous or illuminated surface as perceived by the human eye measured in candelas per area.
Lux	The quantity of light incident on a surface, measured in lumens per square metre. Where 1lx = 1 lm/m^2
Maintained illuminance	The value below which the average illumination is not allowed to fall. Reduction in the luminous flux will occur due to dust particles and wear.
Reflectance	The reflectance indicates the percentage of luminous flux that is reflected by a surface.
Wattage	The wattage of a lamp indicates the number of electricity units in watts it burns per operating hour, e.g. a 100-watt bulb uses 100 watts per hour of operation.
Source: ITP (2008); Licht.de (2010); Winconsin University (2011).	

The zoning of the hotel according to lighting uses and the associated specific lighting requirements should be in compliance with relevant regulations. Lighting requirements for indoor and outdoor workplaces, including for restaurants and hotels, are specified in the EN 12464 standard (Table 7.28). The standard specifies lighting requirements according to task or activity in relation to: (i) maintained illuminance; (ii) upper limit for direct glare; (iii) lower limit for colour rendition index (CRI).

Table 7.28: Specific lighting requirements for indoor areas according to standard EN 12464

Zone or task	Maintained illuminance, E_m (lux)	Upper glare limit, UGR_L	Lower CRI limit, R_a	Recommended lighting density (W/m^2)	Comments
Entrance halls	100	22	80	11.8	
Lounges	200	22	80	-	
Reception	300	22	80	11.8	
Kitchen	500	22	80		Transition zone between kitchen and restaurant required.
Restaurant, dining room	-	-	80	-	Lighting should be designed to create the appropriate ambiance.
Self-service restaurant	200	22	80		
Buffet	300	22	80		
Conference rooms	500	19	80	11.8	Lighting should be controllable.
Corridors	100	25	80	5.4	During night-time lower levels are acceptable.
Guest rooms				8.0	
Offices				9.7	
Source: EN 12464; ASHRAE (2009).					

<u>Intelligent lighting control</u>
Lighting can be controlled intelligently by people or using an automated control system. Some lamps, such as fluorescent lamps, are not suited to frequent switching on and off owing to long warm-up times and an adverse effect on lamp lifetime. Therefore, the choice of lighting must be carefully considered alongside control options. For example, it may be more efficient to install sensor-controlled halogen lighting, rather than permanently on CFL lighting, in corridors – but the ideal would be controlled LED lighting. The most common types of lighting controls and typical applications in accommodation are described below.

- Dimmers provide variable indoor lighting and reduce the wattage and output of lamps to save energy. They increase the lifetime of incandescent lamps, but reduce the efficiency. Dimming fluorescent lamps requires special dimming ballasts and lamp holders, but in contrast to incandescent lamps it does not influence the efficiency. Dimmers may be installed in public areas, such as restaurants, or in bedrooms.

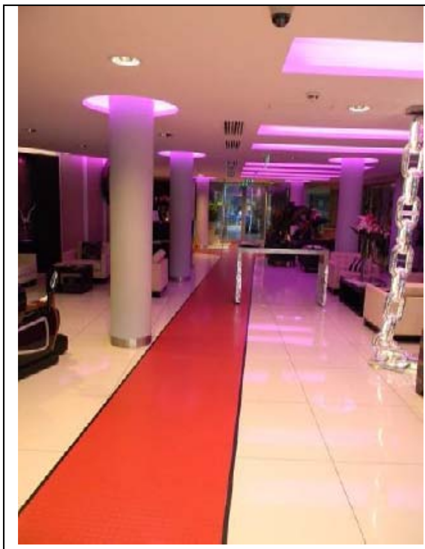
- Motion sensors automatically turn lighting on when motion is detected and turn them off after a preset time. They may be applied in corridors, public toilet and outdoor areas, but are not compatible with fluorescent lamps where the frequency of switching on and off is high. Occupancy sensors include key-card operated lighting, and are particularly useful to ensure bedroom lighting is switched off when the bedroom is unoccupied.

- Photo-sensors sense ambient (natural) lighting and can be used to switch artificial lighting on and off accordingly. They may be combined with dimmers in order to maximise the use of natural lighting. Photosensors are particularly useful in outdoor areas and indoor public spaces.

- Timers can be used to turn lighting on or off at a specified time each day, or in response to manual control. They may be combined with other forms of control, such as motion- or photo-sensors, or simply activated by a switch. They are particularly useful for outdoor areas where lighting may be required for e.g. a few hours after dusk.

Outdoor lighting

Low energy LED lighting is increasingly used for decorative indoor and outdoor lighting. LED technology is available in outdoor spotlights, and is well suited to colour applications often used in accommodation. A few visual examples are presented in Figure 7.32, below.



Source: Rafayel Hotel (2011).

Source: Chylighting (2012).

Figure 7.32: LED feature lighting in the reception of a luxury hotel, and on a building exterior

It is important that installation and control of outdoor lighting avoids light pollution, for example through ensuring appropriate capacity, direction and colour during installation, and appropriate timing control during operation. More information on avoidance of light pollution is provided in section 9.2.

Maintenance

Regular maintenance is important to maintain lighting efficiency. Illuminance levels decrease over time as a result of lamp aging and collection of dust on fixtures, lamps, and lenses. This can reduce the total illumination by 50 % or more while electricity draw remains the same. The following general advice on maintenance programmes will help to ensure that lighting systems operate at optimum efficiency:

– clean fixtures, lamps, and lenses periodically (e.g. every 6 months) especially in areas where grease, lint, dust, humidity, and insects can obscure the surface;

– replace lenses if they appear yellow;

– use light colours on walls, ceilings, window frames and lampshades, and clean and repaint periodically to maximise light reflectance.

Green procurement

Accor (2007) propose the following criteria for efficient mini-bars:

– glass doors, energy consumption less than 1 kWh per day

– solid doors, energy consumption less than 0.8 kWh per day.

The Accor criterion for for mini-bars with solid doors corresponds with ASHRAE (2009) who propose all new mini-bars should have an average power draw of less than 33 W. Meanwhile, Scandic (2003) require television sets to have a maximum consumption of 5 W in standby mode.

Crieria for award of maximum points under the Nordic Swan ecolabel for hotels and hostels include:

- at least 90 % of the television sets have a passive standby setting of maximum 1 W, and if applicable, an active standby setting of maximum 9 W;
- At least 90 % of minibars consume no more than 0.8 kWh per day.

Applicability
These measures are relevant to all serviced accommodation, including luxury establishments. The installation of features to utilise natural lighting is possible during initial design and major refurbishment.

CFL lamps can be fitted in incandescent lamp fittings, and LED lamps can be fitted in halogen lamp fittings, at any time. In some cases, low-energy lamps, particularly LEDs, may require new light fittings in which case it may be more economic to replace them during planned renovations.

Economics
Building design
Use of natural lighting must be considered at the design phase for new-build and renovated premises. The investment cost and payback period is highly dependent on the specific design. Any additional investment costs (e.g. for windows or sky-lights) should be balanced against reduced lighting costs, and the considered alongside any effect on heating/cooling costs.

Low energy fittings
Higher purchase costs for low-energy lamps have a relatively short payback period through reduced electricity and replacement lamp costs. The net saving over the lifetime of low-energy lamps is seven to nine times their purchase price (Table 7.29).

Table 7.29: Lifecycle costs for low energy LED and CFL lamps, compared with conventional equivalents, calculated over the lifetimes of the low-energy lamps (40 000 and 8 000 hours, respectively)

	50 W halogen	7 W LED	75 W incan -descent	20 W CFL
Lamp lifetime (hours)	3 500	40 000	1 300	8 000
Lamp cost (EUR)	1.5	20	0.5	6
Energy consumption (kWh lamp lifetime)	2 000	280	600	160
Energy cost (at €0.10 / kWh)	200	28	60	16
Replacement lamps	11	0	6	0
Replacement lamp costs(*) (EUR)	16.5	0	5.5	0
Total cost over low-energy lamp lifetime	218	48	66	22
Net saving per lamp (EUR)		**170**		**44**

(*)Excludes labour costs

Source: TUI (2011).

Payback period and net financial savings are highly sensitive to electricity price (Figure 7.33). The payback period for a 7 W LED lamp costing EUR 20, versus a 50 W halogen lamp costing EUR 1.50, varies from 1 800 hours of operation at an electricity price of EUR 0.25 per kWh to 5 700 hours at EUR 0.07 per kWh (approximately 5 to 16 months if operating 12 hours per day). Financial savings over the LED lamp lifetime range from EUR 118 to 428.

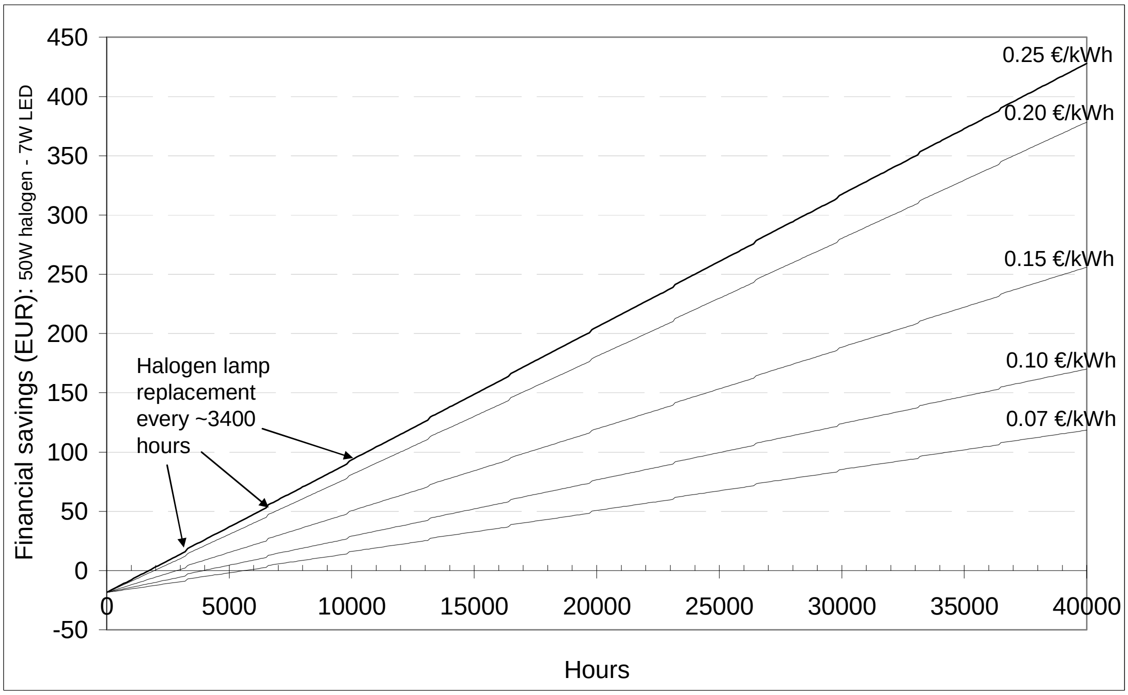


Figure 7.33: Financial cost savings over the 40 000-hour LED lamp lifetime, compared with 50 W halogen lamps, at different electricity prices

<u>Intelligent control systems</u>
Electricity and lighting control devices in rooms and corridors can achieve a similar magnitude of savings, and relatively short payback periods, by considerably reducing the hours of lamp operation. Two examples are illustrated below.

- Installation of sensor-control in the reference 65-room luxury hotel referred to above would result in an annual saving of EUR 4 240 in electricity alone, at an electricity price of EUR 0.10/kWh.
- Installation of a key-card control system in rooms at the Mövenpick Resort Petra cost EUR 13 200, but resulted in an annual saving of EUR 39 000 and a payback time of just four months (ITP, 2008).

<u>Hotel energy and maintenance savings</u>
Previously referred to examples indicate the magnitude of operational cost savings possible from the installation of low energy lighting throughout a hotel. The Tomo Hotel in Latvia achieved an estimated annual reduction of 73 % in lighting electricity, equivalent to over EUR 12 500 per year at an electricity price of EUR 0.10/kWh. The Prague Marriott Hotel reduced electricity use by 404 MWh/year, equivalent to approximately EUR 44 000 per year.

As indicated in Table 7.29, savings associated with less frequent lamp replacement are also significant, and can be larger than electricity savings. An energy audit of the reference luxury 65-room hotel estimated annual savings from reduced electricity consumption (at a price of EUR 0.10/kWh) and maintenance of EUR 50 000 and EUR 70 000, respectively, totalling over EUR 120 000 per year in savings (Figure 7.34).

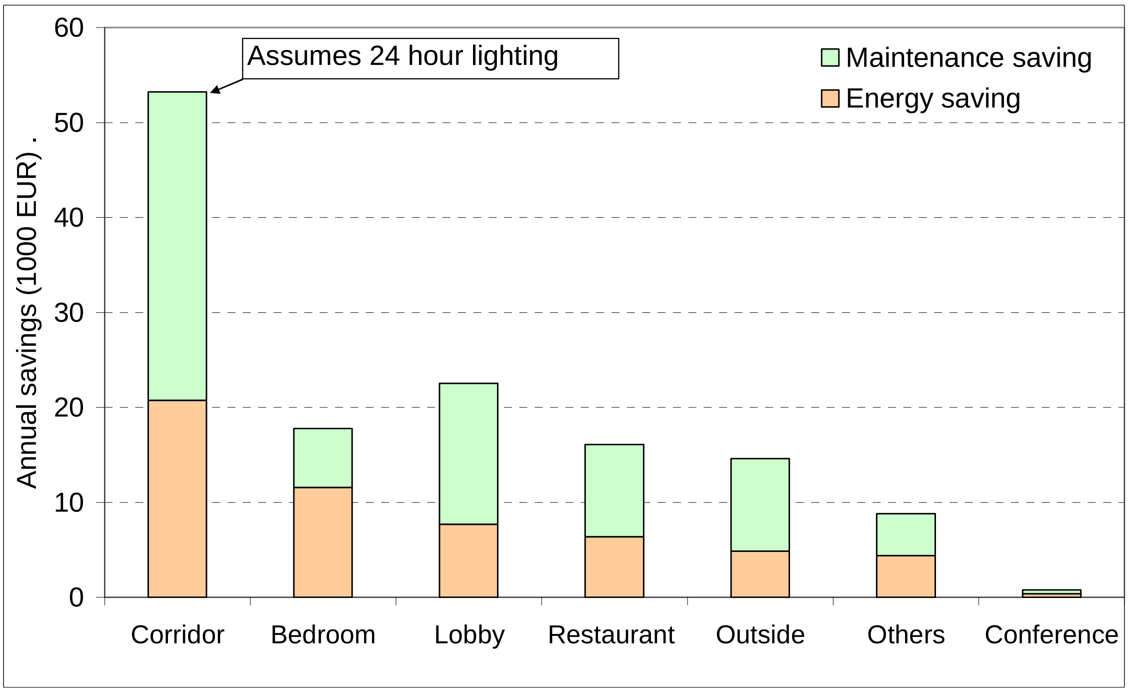


Figure 7.34: Annualised financial savings associated with reduced energy consumption and lower maintenance requirements arising from extensive installation of LED and CFL lighting in a 65-room hotel, compared with a reference scenario of incandescent, halogen and CFL lighting

Driving force for implementation

Installation of efficient lighting systems can improve the quality of lighting whilst reducing operating costs. It is also a visible example of efficient and environmentally-friendly hotel management. The main driving forces can be summarised as:

- reduced energy consumption and costs
- reduced maintenance costs by switching to lighting technology with longer lifetime
- well being of guests and staff (improved lighting quality)
- environmental credentials and CSR (reduced CO_2 emissions)
- rapid development of new lighting technology, especially LEDs.

In addition, European legislation requiring the phase-out of incandescent lamps for most uses is a powerful driving force behind the change in lighting technology to more energy efficient types such as fluorescent and LED lighting technologies.

Reference organisations

Marriott Hotel Prague, Rafayel Hotel London, Scandic Hotel Berlin, Tomo Hotel, Latvia

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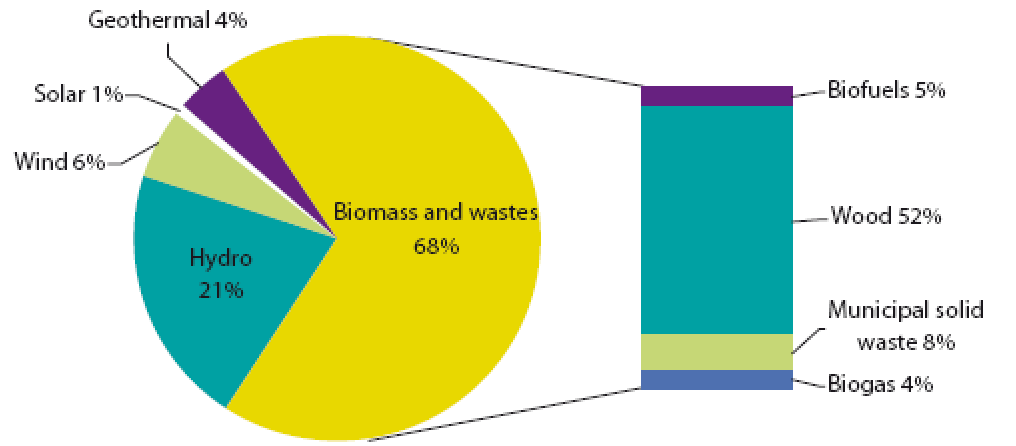
7.6 Renewable energy sources

Description

After implementation of measures to reduce energy demand, further reductions in primary energy consumption and associated environmental benefits can be achieved through measures to increase the supply of renewable energy (RE). Most currently exploited energy sources ultimately originate from solar energy. In the first instance, passive use of solar energy for heating through good building design (passive gain through south facing windows in cold climates) is the first important best practice measure (section 7.2). Active utilisation of RE sources exploits energy carriers that do not necessitate the depletion of finite reserves, and that do not release carbon sequestered in fossil resources to the atmosphere where it contributes to climate change.

The Renewables Directive (2009/28/EC) establishes mandatory national targets for RE shares consistent with at least a 20 % of energy from renewable sources across the EU in 2020. Member States must demonstrate implementation of national RE action plans. This target requires rapid expansion in RE generation from the 1 481 882 GWh produced in the EU-27 in 2006, representing 7 % of final consumption. Latest available data from Eurostat indicate that RE production rose to 1 643 726 GWh in 2010. Figure 7.35 displays the breakdown of EU-27 RE production in 2006. Biomass and wastes, specifically wood, dominate RE production, reflecting the compatibility of bioenergy with traditional energy conversion processes (i.e. supply and combustion of solid fuels).



Source: Eurostat (2009).

Figure 7.35: Contribution of specified sources to total primary RE production in the EU-27

Table 7.30 summarises the main best practice RE options for accommodation. Heat pumps and geothermal systems utilise renewable aerothermal, hydrothermal and geothermal energy but require significant amounts of conventional energy (typically electricity) to operate, and are described separately in section 7.4 as options to reduce energy demand. Less widely applicable and emerging options not referred to in Table 7.30 include heat and electricity generation from biogas, and hydro-power. On-site production of biogas is an emerging option for accommodation enterprises that generate large quantities of organic waste, but only represents best practice where the organic waste cannot be sent to centralised biogas plants (see section 8.2). Considering the limited availability of biogas as a sustainable transport fuel, use for decentralised building heating or electricity generation is not considered best practice. Generation of electricity from small hydro-plants situated on adjacent streams or rivers is a best practice option for a small number of appropriately sited accommodation enterprises. An overview of the main RE technologies is provided below.

Table 7.30: Descriptions and applicability of major best practice RE options for accommodation

RE technology	Best practice description	Applicability
Off-site RE	Where it is not efficient to exploit RE directly on site, the preferred best practice measure is for accommodation enterprises to invest in RE schemes to install a RE generating capacity equivalent to that which would be required to supply on-site demand. An alternative, less rigorous, best practice measure is for accommodations to purchase 'green' electricity that can be traced to a specific renewable source that is not accounted for in national average (emission) factors for grid-supplied electricity as per GHG accounting guidelines provided by BSI (2011).	All accommodation providers.
Biomass heating	The main source of biomass heating is wood or pellet boilers that may be used to heat water feeding DHW and HVAC systems. The use of gasifying boilers fed by logs also represents best practice, and is described in section 9.2 for campsites. Best practice operation of wood boilers involves continuous operation at partial load wherever possible, in order to minimise emissions to air.	Any accommodation, but best suited to non-urban areas with a local wood supply and where combustion emissions pose a lower health risk.
Solar thermal	Flat plate or evacuated tube solar collectors can be placed on accommodation building roofs or in adjacent areas to heat DHW. Solar thermal water heating is particularly well suited to accommodation premises where occupancy and peak DHW demand occurs in summer, coinciding with peak solar irradiance.	Any building with suitable exposure to the sun, including at mid- to high-latitudes and in cloudy climates. Potential contribution to DHW heating is limited for large urban buildings.
Solar photovoltaic	Solar photovoltaic cells can be installed on or integrated with the building envelope – in particular roofs, exterior walls and shading devices – to generate electricity. Generated electricity may be used for on-site processes or fed into the grid in order to avail of feed-in tariffs for solar electricity.	Any building with suitable exposure to the sun (i.e. not shaded). More effective at lower latitudes and in sunny climates, but most cost-effective where high solar feed-in tariffs are available (e.g. Germany).
Wind turbines	Building-mounted wind turbines with a capacity of 1 – 6 kW are an emerging technology with low electricity outputs and typically poor return on investment compared with alternative RE options. Therefore, best practice is to install on-site free-standing turbines of tens to hundreds of kW capacity where space and wind conditions allow, or to invest in offsite large wind turbines of MWs capacity.	Best practice installation of larger turbines is restricted to accommodations in open (e.g. rural or coastal) areas. However, wind turbines are a good option for green electricity investment by all accommodation enterprises (see above).

Biomass heat

The most relevant source of biomass heat for accommodations is wood, and the most efficient conversion pathway is through direct combustion of wood chips or wood pellets in boilers, or combustion of larger wood pieces in gasifying wood boilers (application of a gasifying wood boiler is described in section 9.3).

Pellet boilers are highly automated and are well suited to meeting variable load demands. They are typically rated from 8 – 500 kW (Carbon Trust, 2008) and achieve efficiencies of 85 – 90 %. Pollutant emissions are lower than for other types of wood boiler owing to precise control of feed rates and combustion air possible with automated systems and homogenous pellet composition, so that pellet boilers represent state-of-the-art for solid biomass combustion alongside gasifying boilers. The buffer capacity of DHW storage tanks facilitate continuous operation at maximum combustion efficiency with minimum emissions.

Wood chip boilers work on the same principle as pellet boilers, with automated control of chip feed supply. Whilst boiler operation is similar to pellet boilers, the average heating value and homogeneity of wood chips is lower than for pellets, resulting in more variable performance and slightly lower efficiency. Wood chip boilers usually incorporate a fuel stoking system whilst pellet boilers use a simpler pellet metering system, and are better suited to larger applications of 30 – 10 000 kW capacity (Carbon Trust, 2008). Wood chips are often available at lower cost than pellets, per MJ energy content, owing to lower processing requirements.

Solar thermal

Solar thermal collectors absorb energy from solar radiation and transfer it to heat water via heat exchangers. Solar collectors are well suited for installation on accommodation roofs with orientation from 90 º to 270 º from north (180 º – due south – is optimum), and peak output in summer months may coincide with peak occupancy and therefore DHW demand in many accommodation enterprises. There are two main types of solar collector:

- flat plate collectors that can be built into the roof, transferring 50 % received incident radiation into heat
- evacuated tube collectors that must be mounted on top of the roof, transferring 60 % of received incident radiation into heat.

Thus evacuated tube collectors produce approximately 20 % more heating energy than flat plate collectors per m^2 of aperture (light entry) area, but actual output is highly site specific. Accor (2007) suggest that solar collectors can easily cover 40 % of hotel hot water demand.

Solar photovoltaic

Solar photovoltaic (PV) cells are made from layers of semi-conducting materials that generate a direct current when exposed to light. Solar PV installation has been growing exponentially since the late 1990s, and reached 15.6 GWp installed capacity by 2008, 60 % of which was in Europe (EPIA, 2009). Currently, 90 % of PV cells are made by slicing or growing crystalline silicon, whilst the remaining 10 % are made using film technology that involves depositing thin layers of photosensitive materials onto backing materials such as glass, stainless steel or plastic. Solar PV cell performance is measured according to the percentage of solar energy striking its surface converted into electricity. A typical commercial solar cell has an efficiency of approximately 15 %, and the main barrier to increased PV uptake has been capital cost per kW output capacity. Emerging technologies include concentrated PV cells that use concentrating collectors to increase the output of the expensive semiconducting PV material, and flexible cells derived from film technology (EPIA, 2011).

Wind

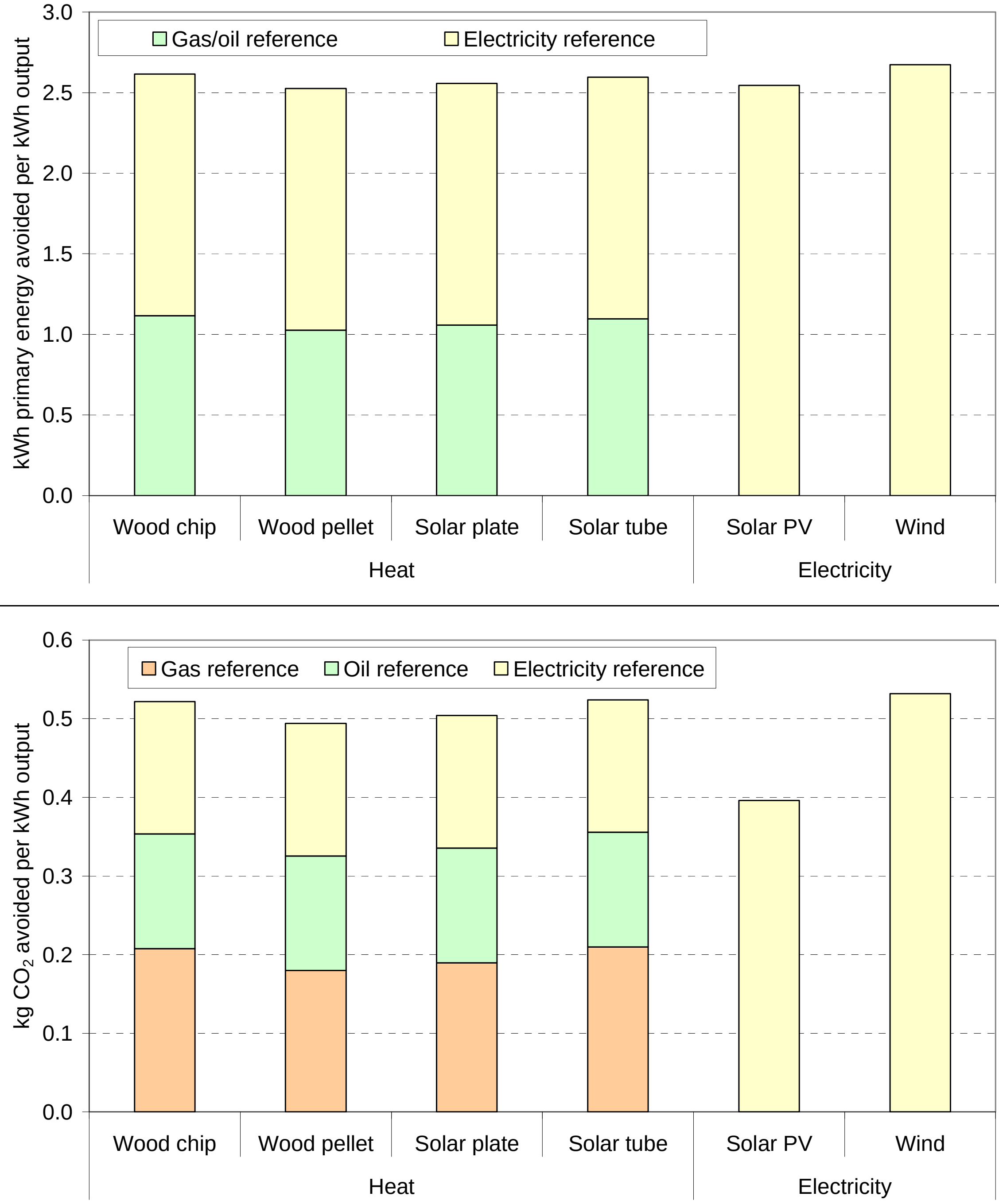
Wind turbines convert the linear motion of air in wind currents to rotary motion in order to drive electricity generators, usually via large rotors (impellors). Wind turbines range in capacity from small units with peak rated output of less than 1 kW to stand-alone units with a peak rated output of 7.5 MW and 130 m diameter rotors. The main limiting factors for larger wind turbines are the availability of sufficient space and sufficient wind speed. Turbines operate from wind speeds of around 4 m/s, but work best in locations with mean wind speeds of 7m/s or higher (Carbon Trust, 2008).

Achieved environmental benefit

Technology specific GHG avoidance

Figure 7.36 displays primary energy and GHG emission avoidance per kWh useful heat and electricity output for different RE options. Compared with conventional heating and electricity options, RE technologies reduce GHG emissions by between 76 % (solar PV) and 97 % (wind turbines). Thus, the type of energy displaced has a greater influence on primary energy and GHG emission avoidance than the type of RE option applied.

For example, displacing inefficient direct electric resistance heating with a wood-chip boiler results in a GHG saving of 0.52 kg CO_2 eq. compared with a saving of 0.21 kg CO_2 eq. When natural gas heating is the reference. Primary energy savings range from 1.03 kWh per kWh heat delivered for wood pellet heating replacing gas heating, to 2.67 kWh per kWh electricity delivered for wind turbines replacing grid electricity.

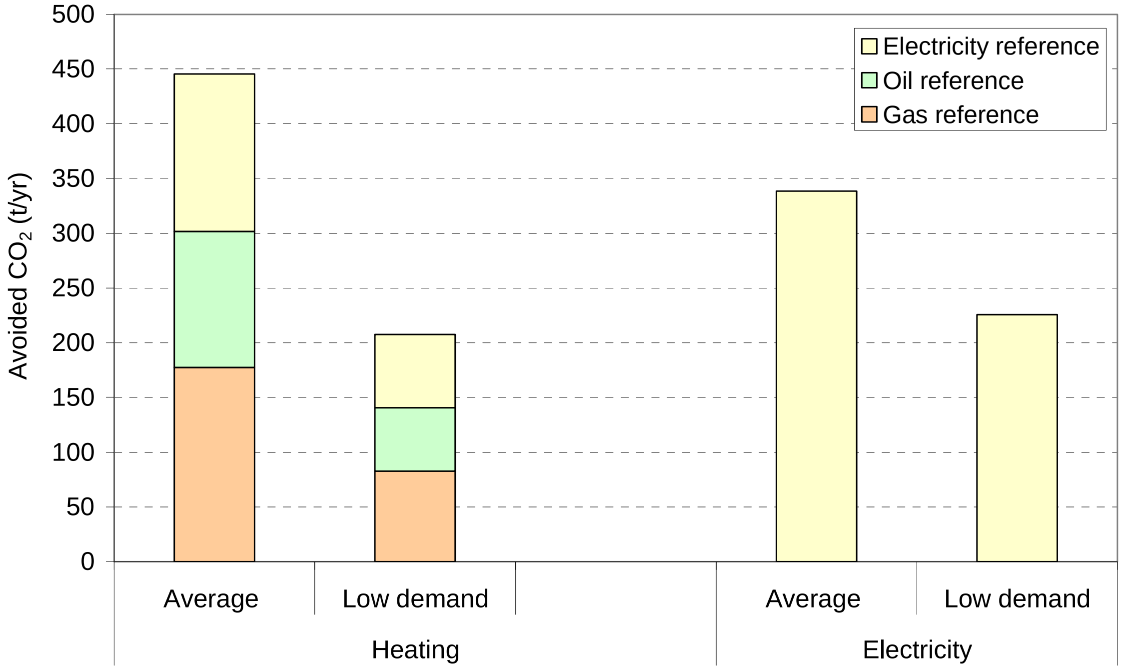


NB: Avoided primary energy and GHG emissions are calculated relative to gas heating, oil heating, electric resistance heating and average grid electricity supply. Assume 90 % boiler efficiency and 5 % additional emissions from boiler manufacture and maintenance.

Figure 7.36: Lifecycle avoided primary energy consumption (above) and GHG emissions (below) per kWh useful heat or electricity generated by different RE technologies, relative to conventional reference heating and electricity options

<u>Accommodation GHG avoidance</u>

Figure 7.37 provides an example of maximum GHG avoidance achievable through use of RE to provide 100 % of HVAC (wood chip boiler) and 100 % of electricity (wind turbine) demands for a 100-room hotel with average energy demand and best performance energy demand. Maximum GHG avoidance for a 100-room average hotel ranges from 516 to 784 t CO_2 per year, whilst maximum GHG avoidance for a low energy demand hotel implementing best practice ranges from 308 to 433 t CO_2 per year.



NB: Average and low HVAC demand of 161 and 75 kWh/m²yr respectively; average and low electricity demand of 120 and 80 kWh/m²yr respectively; 5 300 m² indoor floor area.

Figure 7.37: Maximum annual GHG avoidance possible for a 100-room hotel by substituting 100 % gas, oil or electric HVAC heating with wood heating, and 100 % grid electricity with wind electricity

Table 7.31 provides some less ambitious, and in the short term more realistic, examples of achievable GHG avoidance through implementation of different RE options for a 100-room hotel, again assuming average and low energy demand. Wood heating and (off site) wind electricity generation offer the largest realistic savings potentials, with smaller but significant savings achievable by installing solar collectors for DHW heating.

Table 7.31: Achievable annual GHG avoidance scenarios for RE installation in a 100-room hotel

Scenario	RE technology	Reference option	Avoidance (t CO_2/yr)	
			Low demand	Average demand
HVAC 50 %	Wood chip boiler	Gas boiler	41	89
HVAC 100 %		Oil boiler	141	302
Electricity 20 %	Solar PV (on site)	Grid electricity	34	50
Electricity 100 %	Wind (off site)		226	338
DHW 20 %	Solar evac. tube	Gas boiler	6	11
DHW 50 %		Electric heating	35	69

NB: Low and average HVAC demand of 75 and 161 kWh/m²yr; low and average electricity demand of 80 and 120 kWh/m²yr; low and average DHW demand of 25 and 50 kWh/m²yr.

Appropriate environmental indicator

Off-site RE

The most direct and verifiable way to invest in off-site RE is to do so directly by contributing to RE schemes. The annual generating capacity of off-site renewable installations directly supported by the accommodation's investment may be considered equivalent to on-site renewable generation.

Attributing additionality to purchased 'renewable' electricity is a complex task for which a European methodology is being developed (EPED, 2012). According to the UK Publicly Available Specification (PAS) 2050 for the calculation of GHG emissions of goods and services (BSI, 2011), off-site RE generation can only be considered valid if the following conditions can be demonstrated:

- off-site energy generation is of the same form (e.g. heat or electricity) as that used on-site
- the generated RE has not been accounted for as RE consumption by another process or organisation and is excluded from the national average emission factor for electricity generation.

The PAS 2050 specification is primarily concerned with avoiding double accounting of RE consumption. However, the requirement for traceability and exclusive accounting of RE consumption provides a useful indication of additionality. Another potential indicator is that purchased RE should originate from new capacity, installed within the past e.g. two years.

Therefore, where accommodation enterprises can trace purchased RE to specific generation in accordance with the above conditions, such energy may be regarded as genuine purchased RE (see the second benchmark, below).

RE performance

The energy performance of RE technologies can be expressed as primary energy ratios (PERs), and compared with PERs for conventional energy sources (Table 7.4 in section 7.1) and for heat pump heating (Table 7.18 in section 7.4).

Lifecycle GHG emissions, expressed per kWh heat or electricity produced, is another environmental indicator of RE performance that is useful for sustainability reporting. Table 7.32 presents default PER and lifecycle CO_2 burdens for different RE technologies, taken from the GEMIS LCA database.

Table 7.32: Primary energy ratios and lifecycle GHG burdens per kWh_{th} or kWh_e delivered energy for different RE technologies from the GEMIS lifecycle assessment database

Technology / energy carrier	PER	CO_2eq./kWh
Wood chip boiler	0.08	0.028
Wood pellet boiler	0.18	0.056
Flat plate solar collector	0.14	0.046
Vacuum tube solar collector	0.10	0.026
Solar PV	0.48	0.154
Wind turbine	0.03	0.018
Source: GEMIS (2005).		

Energy content of wood fuel

In order to calculate on-site energy consumption, and to compare the price per unit energy of delivered fuel, information on the moisture content of wood fuel delivered for heating should be known as this is the primary factor affecting the net calorific value energy content of wood (dry value of 18 MJ/kg). This information can be provided by suppliers, and should be certified for relatively homogenous and standardised pellets. Table 7.33 provides indicative values for different wood fuel types.

Table 7.33: Typical moisture and energy contents of supplied wood fuel

	Dried logs	Dried wood chip	Wood pellet
Moisture content (% wet weight)	20 – 25	20 – 30	5 – 12
Energy content (kWh/kg)	3 – 4	2.5 – 3.5	4.8 – 5
Source: Carbon Trust (2008).			

Accounting for RE use by heat pumps

According to the Renewable Energy Directive (2009/28/EC), aerothermal, geothermal or hydrothermal energy captured by heat pumps can be considered renewable and calculated according to the following formula:

$$RE = Q_{final} \times (1 - 1/SPF)$$

Where Q_{final} is the final useful energy delivered by the heat pumps and SPF is the estimated average seasonal performance factor (HSPF for heating and SEER for cooling in section 7.4).

NB: Only heat pumps for which $SPF > 1.15 \times 1/\eta$ shall be taken into account, where η is the ratio between gross electricity generation and the primary energy consumption for electricity generation according to the EU average taken from Eurostat.

Renewable energy captured by heat pumps may be included in the share of RE used by accommodation, where total final energy consumption is recalculated to include the final energy delivered by the heat pump (Q_{final} above). Q_{final} may be estimated by multiplying energy consumed by the heat pump by the SPF calculated by the suppliers or installers. It is important to note that final energy consumption calculated in this way for accommodation premises using heat pumps will be considerably higher than final energy consumption calculated as the sum of on-site fuel and electricity consumption.

Benchmark of excellence

There are no extensive data on shares of RE across accommodation enterprises, but there are some examples of high shares, especially where geothermal systems are used. Renewable energy shares may be high where onsite energy consumption is minimised. Considering these factors, the following benchmark of excellence is proposed:

BM: the equivalent of 50 % of the accommodation's annual energy consumption is generated by on-site renewable sources, or by verifiably additional off-site RE sources.

An alternative benchmark of excellence where electricity flows can be accounted for at the necessary level of disaggregation is:

BM: 100 % of electricity is from traceable renewable electricity sources not already accounted for by another organisation or in the national electricity average generating mix, or that is less than two years old.

Cross-media effects
The main cross-media effects and options to mitigate them are summarised for each main RE technology in Table 7.34 below.

Table 7.34: Cross-media effects for different RE options

Technology	Cross-media effects	Mitigation options
Wood boilers	Wood burning emits CO, NO_x, hydrocarbons, particles and soot to air and produces bottom ash for disposal. These substances indicate incomplete combustion performance, and occur especially during start-up, shutdown and load variation. Wood chip boilers typically emit slightly more polluting gases than pellet boilers owing to lower fuel homogeneity, but emissions are low compared with other solid fuel boilers.	CO, hydrocarbons, soot and black carbon particles can be reduced by using continuously operating wood chip or wood pellet boilers.
Solar thermal	Production of solar thermal collectors requires energy and materials, and emits gases such as CO_2. The energy embodied in solar thermal cells is typically paid back within two to three years of operation depending on site-specific application, so that energy produced over the remaining ~20 years operating lifetime creates a large positive balance.	Maximise output through optimised siting and installation (e.g. south orientation), and ensuring long operational lifetime.
Solar PV	As with solar collectors, production of solar PV cells requires energy and materials and emits gases. Owing to lower conversion efficiencies and more complex production methods, energy payback times are estimated at three to four years by against 30-year operating lifetimes (US NREL, 2004). It is expected that energy payback times will be reduce to approximately one year with anticipated thin-film technology.	As above.
Wind turbines	Embodied energy in wind turbines typically represents less than one year's electricity output over typical operating lifetimes of 20 years.	Maximise output through appropriate siting (e.g. in areas of high and consistent wind speeds).

Operational data
Biomass heating

Wood fuel supplies can vary significantly from one location to another in terms of reliability and cost. Before installing a wood boiler, it is essential to ascertain the local availability, reliability and price of wood fuel. Owing to the lower energy density of wood fuel compared with oil, wood boilers require relatively large fuel storage areas for the chips or pellets, usually at ground or below ground level. Operational measures to reduce operating emissions from wood boilers are described below.

Combustion efficiency in wood boilers is optimised through air staging (splitting the combustion air into a primary air flow directly to the flame and a secondary air flow in direction of the combustion gases) to avoid excess oxygen in the combustion zone and ensure sufficient oxygen above the combustion zone. Secondary air injection increases the low-temperature outer-flame volume to ensure full oxidisation of hydrocarbons, black carbon and carbon monoxide following combustion.

Boilers connected to small hot water storage tanks operate under variable load conditions throughout the day, thereby producing relatively large quantities of partially oxidised compounds. Air and fuel feeding systems can ensure optimised combustion performance at loads of between 50 – 100 %. The installation of large hot water storage tanks can enable wood boilers to operate for longer periods at peak or close to peak load, and reduce the number of start-ups and shut downs during the day, thereby reducing emissions. Some important information related to wood boilers contained in the SRD for the buildings and contruction sector (EC, 2012) is summarised below.

The EN-standard for automatic biomass boilers with nominal heat output of 50 to 150 kW (EN 303-5) establishes the emission limits shown in Table 7.35 for pellet boiler class types 1 (worst) to 3 (best).

Table 7.35: EN 303-5 test stand emission limit values for pellet boilers

	Class 1	Class 3
Energy efficiency (NCV)	67 + 6 log (Q_N)	47 + 6 log (Q_N)
CO emissions (mg/Nm³)	12,500	2,500
PM emissions (mg/Nm³)	200	150
Organic compounds emissions (mg/Nm³)	1,250	80
Source: EC (2009).		

Meanwhile, a preparatory study for solid fuel combustion under the Eco-design Directive (EC, 2009) proposes best performance emission parameters for wood pellet and wood chip boilers that may be used to guide selection of the most environmentally friendly boilers during procurement (Table 7.36).

Table 7.36: EcoDesign performance indicators for pellet boilers and combined pellet/wood-chip boilers

	Pellet	Wood Chip
Energy efficiency (NCV)	94 %	92 %
CO emissions (mg/Nm³)	30	30
PM emissions (mg/Nm³)	10	20
NO_x emissions (mg/Nm³)	90	90
Organic compounds emissions (mg/Nm³)	1.5	1.5
NB: reference O_2 content: 13 % vol.. *Source*: EC (2009).		

Studies have shown that optimising the combustion process can almost completely prevent large particle emission, but can leader to higher emissions of fine particles (diameter <0.1 µm). Secondary abatement techniques like electrostatic precipitators and fabric filters are therefore necessary to minimise emissions of fine particles, and can reduce total PM emission by 50 – 70 %. After-burning catalysts are available to reduce carbon monoxide and volatile hydrocarbon emissions.

Solar thermal

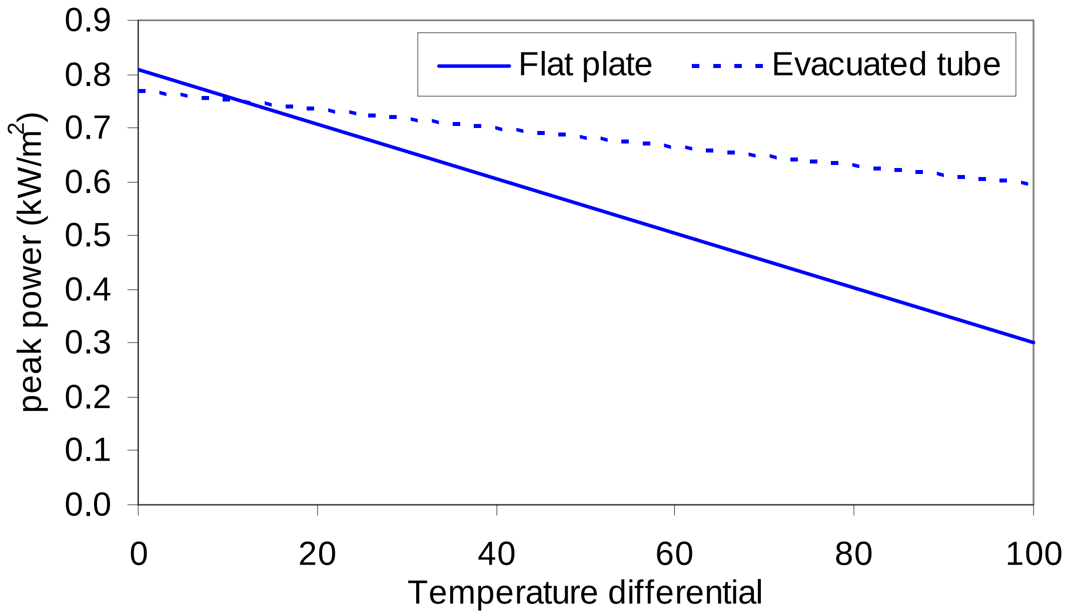
The heating output from solar collectors is highly dependent on the situation, especially:

- annual quantity incident solar radiation (function of latitude, cloud cover, shading)
- orientation
- tilt angle
- temperature difference between heated water and outside air.

Situation specific annual incident solar radiation and heat output can be calculated based on latitude and local climatic data, planned collector type and installation orientation and tilt. In Switzerland, south facing collectors can provide over 850 kWh/m^2yr of water heating (SPF, 2011). However, Ecocamping (2010) report that, on average, flat plate collectors installed in Germany can be expected to generate approximately 350 kWh/m^2yr water heating, and evacuated tube collectors approximately 450 kWh/m^2yr of water heating (Ecocamping, 2010). South-facing flat plate panels in Seehof campsite, northern Germany, provided an average of 600 kWh/m^2yr of water heating between 2010 and 2011 (see section 9.2).

The ideal situation for solar panels is on a south-facing roof with a tilt angle of 30º to 45º. However, in typical mid- to high- latitude (40º to 60º N) European situations, output is reduced by just 5 % when oriented SE or SW, and solar panels function adequately on E- and W-oriented roofs. When selecting solar collectors, the European Solar Keymark (ESTIF, 2012) provides assurance of compliance with European standards.

Climatic, seasonal and system design features also influence operating efficiency via the temperature differential between ambient outdoor air and maximum heated water temperature. This effect is greater for flat plate than for evacuated tube collectors (Figure 7.38). Solar collector output can be maximised by reducing the maximum water temperature required, for example by using solar thermal to provide water pre-heating. Reducing the maximum temperature differential (i.e. system maximum water temperature) by 20 ºC can increase peak heat output by 5 % and 13 % for flat plate and evacuated tube collectors, respectively.



Source: SPF (2008).

Figure 7.38: Variation in standard test peak power out put from two solar collectors relative to temperature differential (maximum water temperature minus ambient temperature)

Calculated heat output in the specific situation can then be used to calculate optimum collector area – too large an area leads to redundant capacity in summer months, and is therefore uneconomic. It is usually economically attractive to cover up to 60 % of hot water demand with solar heating, and a general guide for campsites in Germany is to install 0.1 to 0.2 m^2 of flat-plate collector area per pitch (25 % less area required for evacuated tube collectors). Seasonal variations in water demand must also be considered.

Installed hot water storage capacity should be calculated according to the area of solar collectors, and be at a minimum:

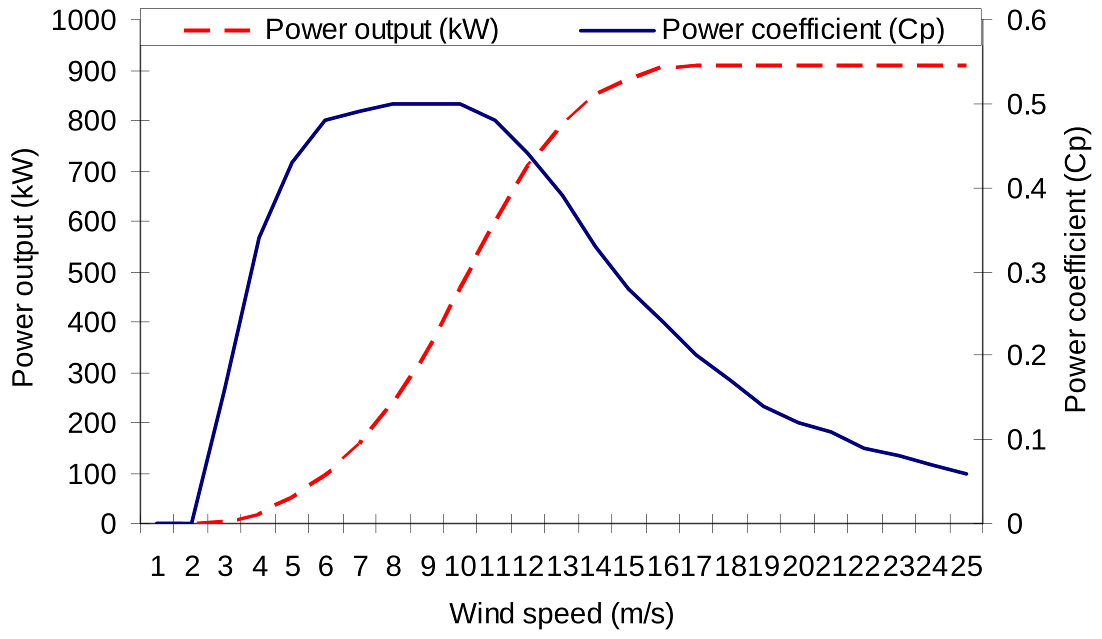
- 100L per m^2 flat-plate collector
- 133 L per m^2 evacuated tube collector (Ecocamping, 2011).

Storage tanks and all pipework should be well insulated. A minimum of 50 mm insulation is recommended for storage tanks, preferably factory fitted, while pipe insulation should be of a thickness at least equivalent to the outer diameter of the pipes (SEIA, 2010).

It is important to install an expansion vessel and pressure release valve to protect the solar heating loop from overheating and excessive pressure during periods of high solar gain. A control system is required with sensors on the solar collectors and in the water tanks to switch on circulating pumps when sufficient solar radiation is reaching the collectors and when water requires heating.

<u>Solar PV</u>
Factors affecting output from PV panels are similar to those described above for solar thermal panels. Aspect and tilt angle are important. In addition, more recent developments in PV cell technology make it feasible to apply solar PV cells onto vertical façades and shading devices. Cells must be cleaned at least once per year, more often where there are sources of deposition such as air pollution, sea spray, or a high concentration of birds, etc.

<u>Wind</u>
The main limiting factors for larger wind turbines are the availability of sufficient space and sufficient wind speed. Turbines operate from wind speeds of around 4 m/s, but work best in locations with mean wind speeds of 7 m/s or higher (Carbon Trust, 2008). Figure 7.39 shows the relationship between wind speed, power output and conversion efficiency (coefficient of performance, Cp) for a large 900 kW turbine (Enercon, 2011).



NB: Wind speed measured at hub height (45 m)
Source: Data from Enercon (2011).

Figure 7.39: Evolution of power output and conversion efficiency (Cp) with wind speed for a 900 kW turbine

In the first instance, indicative information on wind speeds can be obtained from meteorological data from the nearest weather station, or from national databases such as the BERR/NOABL Wind Speed Database in the UK (Renewable UK, 2012). However, local topography and buildings can significantly influence local wind speeds and generate turbulent flow patterns so that site surveys should be carried out before installation of wind turbines.

The economic viability of installing a wind turbine can be calculated by comparing total investment costs with annual electricity output and output value (electricity prices and any feed-in tariffs available), as described under 'Economics'. The annual electricity output from a wind turbine of a given capacity can be calculated based on the average annual wind speed according to product performance specifications such as those presented in Figure 7.39 according to the following equation:

$E_a = C_{kw} \times T \times Cp$
Where E_a is annual electricity output in kWh; C_{kw} is turbine capacity, in kW, T is time 'online' expressed as hours per year; Cp is the average coefficient of performance (based on average wind speed).

Assuming the 900 kW turbine for which output data are displayed in Figure 7.39 is online all year (8 760 hours) at a site with an average wind speed of 12 m/s (Cp = 0.44), the annual electricity output would equate to: 900 x 8760 x 0.44 = 36 468 960 kWh, or 36 960 MWh.

Installation of larger wind turbines may require an Environmental Impact Assessment to be carried out, and potential interference with aviation and telecommunications must be assessed. There are few maintenance requirements but a service check should be performed at least every two years (Carbon Trust, 2008).

Applicability

The potential to exploit particular RE resources on site depends on location- and site-specific factors such as climate, shading, available space, etc, as summarised in Table 7.30. These issues are not barriers to investment in off-site RE installations, although the opportunities for investment in off-site RE may depend somewhat on the national prevalence of RE schemes.

Economics

Subsidies

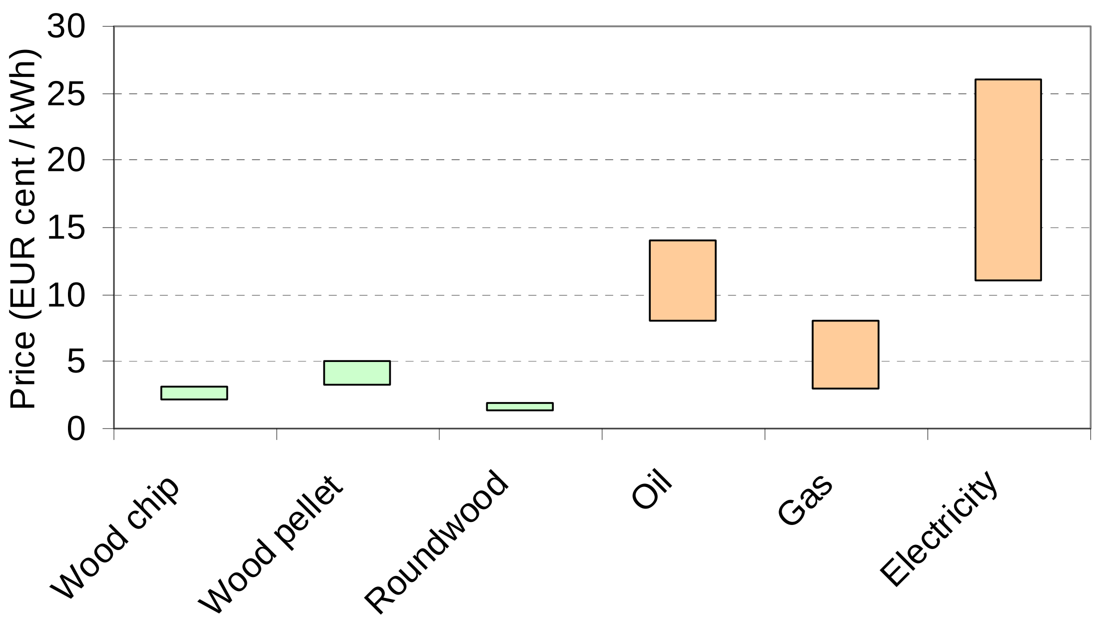
Subsidies may be available for the installation many RE technologies, reducing net installation costs and payback periods. Such schemes vary across countries. In the UK, the capital cost of many RE technologies can be offset against tax under the Enhanced Capital Allowance scheme. In some countries, RE electricity fed into the national grid is eligible for feed-in tariffs significantly above market electricity prices. These subsidies are referred to for specific RE technologies, below.

Biomass

Wood is a relatively cheap fuel although prices vary considerably depending on sources, transport distance, quantity purchased and preparation, from less than EUR 1.50 per MWh for delivered roundwood (logs) to over EUR 5 per MWh for delivered pellets (Figure 7.40).

Wood pellet boilers of 125 kW and 250 kW capacities are available for prices of EUR 30 000 to EUR 45 000 (excl. VAT), respectively. Installation of the complete heating system, including water storage tanks, approximately doubles the price, leading to total installation costs from approximately EUR 230 up to EUR 530 per kW installed capacity (Carbon Trust, 2008). Payback periods are estimated at five to 12 years.

Subsidies may be available for the installation of wood heating systems, reducing net installation costs and payback periods. For example, biomass boilers are covered by the Enhanced Capital Allowance scheme in the UK.



NB: Prices per delivered fuel, including taxes, and chipped/pelleted wood.
Source: Carbon Trust (2009); Energy.EU (2011).

Figure 7.40: Price range for wood fuel in UK, and price range for oil, gas and electricity across the EU, expressed per kWh energy content

Solar thermal

As with other RE options, installation costs vary considerably depending on situation-specific factors, especially the location of the collectors relative to the water storage tanks. In Germany, the retail price of flat plate solar collectors is approximately EUR 400 per m^2, although wholesale prices for large projects can be significantly lower (EUR 170 to EUR 250 per m^2). Total installation costs may be upwards of EUR 850 per m^2 of flat plate solar collectors, and upwards of EUR 1 000 per m^2 of evacuated tube collectors (Carbon Trust, 2008).

Figure 7.41 presents indicative payback times for a system costing EUR 850 m^2 to install, with outputs ranging from 200 to 800 kWh per m^2 per year, and at different energy prices. For installation costs to be paid back within the maximum collector operating lifetime of 25 years, energy prices need to be above EUR 0.04 per kWh for a high output system, and EUR 0.17 per kWh for a low output system. A typical payback time, for a system with an output of 400 kWh per m^2 per year and an energy price of EUR 0.10 per kWh (electricity), is approximately 20 years. In some circumstances, where systems achieve high output and displace expensive electric heating, payback times can be as low as five years. These payback times do not consider interest or discount rates.

In practice, payback times may be significantly reduced if government financial assistance is provided for solar thermal system installation. Solar thermal systems are covered by the Enhanced Capital Allowance scheme in the UK. In section 9.2, an example is provided of solar thermal installation in a German campsite with an estimated payback time of 10 years compared with gas heating owing to the availability of a government subsidy for installation.

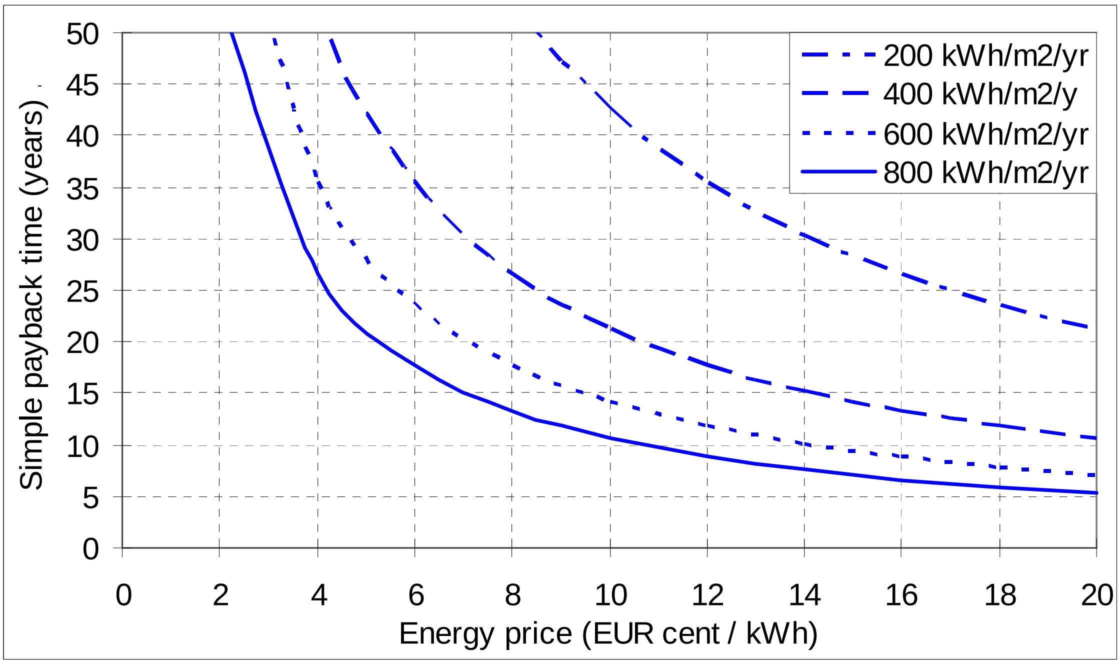


Figure 7.41: Simple payback time for solar thermal systems at different energy prices and annual thermal output, assuming an installation cost of EUR 850 per m^2

Solar PV

The price of solar PV cells has declined rapidly over recent years. The Carbon Trust (2008) quoted installation costs of approximately EUR 6 000 to EUR 9 500 per kW capacity, whilst a typical UK installer quotes installation costs ranging from EUR 2 100 to 3000 per kW installed capacity depending on system size (South-facing, 2012).

Many countries now implement a feed-in tariff for electricity generated by solar PV electricity. The value of this tariff in the UK varies depending on installed capacity, from EUR 0.10 to

EUR 0.255 per kWh (Table 7.37), is guaranteed for 25 years at an inflation-indexed rate, and can be claimed whether the electricity generated is used on site or is exported. Feed-in tariffs provide an additional return on investment over and above savings made through avoided purchasing of grid electricity.

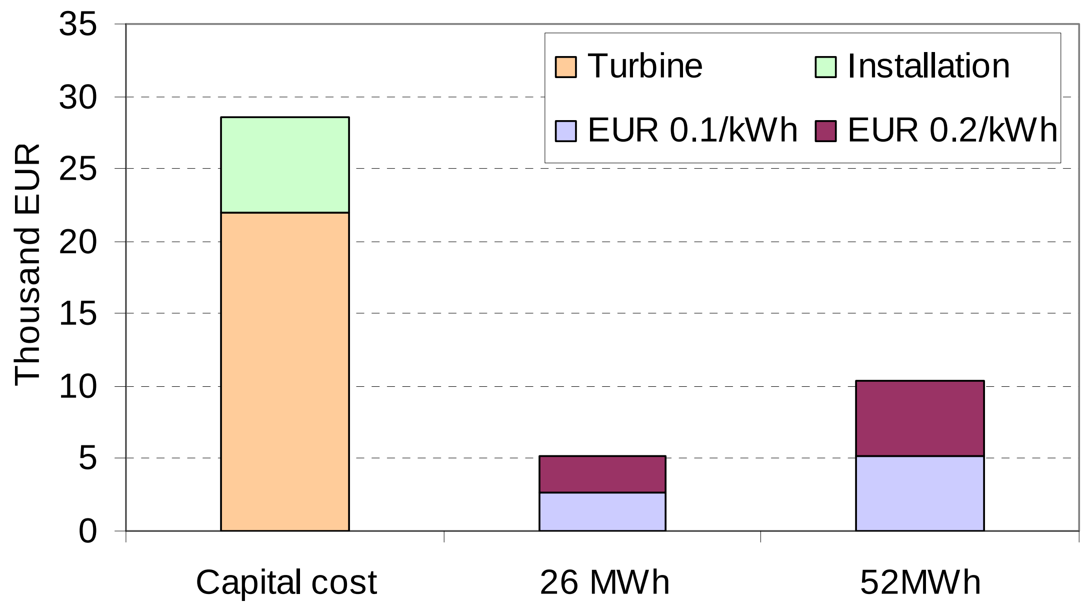
Based on the above information, assuming electricity output of 850 kWh per kW installed capacity in the UK, and an electricity price of EUR 0.1 to EUR 0.2 per kWh, payback times of eight to 11 years are achievable. Solar PV payback times will vary significantly depending on country-specific feed-in tariffs and electricity prices.

Table 7.37: Feed-in tariff rates for electricity generated by solar PV systems of different capacity in the UK

System size (kW)	0 – 4	4 – 10	10 – 50	50 – 250	250 – 5 000
FI tariff (EUR/kWh)	0.255	0.198	0.179	0.152	0.10

<u>Wind</u>

The lifetime of a wind turbine is approximately 25 years. The capital costs of small-scale turbines are up to approximately EUR 22 000 for a 20 kW model (Carbon Trust, 2008). Additional costs are associated with the site suitability survey, applying for planning permission and grid connection and metering. The return on investment for wind turbines involves a number of components, and is highly dependent on local and enterprise-specific aspects. Firstly, demand from the grid and associated electricity prices can be avoided. Secondly, electricity may be sold to the grid. Thirdly, produced electricity may be eligible for government support such as feed-in tariffs. Returns are therefore heavily dependent on the price of electricity and any government support schemes, but may be optimised by controlling the quantity and timing of generated electricity used on site and exported to the grid. For example, it may be worthwhile to invest in battery storage in order to store electricity generated overnight and sell electricity generated during the day at higher daytime electricity rates. Figure 7.42 provides an indication of capital costs and possible returns for a 20 kW wind turbine. The payback period ranges from 2.7 years (52 MWh annual output valued at EUR 0.2 per kWh) to 11 years (26 MWh annual output valued at EUR 0.1 per kWh).



NB: Assumes additional installation costs equivalent to 30 % of turbine cost; EUR/kWh reflects electricity price plus any subsidies.

Figure 7.42: Capital cost and potential annual returns for a 20 kW wind turbine at different annual outputs and output values

The payback period for large free-standing turbines of 0.5 to 5 MW capacity is typically between four and eight years on appropriate sites (Carbon Trust, 2008). Accommodation enterprises may avail of such returns directly by installing free-standing turbines in rural areas, or indirectly via investment in off-site wind farms.

Driving force for implementation

The main driving forces for installation of RE on accommodation premises are:

- government financial assistance for RE installation
- feed-in tariffs for generated RE
- GHG emission redcution
- corporate social responsibility
- to improve business image.

Reference companies

The HES publication 'best Practices Guide – successful RE technologies integration in SME hotels' (HES, 2011) provides a range of examples of RE applications in accommodation enterprises. Two additional examples are summarised below, for a large and small accommodation enterprise respectively.

<u>Crowne Plaza Copenhagen Towers</u>

In addition to the use of geothermal energy for heating and cooling (see section 7.4), the 360-room Crowne Plaza Copenhagen Towers hotel incorporates ultra-thin solar PV panels on all sunny exterior surfaces. These generate 200 000 kWh electricity per year, approximately 8 % of on-site electricity demand.

Huerta Cinco Lunas

Huerta Cinco Lunas is a traditional Andalucian farmhouse ('finca') providing bed and breakfast accommodation in three rooms. It was renovated using local materials in the traditional style, which includes small windows and thick walls made of stone and limestone plaster painted white. The high thermal mass of this design reduces summer daytime temperatures and avoids the need for air conditioning. All space and water heating is provided by renewable sources, avoiding the use of propane gas. During summer, energy for heating hot water is provided by 2 m^2 on-site solar panels. During winter (approximately 100 days per year), space and water heating is provided by a wood pellet boiler that consumes approximately 3 tonnes pellets per year (bought locally in 15 kg sacks at a total cost of EUR 730 per year). Installation costs were EUR 6 591 for the wood pellet boiler, and EUR 2 367 for the solar panels. Residual energy requirements for operation of pumps and appliances average 7 kWh per day, and are supplied by grid electricity (Huerta Cinco Lunas, 2011).

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8 RESTAURANT AND HOTEL KITCHENS BEST ENVIRONMENTAL MANAGEMENT PRACTICES

Overview

The preparation of meals, snacks and drinks is a core tourism service undertaken in most types of accommodations, and in dedicated restaurants and bars. This chapter covers the main measures available to minimise environmental impacts attributable, directly and indirectly, to operations in restaurant and hotel kitchens. Many of these techniques are also applicable to smaller food and drink services such a bars or breakfast preparation in small bed and breakfast accommodations.

Catering establishments prioritise food quality, and operatives often work under high pressure. Water and energy efficiency measures have therefore traditionally been a low priority for such establishments. Few catering supervisors have any input into equipment selection, especially in terms of energy and water efficiency, whilst the behaviour of catering staff is largely determined by a need to deliver quality and service using the equipment available (Carbon Trust, 2011).

Supply chains

As shown in Figure 2.4 in section 2.2, upstream environmental impacts arising during the production and transport of ingredients used to prepare meals in restaurant and accommodation kitchens are greater than the environmental impacts arising directly from kitchen processes. Best practice in green procurement is described in section 8.1.

Waste management

Figure 2.4 in section 2.1 also shows that waste management can make a significant contribution to the lifecycle environmental burden of food value chains. Specifically, disposal of food in landfill leads to significant GHG emissions and other impacts such as land occupation and leachate. On average in UK restaurants, 0.48 kg of food waste is generated per diner (SRA, 2010). In addition, food waste contributes to unnecessary food production impacts. Best practice in the avoidance and management of waste is described in section 8.2.

Water consumption

For relatively water-efficient hotels with small restaurants that serve breakfast for all guests plus cover meals to conference and à-la-carte guests numbering no more than half the number of overnight guests, water consumption in bar and restaurant areas equates to approximately 15 % of total water consumption, or just over 20 L/gn (Scandic Hotels, 2012). This corresponds with modelled water consumption for hotels presented in Figure 5.3 (section 5). These values will be higher for hotels with larger restaurants serving a higher proportion of conference guests and walk-in diners. Bohdanowicz and Martinac (2007) refer to average water consumption of between 35 and 45 L per cover meal served in hotels. Water consumption in kitchens is dominated by dish washing. Best practice to minimise water consumption in kitchens, with an emphasis on efficient dish washing, is described in section 8.3.

Energy consumption

According to ÅF-Energikonsult AB (2001), kitchens represent 25% of total hotel energy consumption, through demand for cooking, appliances, refrigeration and ventilation. Bohdanowicz and Martinac (2007) refer to average energy consumption of between 4 and 6 kWh per cover meal served in hotels. However, this value varies considerably depending on the type of meal served. ÅF-Energikonsult AB (2001) estimate average energy consumption in hotel kitchens of between 1 and 2 kWh per meal. Best practice to minimise energy consumption in kitchens, with a focus on cooking, ventilation and refrigeration, is described in section 8.4.

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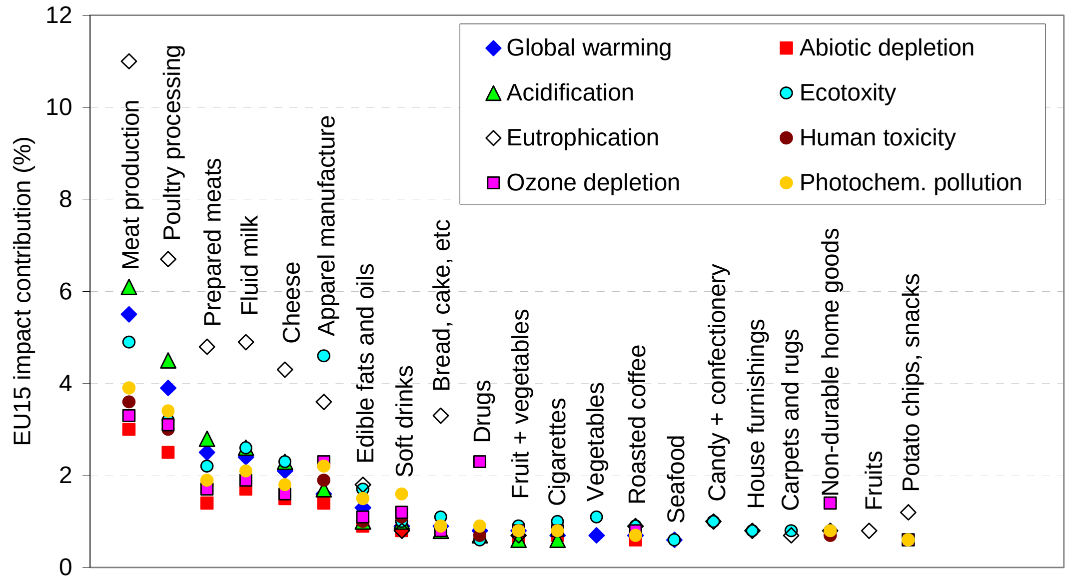
8.1 Green sourcing of food and drink products

Description

The product category 'food and alcoholic beverages' is the largest contributory group to major environmental pressures arising from production and consumption in the EU, accounting for 30 % of EU environmental pressure, and over half (58 %) of eutrophication pressure (EC, 2006). Figure 8.1 highlights the particular importance of meat and dairy production with respect to environmental pressure.



NB: Product groups are ordered according to global warming impact ranking
Source: derived from data in EIPRO study (EC, 2006).

Figure 8.1: The relative contribution of different product groups to eight environmental impacts in the EU-25

The upstream environmental impacts associated with the production of food and drinks consumed on accommodation and restaurant premises may be considerably greater than direct environmental impacts arising from on-site operations (see Figure 2.4 in section 2.2). Green procurement based on selection of lower environmental impact products is therefore an important mechanism for accommodation and restaurant managers to leverage environmental improvement. Although the environmental benefits of green procurement are often not reflected in environmental reporting, green procurement can be conveyed to clients as an important indicator of social responsibility and added value of the service provided.

In the first instance, collaboration amongst chefs, procurement and marketing personnel is recommended to develop a responsible menu offer that includes environmentally-driven objectives such as:

- appropriate portion sizing (also to reduce waste: section 8.2)
- high proportion of fruit, vegetables, cereals and pulses
- judicious portioning of meat and dairy products
- emphasis on seasonal produce (seasonal menus)
- local sourcing of fresh produce.

Procurement personnel may then seek the most sustainable brands or suppliers of the required main ingredients. Key criteria include: environmental certification, organic labelling, country or region of origin. The sectoral reference document for Retail Trade (EC, 2011) refers to relevant certification standards for green sourcing of various food products. These are summarised under 'Operational data', below. Nordic Swan ecolabel criteria for restaurants require documentation of the country of origin for all main ingredients (Nordic Ecolabelling, 2009).

An important component of best practice is the marketing of 'green' food and drink, in advertising and in menus, so that customers choose such products and are willing to pay any associated price premium.

There is overlap between this technique and green procurement to reduce waste from packaging (section 6.1) and measures to reduce organic waste (section 8.2). Local sourcing is also a factor that tour operators may influence to improve the sustainability of their packages at the (section 4.4).

Achieved environmental benefit

Products certified according to standards containing environmental criteria should be associated with reduced environmental 'hotspot' pressures, and lower overall lifecycle environmental pressures, compared with average non-certified products. The main features and achieved environmental benefits of common environmental standards for food products are described in Table 8.1.

Table 8.1: Widely-used third-party basic environmental standards applicable to product groups

Standard	Features	Main environmental benefits
Basel Criteria on Responsible Soy Production	Established in 2004 by Coop CH and the WWF, the BCRSP is composed of 37 criteria relating to environmental management, minimization of chemical inputs, and sustainable land use, for soy production	– Avoids agricultural encroachment into high conservation areas; – Reduces resource consumption; – Reduces soil erosion; – Reduces water and air pollution.
Better Sugarcane Initiative (BSI)	Comprises 48 metric benchmarks for sugarcane farmers and processors, based on five key sections, including Obey the Law; Production and Processing; Biodiversity and Ecosystems; Continuous Improvement. Contains rigorously defined, performance-based standards (BSI, 2010)	– Avoids agricultural encroachment into high conservation areas; – Reduces resource consumption; – Reduces soil erosion; – Reduces water and air pollution.
Common Code for the Coffee Community Association (4C)	Based on ten unacceptable practices, and a Code Matrix comprised of 28 principles for which 'green', 'yellow' and 'red' criteria have been defined (4C Association, 2010). Farmers and processors must achieve an average of 'yellow' across principles	– Avoids agricultural encroachment into high conservation areas; – Reduces resource consumption; – Reduces soil erosion; – Reduces water and air pollution.

Standard	Features	Main environmental benefits
Fairtrade (FT)	This exemplary social standard contains detailed requirements for land use and good environmental management practices for farmers, including biodiversity management and nutrient and pesticide application restrictions (Fairtrade, 2009)	– Avoids encroachment into high-conservation-value areas; – Reduces resource consumption; – Reduces soil erosion; – Reduces water and air pollution.
Global Good Agricultural Practice (GAP) and benchmarked standards	The GlobalGAP standard is widespread (94 000 certified producers in over 100 countries), and is primarily focused on food hygiene and health and safety. Environmental protection arises from site management and waste disposal 'musts' and various 'recommended' measures to reduce erosion and water use (GlobalGAP, 2009)	– Avoids excessive use of resources and bad environmental practices.
Organic (OC)	Organic certification is awarded by various organisations according in compliance with Commission Regulation (EC) No 889/2008 within the EU. At least 95 % of a product's agricultural ingredients must be organic. Detailed requirements and restrictions prioritise the use of internal resources in closed cycles rather than the use of external resources in open cycles. External resources should be from other organic farms, natural materials, and low soluble mineral fertilisers. Chemical synthetic resources are permitted only in exceptional cases.	– Maintains higher agricultural biodiversity; – Reduces resource consumption; – Improves soil quality; – Sequesters carbon in soil; – Reduces GHG emissions for some crops; – (see Table 8.2).
Marine Stewardship Council (MSC)	MSC certification is based on three principles and associated criteria that require fisheries to be sustainable. Specifically, MSC requires: (i) maintenance and re-establishment of healthy populations of targeted species; (ii) maintenance of the integrity of ecosystems; (iii) development and maintenance of effective fisheries management systems, taking into account all relevant biological, social, and environmental aspects; (iv) compliance with relevant laws and international agreements (MSC, 2010)	– Preservation of endangered fish species; – Maintenance of marine fishery ecosystem integrity and biodiversity.
National (or regional) Product Certification (NPC)	A number of certification schemes guarantee that products have been sourced within a particular European country or region, including the Red Tractor (Assured Food Standards, 2010) in the UK and Suisse Garantie (Suissegarnatie, 2010) in Switzerland.	– Avoids worst environmental management practices employed in some poorly regulated developing countries.
Rainforest Alliance (RA)	The Rainforest Alliance Certified seal (SAN, 2010) applies to over 100 types of crops and livestock from Africa, Latin America, Asia and Hawaii. Farmers must comply with at least 80 % of applicable social and environmental criteria from a list of 100 criteria within ten principles, including specific requirements for good environmental management	– Avoids encroachment into high-conservation-value areas; – Reduces resource consumption; – Reduces soil erosion – Reduces water and air pollution.
Red-listed fish (RLF)	Greenpeace, the IUCN and MSC have listed fish species from particular regions that are likely to come from unsustainable fisheries (Greenpeace, 2010; MSC, 2010).	– Preserves acutely endangered fish species.

Standard	Features	Main environmental benefits
Round Table on Sustainable Palm Oil (RSPO)	The RSPO standard (RSPO, 2007) is based on five principles, including environmental responsibility and good agricultural practice, and contains 39 and criteria regarding traceability and social and environmental performance.	– Avoids agricultural encroachment into high conservation areas; – Reduces resource consumption; – Reduces soil erosion; – Reduces water and air pollution.
Round Table on Responsible Soy (RTRS)	The RTRS standard (RTRS, 2010) was finalised in 2010 and is based on five principles, including environmental responsibility and good agricultural practice. Guidance is provided for 98 specified compliance criteria, including requirements for environmental monitoring and specific management plans that provide a framework for continuous improvement.	– Avoids agricultural encroachment into high conservation areas; – Reduces resource consumption; – Reduces soil erosion; – Reduces water and air pollution.
UTZ	Based on a code of conduct comprising 175 control points across 11 themes, including many relevant environmental requirements. Mandatory control points increase from 95 in first year of certification to 152 in 4th year of certification, and must be complied with where applicable to operations (UTZ, 2010)	– Avoids encroachment into high-conservation-value areas; – Reduces resource consumption; – Reduces soil erosion; – Reduces water and air pollution.

There remains considerable debate over the advantages and disadvantages of organic agricultural production relative to agricultural mainstream production. Lower yields for organic production incur indirect land use effects associated with compensatory production. These effects are difficult to assess as they are determined by global trade forces and secondary consumption effects (overall consumption may be reduced owing to the higher price paid for organic food).

Nonetheless, organic production has a number of benefits compared with average (non-certified) mainstream production (Table 8.2), particularly in relation to sustainability challenges such as high rates of soil erosion (Verheijen et al., 2009), dependence on finite abiotic resources (e.g. fossil fuels and phosphate rock), and crop breeding focussed on crop response to synthetic inputs. The comparative environmental performance of organic and mainstream agriculture is presented in more detail under 'Cross-media effects', below.

Table 8.2: Relative advantages of organic production compared with mainstream production from a farm system and product lifecycle perspective

Organic farm system advantages	Organic product lifecycle advantages(*)
– Higher on-farm biodiversity (Mäder et al., 2002; Nemecek et al., 2011) – Improved soil quality (organic matter and microbe content) (Mäder et al., 2002) – Higher rates of soil biological nutrient cycling (Mäder et al., 2002) – Soil carbon sequestration (IFOAM, 2009; Pimental et al., 2005) – Crop-breeding for good performance under low-input conditions (CoopCH, 2010)	– Lower abiotic resource depletion (Nemecek et al., 2011) – Lower energy use (Corré et al., 2003) – Lower ecotoxicity (Nemecek et al., 2011) – Lower GHG emissions for cereals, crops and some meat production (Hirschfield et al., 2008).
(*)per kg product.	

It is difficult to estimate the scale of environmental benefits achieved by green procurement for a typical establishment owing to the wide range of products and standards involved, and difficult-to-quantify product lifecycle benefits compared with average non-certified products. However, Table 8.3 indicates the possible magnitude of GHG emission reductions achievable from green procurement of a few types of products based on documented differences across varieties of these product types.

Furthermore, Figure 8.6 and Figure 8.5 (below) indicate the potential percentage reductions in environmental impact for sugar and fresh fruit and vegetables, respectively, with reference to carbon footprint and in a Swiss context.

Table 8.3: Potential GHG emission reductions arising from the sourcing of lower-impact options of three products

Product	Annual saving	Main source of saving	Reference
	kg CO_2 eq.		
1 000 kg fresh fruit and vegetables	11 500	Avoid air-freighted produce	Climatop (2009)
1 000 litres milk	1 720	Good on-farm management practices	Sainsbury's (2010)
1 000 kg sugar	280	More efficient feedstock (sugarcane instead of sugarbeet)	Climatop (2008)

Appropriate environmental indicator

Product standards and criteria

Table 8.4 indicates relevant standards and criteria for green procurement across broad product groups. The percentage of products procured that fulfil these standards and criteria is a relevant indicator of performance. Percentages may be expressed for each product group, as recommended for retail best practice in green procurement (EC, 2011), and/or as aggregated performance across all product groups. Nordic Swan (2009) propose the use of purchase value for calculation of percentages, as these data should be readily available from standard account keeping (it may be necessary to specify within the accounts which suppliers are associated with which environmental criteria or standards.

Table 8.4: Relevant product standards (and criteria) for broad product groups, classified as 'basic' and 'high' environmental performance

Product groups	Basic standard	High standard
Coffee, chocolate, tea		4C, FT, OC, UTZ
Dairy	GAP, NPC	OC
Fruit and vegetables	GAP (avoid airfreight, from heated greenhouses)	FT, NPC, OC (in season)
Fats and oils	GAP, NPC	RSPO, RTRS, OC
Grains and pulses	GAP, NPC	OC
Poultry, eggs	GAP, NPC	OC
Red meat	GAP, NPC, RA	
Fish and seafood(*)	RLF	ASC, MSC
Soft drinks	See sugar, below	
Sugar	GAP	BSI, FT, OC (cane sugar)
Water		(filtered) tap water
NB: ASC: Aquaculture Stewardship Council; BSI: Better Sugarcane Initiative; FT: Fairtrade; GAP: Good Agricultural Practice; MSC: Marine Stewardship Council; NPC: National (or regional) Production Certification; OC: Organic (labels such as BioSuisse, EU leaf, KRAV, Soil Association); RA: Rainforest Alliance; RSPO: Roundtable on Sustainable Palm Oil; RTRS: Round Table on Responsibel Soy.		
(*)all fresh and saltwater fish, fish eggs and shell fish *Source:* Derived from EC (2011).		

Benchmarks of excellence

Benchmarks of excellence for green procurement of food and drink products are:

BM: the enterprise is able to provide documented information, at least including country of origin, for all main ingredients[12].

BM: at least 60 % food and drink products, by procurement value, are certified according to basic or high environmental standards or criteria.

BM: at least 40 % food and drink products, by procurement value, are certified according to high environmental standards or criteria.

These benchmarks refer to aggregate percentages for all food and drink products purchased, expressed by purchase value. Data may also be expressed for particular product groups to demonstrate progress towards these overall benchmarks. Where products are produced onsite, percentages may be expressed based on equivalent purchase value. Figure 8.2 shows the performance achieved by a small 'vivienda rural' in Spain (described in more detail under 'Case studies', below). Meanwhile, Green Hotelier (2011) report that 60 % of food served in Fairmont

[12] Nordic Ecolabelling (2006) define potatoes, pasta, meat, fish and beans, etc., as 'main ingredients'. Accompaniments and ingredients which form only a small part of the meal such as spices, salt, herbs, mustard, ketchup, dressing and food oil are not defined as main ingredients.

Copley Plaza's Oak Room Restaurant, in Boston, comprises local ingredients purchased from a farmer's market across the street.

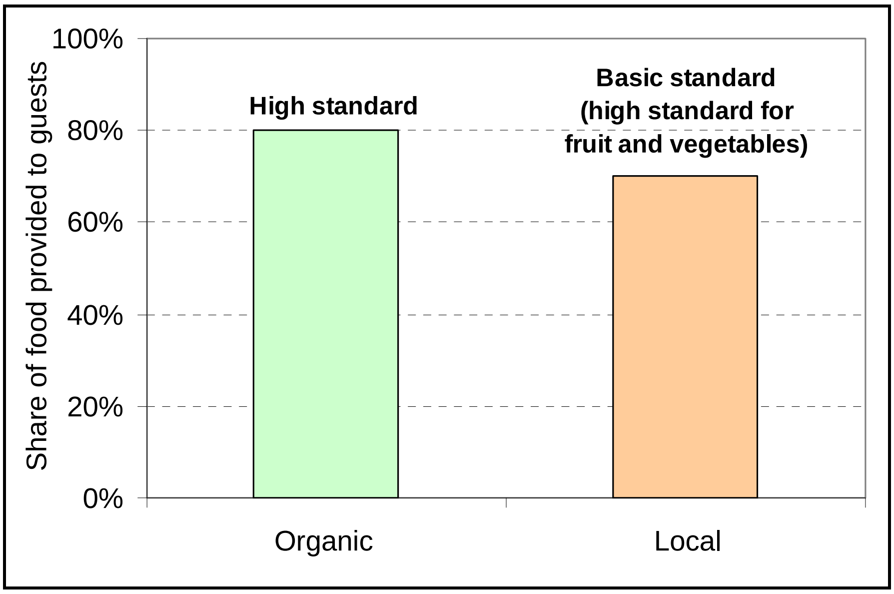


Figure 8.2: Share of food and drink products provided to guests at the Huerta Cinco Lunas vivienda rural in Andalucia, Spain

Meanwhile, at the destination level, the EC Tourism Sustainability Group recommend a minimum threshold of 25 % of food and drink products locally sourced from within destinations (see section 3.1).

Cross-media effects

Local sourcing versus certification

It is important to base green procurement decisions on the appropriate environmental indicators. For example, the environmental impact of fresh fruit and vegetables can be dominated by long-distance transport, especially air freight (Climatop, 2009), so that local sourcing is an appropriate green procurement criterion for fresh fruit and vegetables. Meanwhile, local or regional sourcing is not an appropriate indicator for sugar that is most efficiently produced from sugarcane in warm climates (Figure 8.6). For many products, the better environmental performance is most reliably assured by third-party certification with environmental standards. There may at times be conflicts between environmental and social sustainability objectives, for example in terms of local product options versus Fairtrade certified products from less economically developed countries.

Environmental standards

Certified environmental standards usually target environmental hotspots for particular products, and therefore are not associated with significant cross-media effects.

Organic production

To produce equivalent yields and protein content to non-organic 'mainstream' systems, organic systems have been calculated to require 35 % more land area (Corré et al., 2003). Greater land area requirements of organic systems may lead to increased GHG emissions and biodiversity loss at a global scale that counter direct environmental benefits (Burney et al., 2010: Brentrup et al., 2010), although displaced production is probably lower than 35 % owing to higher prices for organic food (Figure 8.4). Mainstream systems may include 'organic' management practices such as crop rotation, integrated pest management, and application of organic fertilisers (Goulding et al., 2009). The best mainstream systems are more eco-efficient than organic systems, but average organic systems have an advantage over average mainstream systems (Figure 8.4), except for some products such as beef (Hirschfield et al., 2008).

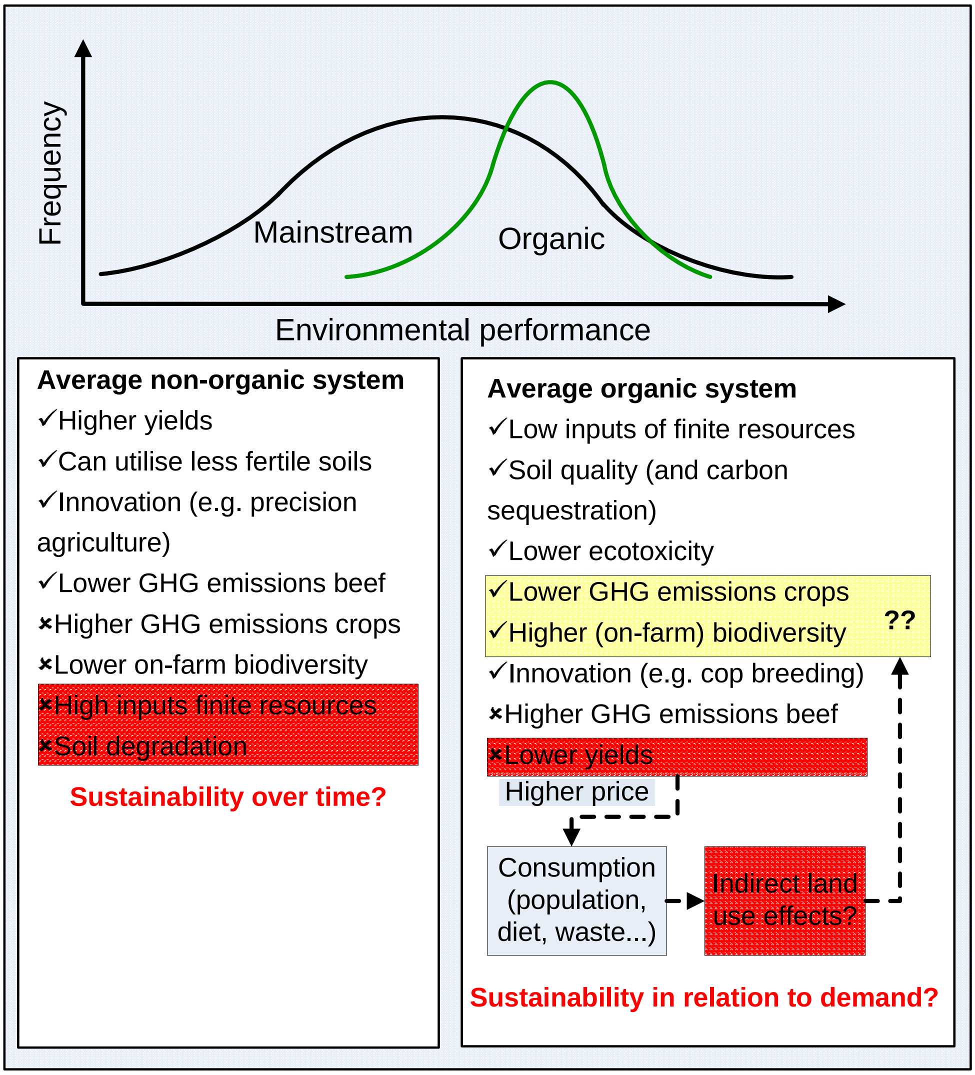


Figure 8.3: The relative strengths and weaknesses of mainstream and organic production systems, and key sustainability issues

Operational data

Identifying priority products and ingredients

Priority products can be identified by a basic audit of the ingredients included in the menu offer (e.g. taken from shopping or order lists). All ingredients used should be listed alongside basic information such as the source location and any certifications awarded. The basic list can be compared with documented environmental priority products, such as, for example, caviar or North Atlantic bluefin tuna (unsustainable stocks), palm oil (farming associated with deforestation and peat soil degradation), beef (high GHG footprint), out-of season green asparagus (often air-freighted).

Full lifecycle assessments (LCA) are not usually necessary, but information from lifecycle databases is useful. Free LCA software includes GEMIS and UMBERTO, for example, whilst the European Reference Life Cycle Database has been developed as an authoritative compilation of European lifecycle data. This and other guidance on LCA tools and databases are provided on a dedicated EC website: http://lca.jrc.ec.europa.eu/lcainfohub/index.vm

For the initial audit, it may be necessary and more efficient to contract third-party experts who should be able to quickly identify priority ingredients and relevant green procurement actions(local sourcing, appropriate certification, etc.). This could be the most expensive (but once-off) component of sustainable sourcing. Guidance on the identification of product improvement options is provided below.

Prioritisation should be based on ingredients with the highest environmental burden, which may include ingredients used in small quantities (e.g. caviar). Thus, a full screening of menu ingredients is important, but improvement may be performed in a step-wise manner, addressing high volume ingredients first.

<u>Product assessment and relevant procurement criteria</u>
Environmental hotspot stages and impacts vary across product groups, and, consequently, so do the most relevant environmental criteria to be considered in green procurement. Guidance on key hotspots and appropriate mitigation measures is provided in the SRD for the retail trade sector (EC, 2011) and websites such as Sustainweb in the UK (Sustainweb, 2011)). Table 8.4, above, summarises relevant criteria and standards across some major product groups. Here, some key product hotspots and relevant green procurement criteria are summarised for a few products as examples.

Beef
The production of beef is associated with particularly high environmental impacts (see Figure 8.1, above). Figure 8.4 displays a breakdown of GHG emissions arising from the supply of frozen beef.

The impact of production is dominated by animal husbandry owing to high emissions of the potent GHG methane from enteric fermentation within cattles' digestive systems. The manufacture of fertiliser applied to grass for grazing and silage, and crops used to produce concentrate food, accounts for a large portion of energy consumption, and fertiliser application gives rise to emissions of the extremely potent GHG nitrous oxide (Figure 8.4). Transport and chilling energy, and refrigerant leakage, make a minor contribution to lifecycle GHG emissions in the case of beef (unlike for fruit and vegetables). Hirschfield et al. (2008) suggest that organic certification is not a useful indicator of more environmentally friendly production for beef, and there are no existing standards that ensure eco-efficient beef production.

However, GHG emissions and overall environmental impact can be considerably higher where beef is produced on land recently cleared of forest or native vegetation, as occurs in Latin America. Therefore, best practice in green procurement is to avoid such beef. As summarised in Table 8.4, relevant criteria and standards for this purpose are (best first):

- local sourcing
- national production certification
- GlobalGAP certification
- Rainforest Alliance certification.

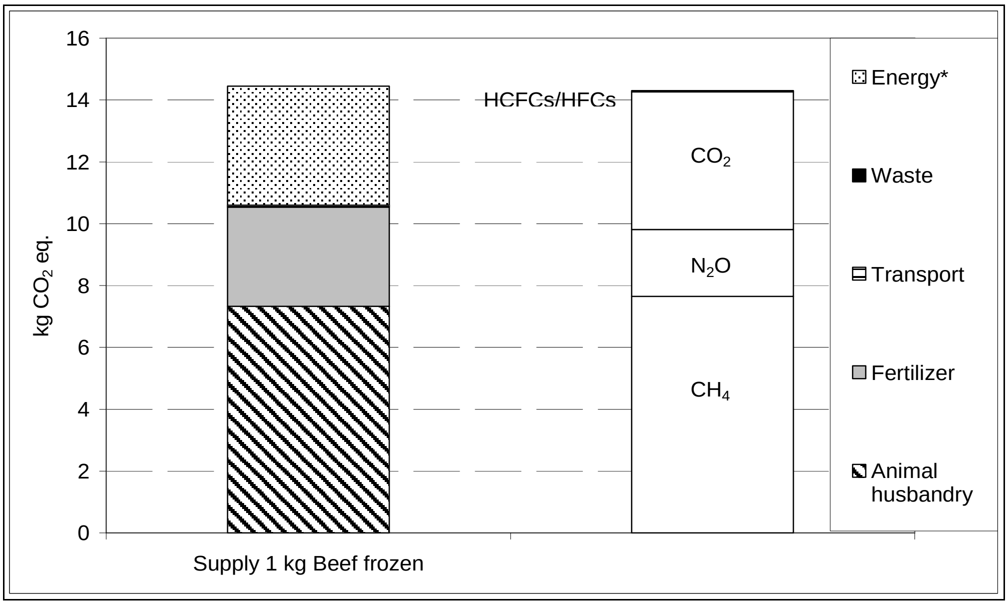
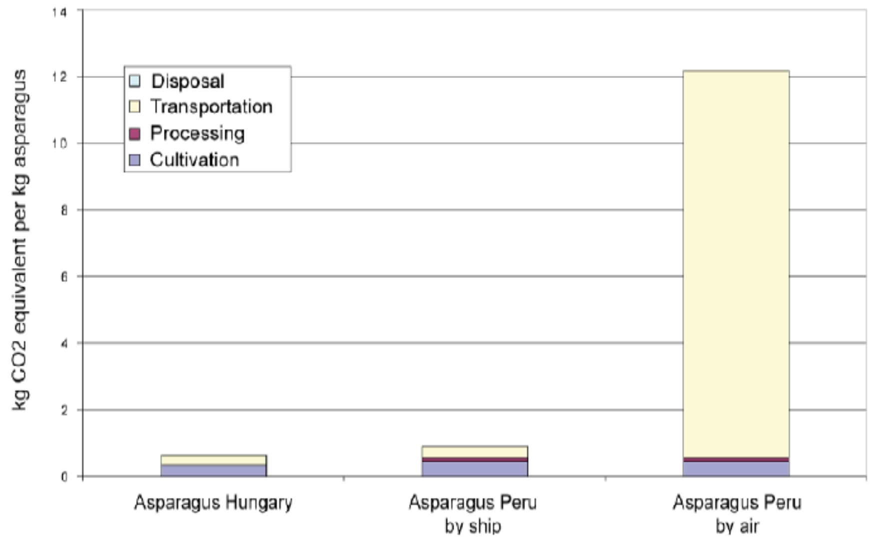


Figure 8.4: The origins and composition of GHG emissions arising during the production and storage of 1 kg of frozen beef, based on average German conditions, calculated using the GEMIS LCA tool

Fresh fruit and vegetables. The results of a lifecycle assessment for fresh green and white asparagus, from production to shop display, are presented in Figure 8.5, and provide an example of the main environmental impacts associated with fresh fruit and vegetables that may be sourced from geographically distant source regions outside of local production seasons. GHG emissions arising from the supply of one kg of asparagus ranged from 0.5 to 12 kg CO_2 eq. Cultivation is the largest source of emissions for asparagus transported by lorry and ship, but air transport completely dominates emissions for air-freighted Mexican and Peruvian asparagus. Cultivation impacts arise mainly from fertiliser application and manufacture, but also from manufacture of plastic sheeting, machinery fuel use, and soil carbon loss under tillage agriculture. Environmental impacts include: soil erosion, depletion of water resources and salinisation where irrigation is applied, eutrophication of water from nutrient run-off, eco toxicity effects from pesticide use, emissions of acidifying gases from fertiliser application, machinery use and transport.

Best practice in the procurement of fresh fruit and vegetables is to avoid air-freight and heated greenhouses, and to use the following criteria, as summarised in Table 8.4 (best first):

- Local sourcing
- Seasonal sourcing
- National production certification
- Organic certification
- Fair-trade certification (provided no air-freight)
- GlobalGAP certification.



Source: Climatop (2009).

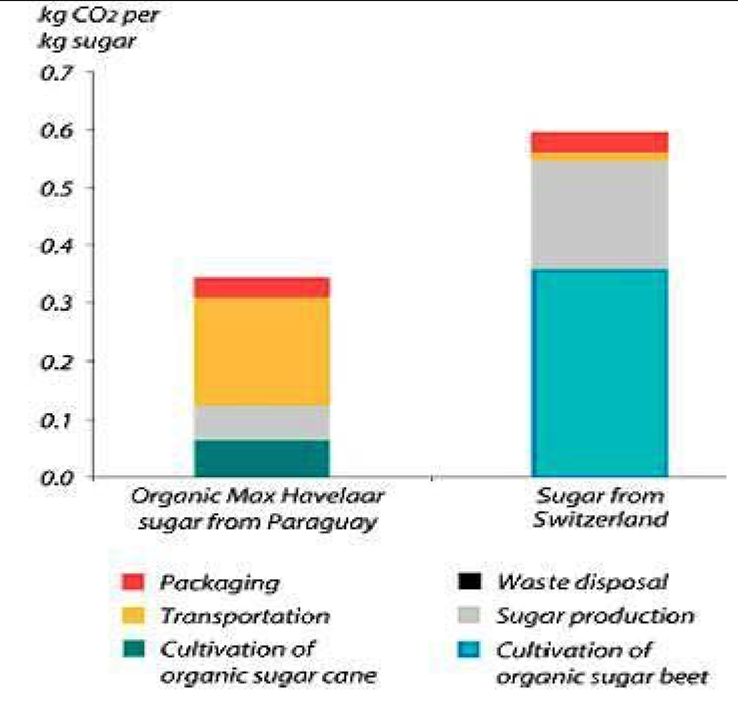
Figure 8.5: Breakdown of GHG emission sources for asparagus from different sources

Sugar

Lifecycle GHG emissions arising over the sugar supply chain, from production to retail display, are presented in Figure 8.6. Six types of sugar were compared, and the carbon footprint varied by a factor of two, primarily due to high cultivation emissions for sugar beet compared with sugarcane (two types of sugar presented in Figure 8.6). Cultivation emissions arise mainly from fertiliser application and manufacture, but also from machinery fuel use and soil carbon loss under tillage agriculture. Organic cultivation was found to result in significantly lower GHG emissions for sugarcane cultivation in Paraguay, but not for sugar beet cultivation in Switzerland or Germany. Additional impacts are similar to those listed for fresh fruit and vegetable production, above. Relevant green procurement criteria and standards include (best first):

- Better sugarcane Initiative certification
- Selection of cane- (rather than beet-) sugar
- Organic certification
- Fairtrade certification
- GlobalGAP certification.

Notably, because of the higher impact of beet sugar than cane sugar, national or local sourcing is **not** good practice for sugar in Europe.



Source: Climatop (2008).

Figure 8.6: Breakdown of GHG emission sources for different sugar products

Eggs

A case study on the carbon footprint of organic eggs was performed by the Product Carbon Footprint consortium (PCF, 2009). The production of six eggs was calculated to cause the emission of 1.18 kg CO_2 eq. (Figure 8.7), from the following sources:

- pullet-rearing and egg-laying farms (62 %)
- use phase – transport, cooking and eating (21 %)
- handling by retailers (10 %)
- supply transport (1.5 %).

Figure 8.7 demonstrates that GHG emissions from the egg laying farm are dominated by manure management and feed production (responsible for approximately 79 % of egg laying farm emissions). These stages also give rise to acidifying (ammonia) emissions and eutrophication (nitrogen run-off). The following GHG reduction options were highlighted in the PCF study (percentage reduction potentials in brackets): installation of biogas plant at egg-laying farms (14 %); consumers using egg boilers for cooking (11 %); using renewable electricity in regional warehouses and stores (9 %); customer shopping by bike or foot (4 %). Thus, restaurants can reduce the lifecycle environmental impact of eggs through efficient cooking (section 8.4), for example using egg boilers, and through optimising the delivery schedule (consolidating orders). Relevant selection criteria for green procurement include (most environmentally rigorous first):

- organic certification
- local sourcing
- national production certification
- GlobalGAP certification.

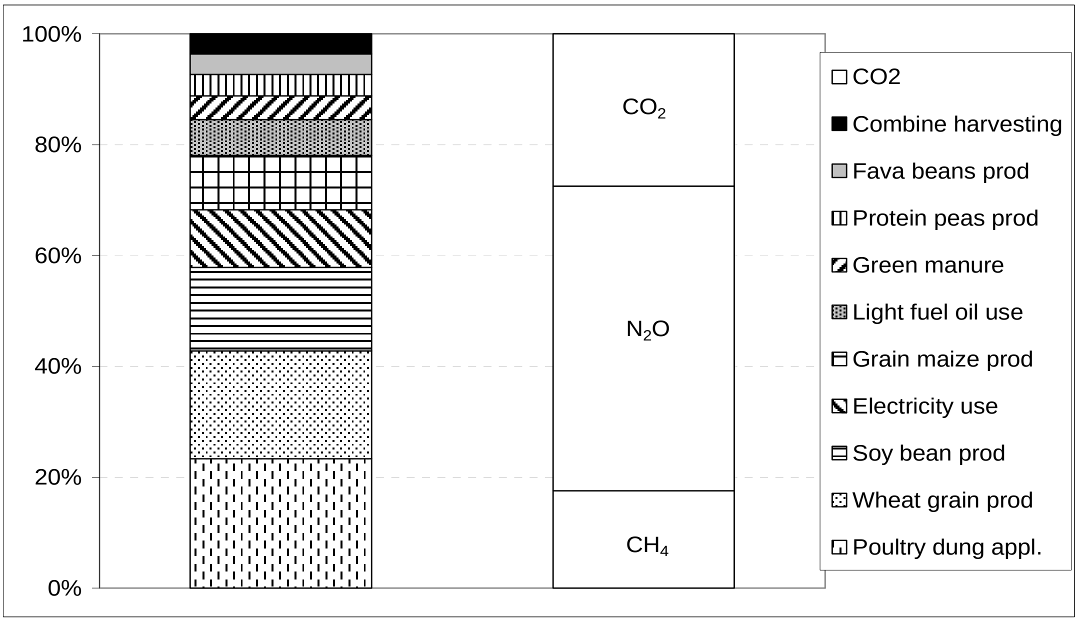


Figure 8.7: The contribution of processes and individual gases to GHG emissions on the egg-laying farm

Instigating green procurement

There may be considerable overlap with green procurement to minimise waste, including packaging waste (section 6.1) and organic waste (section 8.2). For example, avoiding bottled water wherever possible is best practice (see example of filtered water supplied in the five star Rafayel Hotel, in section 6.1).

Personnel from a range of departments should be included in green procurement decisions to ensure that they are practical and successful, but ultimately a single 'champion' is required to drive and coordinate green procurement efforts. Where an enterprise has a purchasing department, someone from within this department would be appropriate. This person has responsibility for identifying new opportunities and suppliers, monitoring supplier performance, and collaborating with staff, e.g. working with chefs to modify recipes or adopt new recipes based on local, seasonal and certified products. Seasonal products are usually available in good quality for two to three months at a time, and 90 % of menu offers may be planned using a calendar of seasonal food availability (Green Hotelier, 2011). The Travel Foundation (2010) suggest that green procurement performance by responsible staff is included as a criterion in reward systems (e.g. linked to bonus pay).

It is important to conduct some basic research and contact relevant authorities and agencies before embarking on a green procurement review. Local authorities, agencies or NGOs may organise, or be aware of existing initiatives for local green procurement. Some examples of free online guidance for sustainable sourcing in the UK are provided in Table 8.5. Many other sources are available.

Table 8.5: Examples of free online sustainable sourcing guidance in the UK

Organisation	Web link	Content
Sustainweb	http://www.sustainweb.org/	Extensive information on sustainable food and suppliers within the London region of UK.
Food Link	http://www.londonfoodlink.org	Similar to above.
Eat the Seasons	http://www.eattheseasons.co.uk	Provides timely advice on in-season produce to include in menu offers.
Soil Association	http://www.soilassociation.org	Information on organic food and suppliers.

The availability of local, seasonal and certified products may be limited. Procurement of such products may require a shift from one large supplier to a number of smaller suppliers. It may be necessary to sign longer-term contracts with smaller (local) businesses to build up capacity for particular products over time. It may be necessary to provide local farmers with advice on expected quality, packaging and health and safety standards. Payment periods may need to be shortened when working with smaller businesses: Travel Foundation (2010) suggest a payment period of no more than 15 days for small businesses.

Green marketing

Green procurement can be an important component of a value-added marketing strategy, for example centred on an ethical, sustainable, or local theme. Collaboration with local suppliers can differentiate the service offered by an accommodation or food and drink establishment, for example through the provision of bespoke products. To achieve this, information can be provided to customers on the origin of the food and any 'story' associated with it, for example on relevant menu pages. Photographs convey messages effectively and concisely (Green Hotelier, 2011). Cookery demonstrations or classes based on traditional local recipes may be provided. Such strategies can be highly effective for tourism marketing (Travel Foundation, 2010). The case study examples describing the Otarian restaurant chain and Le Manoir aux Quat'Saisons Restaurant, below, highlight how sustainable procurement can be used as an important marketing tool.

Case studies

Huerta Cinco Lunas (ES)

Huerta Cinco Lunas is a small 2.5 hectare farm in Andalucia certified as organic by Agrocolor (AGR-02/1033) that provides bed and breakfast accommodation in three rooms within a traditional Andalucian farmhouse ('finca'), renovated using local materials in the traditional style. From the organic garden (Figure 8.8), the owners produce a range of produce, including eggs laid by hens fed with organic waste from the kitchen (Table 8.6). Crops are fertilised using animal manure from a neighbouring organic farm compost from the kitchen. Weeds are controlled through manual weeding.

Table 8.6: Some of the produce grown on-site at Huerta Cinco Lunas

Fruit	Vegetables	Others
– apples – apricots – chessnuts – figs – lemons – oranges – peaches – pears – pomegranates – quinces	– chard – courgette, – cucumber – garlic – leek – lettuce – onions – peppers – potatoes – pumpkin, – tomatoes	– almonds – eggs – olive oil (150 L/yr)
Source: Huerta Cinco Lunas (2011).		

Breakfast provided to guests is comprised of approximately 80 % organic ingredients, many of which are produced onsite: marmalades and jams, eggs, fruits and vegetables. Purchased products include organic cereals, and non-organic bread, coffee, tea and milk. Including evening meals provided for guests on request, the overall share of locally sourced food in the offer is approximately 70 %.

Figure 8.8: Organic fruit and vegetable garden at Huerta Cinco Lunas

Le Manoir aux Quat'Saisons, Oxforshire, UK

Le Manoir aux Quat'Saisons is a Mechelin two-starred restaurant in Oxforshire that places a virtue on the provenance of its food, especially the purity and freshness of ingredients. An on-site organic garden of 0.8 hectares provides 90 types of vegetable and 70 varieties of herb used in the kitchen.

A responsible fish sourcing policy involves collaboration with the Marine Stewardship Council, and comprises the following:

- to only use seafood products that are sustainable and responsibly fished
- to ensure the fishing methods used pose no threat to local marine aquaculture
- to avoid fish species during their spawning season
- to inform guests via the menu of the fishing method and origin of the species
- to inform guests whether the seafood is farmed or wild.

Fish from Cornwall are caught by day boats certified under the Responsible Fishing Scheme. Sea bass and Cornish hake are mostly line-caught; lobsters and brown crabs are caught using pots; turbot, brill, plaice and sole are caught by day boats using nets designed to avoid unsuitable by-catch and by vessels that avoid areas where young fish mature. Mussels are rope grown in the river Fal in Cornwall; sardines are caught in small ring nets by day boats; cockles and clams are hand-gathered on the coast of Dorset. Creel-caught langoustines and hand-dived scallops are caught off the western coast of Scotland. The menu is occasionally adapted to utilise by-catch species.

Otarian restaurant chain

Otarian is a restaurant chain that offers a 100 % vegetarian menu, substantially reducing the environmental burden of food compared with average restaurants serving meat (Otarian, 2011). Sourcing policy is based on the principle 'as close to home as sustainable' to reduce transport-related impacts, and air freight is avoided. Otarian cooperate with suppliers to reduce packaging, for example to avoid double packaging and difficult-to-recycle packaging such as bubble-wrap. Packaging is consolidated by using the same crates for different products, and by extensive (re)use of reusable crates and compostable packaging made from bagasse (a by-product of cane-sugar production).

Otarian have generated carbon footprint data for their entire menu, using the PAS 2050 standard, and use this information to calculate the 'carbon saving' associated with selecting one of the menu's vegetarian options compared with an equivalent meat-, fish-, or egg- containing dish. Customers can register carbon savings on a loyalty card as 'Carbon karma credits'. Carbon footprint information is also used to help the often local suppliers improve their environmental performance. In summary, Otarian provide a good example of sustainable sourcing and effective marketing of the value added achieved by such sourcing.

<u>Thomson resort hotels jungle jams</u>
Sensatori Resort and four other hotels contracted by Thomson Holidays on Mexico’s Yucatan peninsula provide guests with 'jungle jams' for breakfast. These jams are made by a cooperative of Mayan women from the peninsula. This was initiated by a project with the Travel Foundation (see section 4.3) that worked with the women, advising them on customer communications, how to launch the product and establish links with the hotels. Guests appreciate the opportunity to eat authentic, locally made papaya and cactus-fruit jams. In addition to environmental benefits arising from the use of sustainably harvested local produce, procurement of these jams achieve social beneits by empowering local women to earn a living from within their jungle villages (TUI Travel plc, 2011).

<u>SuperClubs 'Eat Jamaican'</u>
The 'Eat Jamaican' campaign was launched in November 2003 by several Jamaican associations and businesses to promote locally-produced goods to residents, visitors and exporters. SuperClubs is a global all-inclusive tour operator that engaged with the 'Eat Jamaica' campaign, coordinating local procurement and promotion of local food across its Jamaican hotels. In 2004, SuperClubs started working more intensively with Jamaican farmers to provide incentives and technical assistance programmes. The hotel also provided the Jamaican government with policy guidelines for initiatives that would benefit both the agricultural and tourism industries. Currently, SuperClubs purchases over USD 110 million worth of local produce annually. One challenge has been to ensure a continuous supply of high quality produce from local suppliers. SuperClubs resorts promote local produce as a unique tourist attraction, for example in 'Celebrating Jamaican Cuisine and Culture' weekend events that combine local culinary delights, music, arts and crafts (Travelife, 2011).

Applicability
As demonstrated above, any type of establishments offering food and drink can implement a green sourcing programme.

Economics
Following a review of food and drink supply chains, it is useful to initiate the green procurement programme by selecting cost-positive or cost-neutral options, such as local products, and move on to any products associated with a price premium as the programme develops. Additional product procurement costs should be considered in the context of marketing, and may be offset by increased turnover arising from marketing of value-added products and services, possibly in the context of a green marketing strategy.

On-site production of food can reduce procurement costs (though labour costs, etc., should be considered). Strattons Hotel and Restaurant in the UK grows fruit and vegetables on site, and uses eggs from laid by chickens kept on site, saving EUR 1 000 per year.

Driving force for implementation
The main driving forces for green sourcing include:

- corporate social responsibility

- food quality considerations
- product/service differentiation and green marketing
- securing reliable and stable supply chains
- improving local relations and reputation.

Reference companies

Strattons Hotel and Restaurant (UK), Gavarni Hotel (F); Huerta Cinco Lunas (ES); Le Manoir aux Quat'Saisons (UK); Otarian restaurant chain; Thomson Holidays.

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8.2 Organic waste management

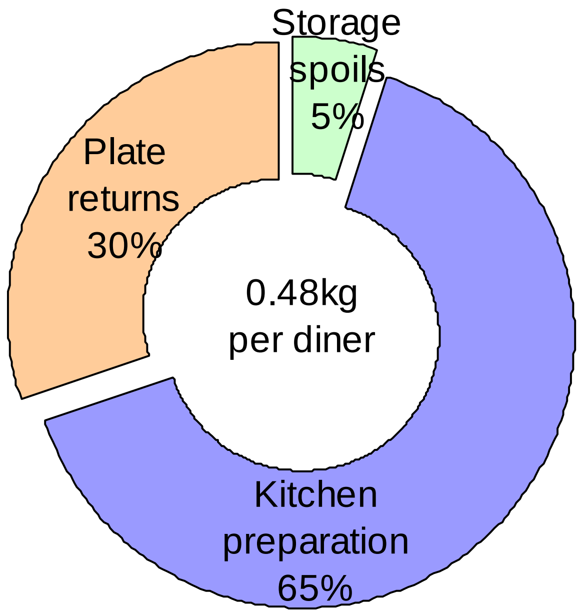
Description

Kitchens generate large quantities of organic waste, including peelings and trimmings, bones, uneaten returns from customer servings, out-of-date products, oil used for frying, etc. Organic waste can represent 37 % of residual waste generated by accommodation, and almost 50 % of residual waste generated by restaurants (WRAP, 2011). It is estimated that the UK hospitality industry disposes of 400 000 tonnes of avoidable food waste per year, at a cost of almost EUR 900 million (WRAP, 2011).

A study of UK restaurants by the Sustainable Restaurant Association (SRA, 2010) found that the average quantity of organic waste generated by restaurants was 0.48 kg per diner (Figure 8.9), dominated by kitchen preparation (65 %), followed by returns on customer plates (30 %). Spoilage of stored food made only a minor contribution (5 %). When assessing restaurant performance in terms of waste generation per diner, it is useful to distinguish between 'avoidable' and 'unavoidable' food waste (WRAP, 2011):

- **Avoidable food waste:** food waste that could have been consumed on site, such as plate returns, spoilage, etc.
- **Unavoidable food waste:** waste arising from on-site food preparation, such as peelings, rind, fruit cores, etc.

The ratio of these fractions can differ significantly across restaurants. For example, restaurants that buy in fresh food for on-site preparation, rather than buying in pre-prepared food, will generate more unavoidable organic waste (but may generate less packaging waste).



Source: SRA (2010).

Figure 8.9: Organic waste produced by UK restaurants

WRAP (2011) calculated that quick service restaurants recycle 55 % of waste, and other restaurants 39 %, indicating considerable scope for improvement. The characteristics of organic waste mean that it can be recycled into useful materials such as fertiliser and bioenergy. Best practice in organic waste management for kitchens is for managers to coordinate actions across all staff, from procurement, through commis chefs to chefs, cleaners and waiting staff, and marketing personnel, so that: (i) the amount of food waste generated is minimised, and; (ii) the quantity of organic waste sent to landfill is minimised. This involves:

- providing optimised offers on the menu;
- considering environmental criteria during procurement (section 2.2);
- careful storage (e.g. correct adjustment of refrigeration temperature: section 8.4);
- providing appropriately sized portions;
- careful food preparation to minimise and separate organic waste;
- separation of organic waste during plate scraping and prewashing;
- recovery of used oil for collection to produce biodiesel.

It is no longer permitted to use food waste from catering centres and restaurants for animal feed, and uncooked meat and animal by-products must be treated according to minimum standards that prohibit their inclusion in some processes such as small-scale composting (DEFRA, 2011). A Danish study carried out in 2004 analysed potential systems for the collection and treatment of food waste. Lifecycle assessment was used to rank the main options for organic waste disposal in the following order of declining preference (Table 8.7).

Table 8.7: Ranking of different organic waste management options in terms of environmental performance according to Miljøstyrelsen (2004)

Rank	Waste management option
1	Biogas production with central collection and pretreatment (collection in bins)
2	Biogas production with decentralised collection and pretreatment, respectively
3	Collection with ordinary mixed waste for incineration
4	Composting with decentralised collection and pretreatment

Composting was rated the least preferred option because it does not generate energy and releases additional GHG emissions through methane production (Miljøstyrelsen, 2004). Composting may be viewed more favorably in terms of nutrient cycling, and is preferable to landfill which remains the dominant waste disposal option in some countries. Thus, best practice is to avoid landfill, and either:

(i) send for anaerobic digestion or incineration with energy recovery, or;

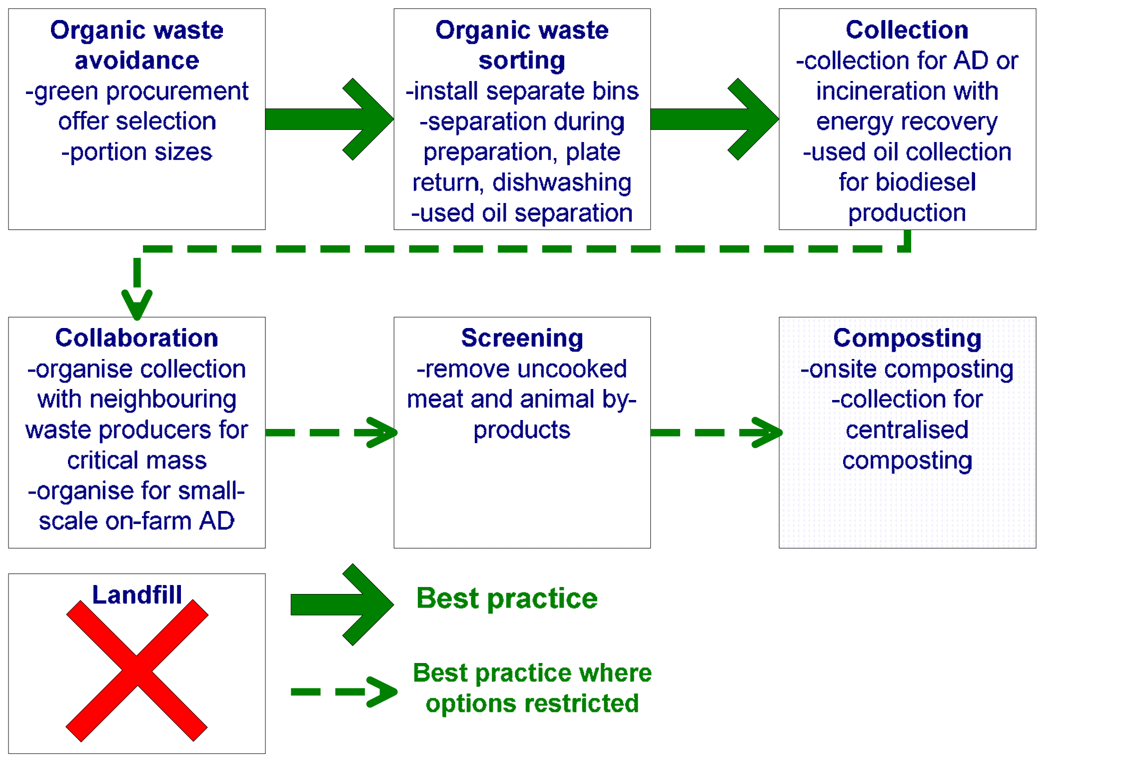
(ii) where first options are unavailable, perform on-site compositing or send for central composting.

Automated systems are now available for the efficient recovery and collection of used cooking oil to produce biodiesel. These systems considerably reduce the risk of accidents arising from handling hot oil, enable oil life to be prolonged by filtering, inform appropriate oil change frequency, and enable optimisation of collection and transport operations. Best practice for large kitchens is to send used cooking oil for biodiesel production using efficient (semi-automated) collection systems.

Figure 8.10 summarises the sequence of best practice in organic waste management for kitchens, depending on locally available options. Best practice is summarised as:

- avoidance
- separation
- anaerobic digestion or incineration with energy recovery

• composting.



NB: AD = anaerobic digestion.

Figure 8.10: Summary of best practice for organic waste management in kitchens

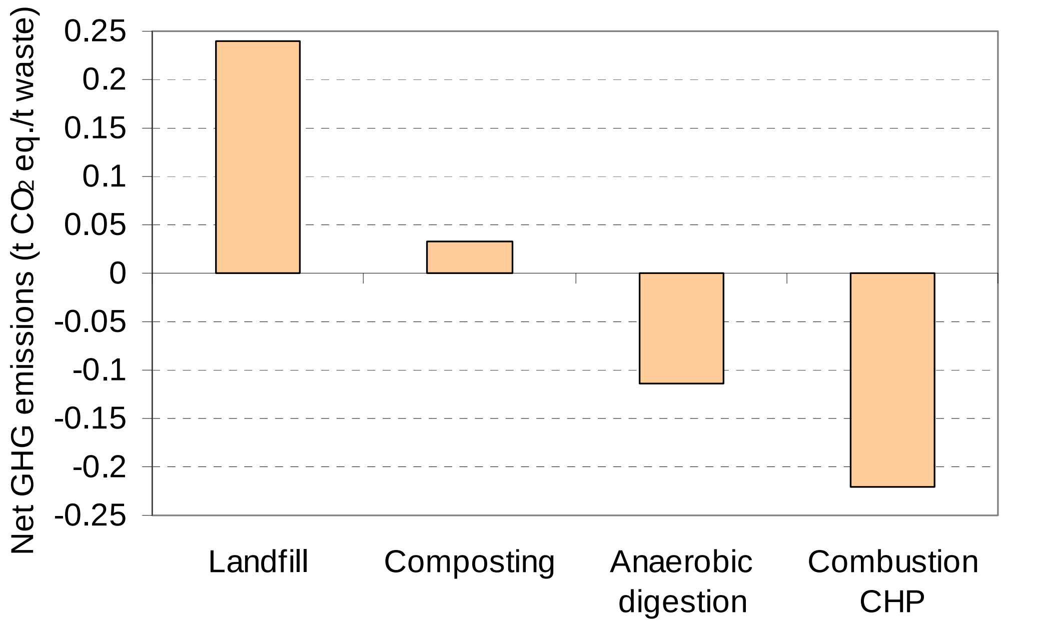
Kitchens also generate large quantities of non-organic waste, for example from food packaging, that should be avoided reused, sorted and recycled wherever possible according to best practice described in section 7.1 and section 7.2.

Achieved environmental benefit

Reducing waste

A survey of UK restaurants calculated that reducing the average quantity of food waste produced by 20 % would equate to an average reduction of 4.36 tonnes per year per restaurant. Reducing food waste reduces impacts associated with waste disposal (below) and the large impacts associated with food production (section 8.1). The environmental impacts avoided by diverting waste from mixed collection are heavily dependent on the management of mixed municipal waste, and will be greatest where landfill without methane flaring is employed and lowest where incineration with energy recovery is employed.

Figure 8.11 presents net GHG emissions arising from landfill, composting, anaerobic digestion and combustion in a combined heat and power plant – considering methane emissions, transport and avoided fossil fuel consumption for energy generation. Net GHG emissions from landfill depend heavily on how the site is managed, and can be substantially higher than indicated in Figure 8.11. One tonne of organic waste can generate up to 1.3 t CO_2 eq. of methane emissions during anaerobic decomposition in a landfill without mitigation measures (Lou and Nair, 2009). However, in modern European landfill sites most of the decomposition gas is captured and used to generate electricity, considerably reducing GHG emisisons.



Source: SRA (2010), ORA (2011), PDM (2011).

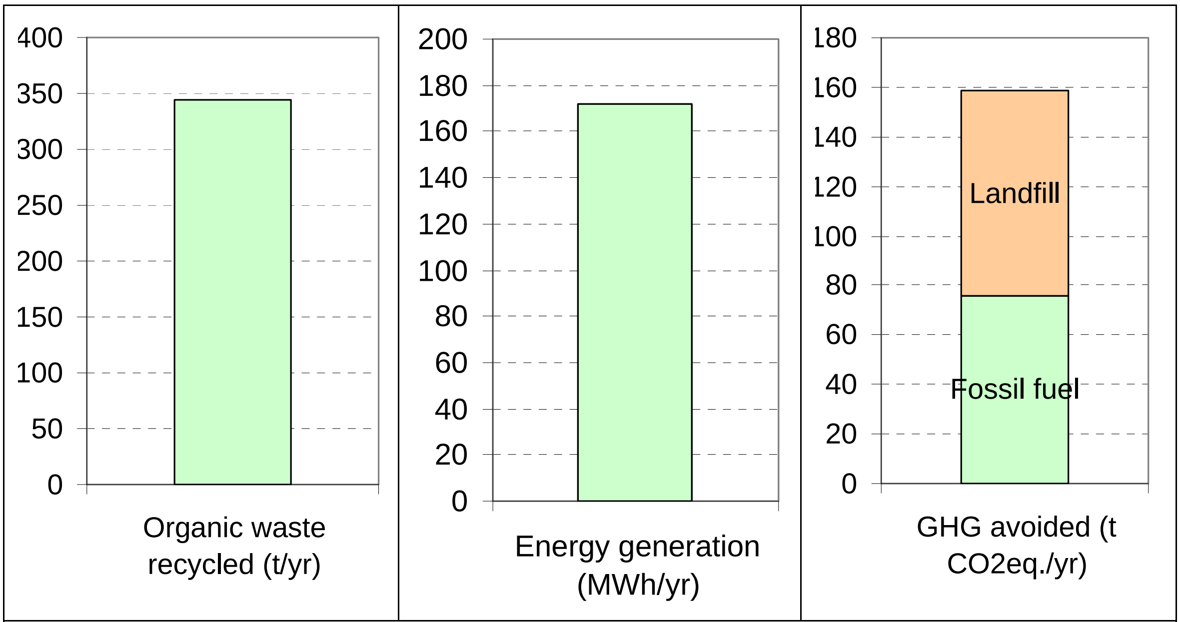
Figure 8.11: Net GHG emissions from landfill, composting and anaerobic digestion of organic waste, per tonne and per average UK restaurant

Energy recovery

Anaerobic digestion yields approximately 2.5 GJ of biogas (108 Nm^3) per tonne of organic waste (Fruergaard and Astrup, 2011), that may be used to substitute fossil fuels for electricity and/or heat generation and/or transport (biogas from one tonne organic waste equivalent to 70 litres of petrol). Compared with disposal in a modern landfill, anaerobic digestion avoids approximately 0.35 t CO_2 eq. per tonne organic waste. Nutrient-rich digestate improves and sequesters carbon in soil, and substitutes fertiliser (avoiding production impacts) when applied to agricultural soil in accordance with crop nutrient requirements.

Incineration with energy recovery does not retain nutrients or have soil improvement benefits, but produces more energy (almost 4 GJ of combined heat and power per tonne of waste) (Fruergaard and Astrup, 2011), avoiding up to 0.46 t CO_2 eq. per tonne organic waste compared with disposal in a modern landfill.

Figure 8.12 shows the energy generated (172 MWh) and GHG emissions avoided (158 t CO_2 eq.) from incineration of 344 tonnes per year of organic waste arising from The Savoy hotel and affiliated restaurant (Simpsons in the Strand). Avoided GHG emissions are based on the alternative disposal of organic waste in landfill.



NB: Annualised values based on data for January to August 2011.

Figure 8.12: Energy generation and carbon dioxide emission avoidance associated with combustion of organic waste from The Savoy to generate heat and electricity, compared with the alternative option of landfill

<u>Composting</u>
The main benefits of composting **compared with landfilling** organic waste are:

- a reduction in GHG emissions (lower methane generation under aerobic decomposition)
- a reduction in land appropriation for landfills
- avoidance or reduction in waste transport (for on-site or nearby composting)
- recycling of nutrients, especially phosphorus (a finite resource), and avoidance of fertiliser manufacture
- soil improvement and carbon sequestration.

Compared with disposal in a modern landfill, composting avoids approximately 0.21 t CO_2 eq. per tonne organic waste (SRA, 2010; ORA, 2011). Further benefits may be realised from soil carbon sequestration: although situation-specific and difficult to quantify, they have been estimated at 0.18 t CO_2 eq. per tonne of compost (Lou and Nair, 2009).

Compost produced from 50 % hotel kitchen waste and 50 % hotel garden waste (by weight) was found to contain 1.5 % nitrogen, 0.5 % phosphate and 1 % potash (potassium) (Envirowise, 2008). Compared with windrow composts, vermicomposts retain a higher proportion of nitrogen owing to lower process temperatures.

Appropriate environmental indicators

<u>Indicators</u>
The appropriate environmental indicator for waste generation intensity is:

- the quantity of <u>unavoidable</u> organic waste generated, expressed in kg, per dining guest.

Restaurants in UK generate on average 0.48 kg food waste per diner. Two large German restaurants within a theme park serve, respectively, 470 000 and 315 000 dining guests annually. They generate 0.26 and 0.36 kg organic waste per diner, respectively.

The appropriate indicator of environmental management for organic waste is:

- the percentage of organic waste sent for anaerobic digestion or alternative energy recovery;
- the percentage of organic waste composted on site or sent for composting, where the alternative waste disposal option is landfill.

Note that the term 'cover' is often used in the food and drink service industry to signify one dining guest.

Benchmarks of excellence

The benchmark for organic waste management is:

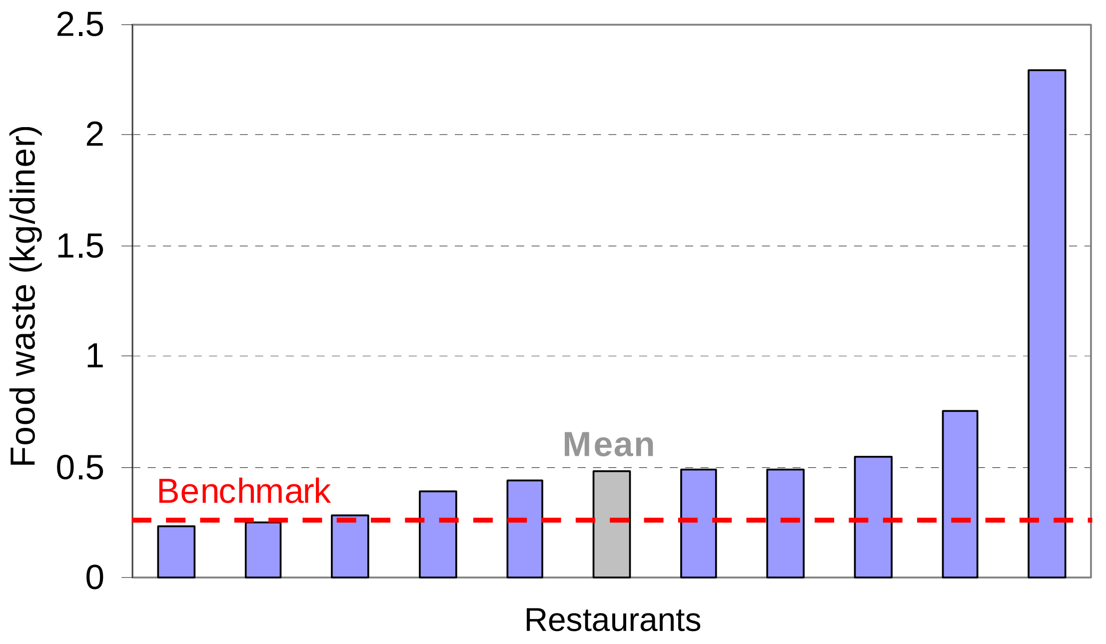
BM: ≥95 % of organic waste separated and diverted from landfill, and, where possible, sent for anaerobic digestion or alternative energy recovery.

For example, The Savoy hotel in London separates all organic waste and sends for combustion in a CHP plant, and the Otarian restaurant chain ensure that 98 % of all restaurant waste is recovered as compost, is recycled or is reused.

Data on waste generation per cover are scarce. However, data for UK restaurants (Figure 8.13 and WRAP, 2011) and German hotels (see above) would support the following preliminary benchmark of excellence for accommodation and restaurant kitchens:

BM: total organic waste generation ≤0.25 kg per cover, and avoidable waste generation ≤0.18 kg per cover.

Owing to the scarcity of data, this benchmark is conservative, and more ambitious targets may be appropriate for some enterprises.



Source: Derived from data in SRA (2010).

Figure 8.13: Food waste generation per cover in UK restaurants, and proposed benchmark of excellence

Cross-media effects

Anaerobic digestion is often performed in centralised plants, necessitating the transport of wet organic waste and giving rise to transport-related impacts that are typically small compared with waste disposal impacts. Fruergaard and Astrup (2011) estimate diesel consumption of 7.2 litres per tonne of organic waste collected for anaerobic digestion, compared with 3.3 litres per tonne for incineration in more widespread incineration plants with energy recovery (Danish situation). Compared with incineration, emissions of methane are higher from anaerobic fermentation owing to leakage that has been reported at rates of between 0 % and 10 % of methane produced (Eggleston et al., 2006). This is more likely to be a problem in small-scale plants. In the Otelfingen plant described below, no wastewater is discharged, and air from all the buildings is evacuated via a biofilter.

The cross-media effects from composting are greenhouse gas emissions (methane and nitrous oxide), odours, dust emissions and leachate. Leachate is a particular problem for open-air composting beds: one mm of rain falling on one m^2 of compost bed produces up to one litre of leachate. Areas under outdoor composting should be sealed with an impermeable membrane and leachate collected for use as a fertiliser. However, these impacts are comparable with those of landfill, whilst composting leads to nutrient recycling and soil conditioning benefits.

Operational data

Waste minimisation and separation

A survey of organic waste generation, including information on sources (e.g. spoilage of stored food, preparation, and plate returns), should be used to inform appropriate avoidance actions. Portion sizing may be reduced without impacting on customer satisfaction. The quantity and type of food returning on customers' plates can be used as a guide for portion sizing and menu planning. Menu planning to avoid waste should be performed in combination with green procurement (section 8.1). One pub-restaurant in Tipperary, Ireland, reduced the amount of food waste generated by over one-third through reducing portion sizes (Irish EPA, 2008). Boxes or bags can be offered to diners to take home food servings that they cannot eat.

Separation of non-organic waste fractions is also important in kitchens, as elaborated for general areas in section 6.2 and displayed for one large hotel kitchen in Figure 8.14.

Figure 8.14: Kitchen non-organic waste sorting in Scandic Berlin

Food preparation accounts for the majority of food waste. Organic waste bins should be conveniently positioned for easy access at all stages of food preparation, plate return and washing. Biodegradable bags made from, e.g. corn starch can be used to collect food waste where necessary, as these breakdown during composting and anaerobic digestion. The sequence below presents an example of organic waste recovery throughout kitchen operations, from food preparation to plate washing, for The Savoy in London.

1. Food preparation

Bins are placed next to chefs during food preparation to separate offcuts and peelings, etc., at source.

2. Plate return

Food scrapings from returned plates separated from other waste (rather than placed in mixed bins, or the sewer via a macerator).

3. Prewashing Food residues are rinsed off crockery and utensils during prewashing and captured in a sieve (also reduces drain blockages).


Separated organic waste can then be placed in large separate waste bins for collection to centralised or decentralised anaerobic digestion plants, or alternatively if other options are not available, for centralised or on-site composting (see below). Food close to its use-by date may be used for staff meals, given to staff to take home, or donated to charities. Food past its use-by date should be placed in organic waste recycling bins for separate collection. Waste bins containing organic waste may be chilled, especially in urban locations, to prevent odour and vermin problems (e.g. Scandic Berlin, 2011).

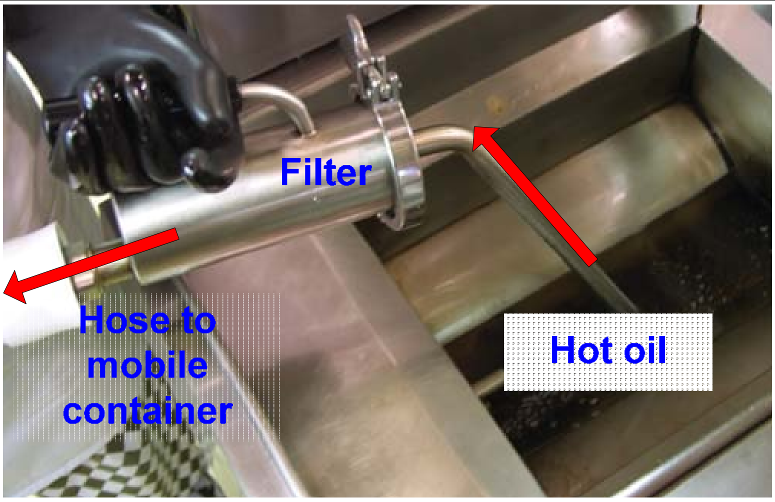
In the case of The Savoy, organic waste is sent to a combined heat and power plant (fluidised bubbling bed reactor) to generate heat and electricity (see Figure 8.12). The electricity generated from the hotel's waste is sufficient to supply 10 % of the hotel’s rooms.

<u>Recovery of used cooking oil</u>
Prior to sending organic waste for anaerobic digestion or composting, it should be screened to separate out useful organic fractions such as cooking oils, fats and grease. Oils can be stored in secure containers for collection by companies specialising in the production of biodiesel, or animal feed, soap or cosmetics production. Oils can also be recovered from oil traps that should be fitted to kitchen drains.

The Savoy in London has one main kitchen serving the restaurants, one large canteen kitchen serving the 600+ staff, and three kitchens for banqueting services. These kitchens generate 600 litres of used oil every month. During a recent refit, a semi-automated cooking oil management system was installed. This system comprises:

- a central storage tank with automatic level recording that is connected via telemetry to the collection company's monitoring system
- a mobile container on wheels with a hose resistant to high temperature oil
- an oil filter and lance that attach on to the hose (Table 8.8)
- a contract with PDM 'Oilsense' that includes:
  - provision of equipment and oil collection as required for a monthly fee
  - payment for oil collected (EUR 0.30 per litre, index linked to diesel prices).

Table 8.8: Operation of the Oilsense used oil collection system



1. Oil extraction from fryers

2. Removal of filter debris

3. Emptying separated water and rinsing of filter

Source: PDM Group (2011).

System operation is summarised in the following three steps.

Step	Description
1	Oil is changed at appropriate intervals, informed by data received from analyses of collected oil (see below). Hot cooking oil is removed from fryers by inserting a lance attached to a mobile vacuum container, or 'pot', (like a vacuum cleaner) via a filter and hose (Table 8.8). Safely removing hot oil reduces fryer degreasing requirements, keeps pipe-work clear, and offers flexibility in terms of timing (e.g. oil from a single fryer can be changed in five minutes between use).

2	The oil is transported in the pot to a depository point, where it is expelled into a pipe feeding a central collection tank (typically 1 000 to 2 000 litres capacity). Used oil may also be returned to fryers after filtration, potentially prolonging necessary change intervals. In the case of The Savoy, owing to the high standards expected in the restaurants, cooking oil is changed daily from the main kitchen, and transferred to the canteen kitchen for reuse. The filter removes debris that can be discarded to an organic bin, and separates water that can be emptied into a sink during rinsing (Table 8.8).
3	Upon receiving telemetry data that indicates the collection tank is full, the collection company dispatches a tanker to collect the filtered oil (25 % less volume owing to prior removal of debris and water), thus optimising collection transport. A sample is taken from each batch collected and a number of chemical parameters are analysed to ensure the oil is suitable for biodiesel production. Results for the free fatty acid concentration are returned to the client to inform them of the quality of collected oil, and facilitate the optimisation of change frequency (free fatty acid concentrations in used oil range from 1.5 % to 9.5 %, but should be below 5 %).

This system is also installed in fast food restaurants across the UK with a centralised collection incorporating piping from the fryers directly to the collection tank (oil is changed at the push of a button). The system is being expanded to deliver fresh cooking oil via tanker, thus reducing packaging and transport.

Operational details relating to central anaerobic digestion plants with energy recovery and central composting are presented in section 3.3 in relation to destination management.

<u>Composting</u>
Prior to composting, organic waste should be screened to separate bones, uncooked meat and animal by-products not suitable for on-site composting (EC 1774/2002; DEFRA, 2011), and reusable organic fractions such as cooking oils, fats and grease. Oils can be stored in secure containers for collection by companies specialising in the production of biodiesel, or animal feed, soap or cosmetics production. Kitchen waste suitable for composting includes: fruit and vegetables, bread, rice, potato peels, kitchen roll, coffee and tea filters, potted plants, meat without the bone, fish, dairy products, egg shells and egg boxes. The screened organic waste may then be collected and taken to centralised composting facilities (e.g. Figure 3.18), or composted on site. Some local authorities and private companies across Europe collect organic waste for composting.

To initiate on-site composting, it is recommended to introduce only garden waste at the beginning, then when the system has been established, to slowly include kitchen waste. Closed vessels should be used for kitchen waste to avoid vermin and odour problems, and can generate quality soil conditioner within 3 – 4 weeks during warmer months (Compost doctors, 2010). Commercially available enzyme supplements may be sprayed onto the food waste to enhance microbial performance. To ensure that material is hygienically treated, the temperature of the compost should be monitored and should be maintained above 60 ºC.

Modern small-scale automated compost systems are available that use monitored information on temperature and moisture to determine the frequency of automated turning. These often include two chambers so that waste can be added to one batch whilst the other matures. The Tower Hotel in Perthshire, Scotland, installed an automated system that consumes less than four kWh per day to generate composted material in around 14 days (compared with 12 – 18 months for the basic compost heaps it replaced). Output is screened for size: material greater than 25 mm is returned for further composting and the finer fraction is stored for maturation for a further two months before use on the hotel grounds. Kitchen vegetable waste is collected in biodegradable bags and six litre bins. In the first year after installation in 2006, the system processed 2.5 m^3

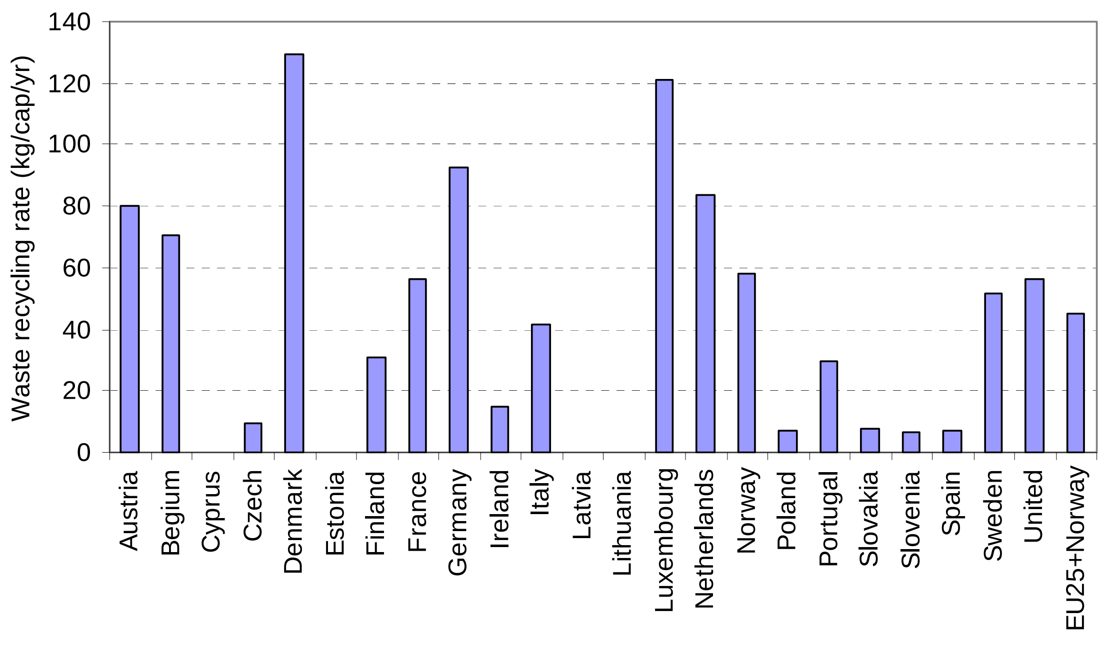
(1.25 tonnes) of vegetable waste from the hotel kitchen, and a further 6 m^3 (1.25 tonnes) of garden waste to produce 1.5 tonnes of compost.

Vermicomposting, based on selected species of earthworms, may be used to accelerate the decomposition of organic wastes into useful compost by aerobic microorganisms such as fungi and bacteria. Unlike composting, effective vermicomposting requires temperatures below 35 ºC (to avoid the death of earthworms). Hence vermicomposting systems require waste to be applied frequently in thin layers of a few centimetres to beds or boxes containing earthworms. Vermiculture may also be large-scale and centralised. Automated reactor systems have been installed which allow waste to be fed from a gantry above the reactors while finished vermicompost is collected from the base using breaker bars. Such a vermicomposting system was installed in 1991 at Montelemar, France to process organic matter from the town's household waste stream. Mixed waste is sorted and then pre-composted for 30 days before being vermicomposted for 60 days by an estimated 1 000 million earthworms. Approximately 27 % of town's total waste stream is converted in a number of reactors to good quality vermicompost which is then bagged and sold.

Applicability

Anaerobic digestion

Some local authorities and private companies across Europe collect organic waste for treatment in centralised anaerobic digestion plants. However, the provision of recycling services for organic waste varies considerably across European countries, and in some cases is poor – reflected in low rates of recycling (Figure 8.15).



Source: ETC/SCP (2010).

Figure 8.15: Organic waste recycling rates across European Member States plus Norway

Where collection to centralised anaerobic digestion facilities is not provided, hotels may enter into agreements with local farmers operating small-scale biogas plants. For example, the Hilton Slussen Hotel in Stockholm sends its waste to a nearby farmer for anaerobic digestion.

Composting

Where neither centralised nor decentralised anaerobic digestion, nor collection for incineration with energy recovery, is available, accommodation and restaurants may either send waste for composting, or, if outdoor space and compost demand is sufficient, compost waste on site. Legislation varies across EU member states with regard to decentralised composting. There may be requirements for the area where composting takes to be paved or sealed for soil and groundwater protection, and for a risk assessment to be performed if the site is within 250 m of a sensitive receptor.

Uncooked meat and animal by-products are subject to regulations including EC 1774/2002 laying down health rules concerning animal by-products not intended for human consumption. For example, the UK's Animal By-products Regulation prevents the decentralised composting of raw meat and other uncooked products of animal origin owing to risk of animal diseases such as Foot and Mouth. Hotels and restaurants may compost their own kitchen waste for use on site provided that livestock are not present (DEFRA, 2011).

Economics

Avoided food purchasing

Minimising organic waste through careful meal preparation and appropriate menu offers reduces the quantity of food that is purchased. This can result in substantial economic savings – greater than those achieved through avoiding landfill. It has been estimated that a 20 % reduction in organic waste arising from UK restaurants would result in an economic saving of more than EUR 2 300 per restaurant per year, on average, in avoided food costs (SRA, 2010). This is equivalent to EUR 530 per tonne waste avoided.

Oil collection

Used kitchen oil generates a small income when collected for biodiesel production. Clients of the 'Oilsense' system described above receive a payment of EUR 0.30 per litre, index linked to diesel prices. Compared with less sophisticated used oil collection systems, the semi-automated 'Oilsense' system is self-financing. Clients with kitchens pay a flat monthly fee for the equipment (no upfront installation cost), and can reduce costs through: (i) reduced handling requirements (less staff time); (ii) fewer accidents handling hot oil; (iii) receipt of oil quality data that can be used to optimise change intervals.

Landfill and incineration

Most European countries impose a landfill levy that is increasing every year. In Ireland, the landfill levy was EUR 50 per tonne in 2011, rising to EUR 75 per tonne in 2012. In the UK, the landfill tax was EUR 65 per tonne in 2011, rising to EUR 100 per tonne in 2014, and these incurred charges are further subject to Value Added Tax. Collection and transport fees are charged in addition to such levies, so that total cost of waste disposal to landfill is typically in the region of EUR 100 to EUR 150 per tonne. In Switzerland, the costs for mixed waste incineration, including transport, are between 110 and 150 EUR per tonne. In Germany, two hotels in Freiburg are charged EUR 116 per tonne for the disposal of organic waste, translating into annual costs of EUR 12 094 and EUR 11 222, and a cost per dining guest of around EUR 0.025 to 0.035, respectively.

Charges for separated organic waste are usually considerably lower than charges for mixed residual waste. In Denmark, the respective charges are EUR 30 and EUR 130 (Affald Og Genbrug, 2011). In addition, separating organic waste can reduce the required frequency for residual waste collection. The Savoy in London reduced mixed waste collection frequency from four-times to twice per week following the removal of food waste from the mixed waste stream, saving EUR 12 000 per year in landfill charges and EUR 12 000 per year in waste collection charges.

Following the introduction of a brown bin service, one large Irish hotel reduced the volume of waste sent to landfill by 70 %, saving EUR 21 000 per year. These savings included avoided compactor rental (lower volume of mixed waste requiring compacting) (Irish EPA, 2008).

Anaerobic digestion

Sending organic waste for anaerobic digestion is comparable in price to sending it for landfill or incineration (SRA, 2010), but it will become cheaper as landfill charges increase (see above). For the Swiss plant mentioned above, a gate fee of approximately EUR 70 per tonne plus transport costs of between 15 and 45 EUR per tonne are paid by the waste generators, including hotels and restaurants. This is lower than Swiss incineration costs of 110 to 150 EUR per tonne referred to above. In Switzerland, the operators of biogas plants receive 11 cents/kWh of electricity fed to the public grid. In case other organisations buy credits for certified eco-electricity, the operator may receive another 6.5 cents/kWh.

Composting

Composting organic waste where other options are not available avoids above-mentioned collection and landfill charges, but incurs equipment and management costs for which subsidies may be available. Compost may be used on site for soil conditioning and fertilisation, reducing expenditure on soil conditioners and fertilisers. A cost-benefit analysis was performed for an automated composter unit comprising a two-chamber composting system capable of handling up to 100 litres or 50 kg of waste per day and with an electricity demand of 900 kWh per year (Smartsoil, 2011). The significant investment is paid back within nine years, assuming waste disposal costs of EUR 115 per year (Table 8.9). It is likely that waste disposal costs will continue to increase annually, thus resulting in shorter payback times.

Table 8.9: Calculation of annual savings and payback period for installation of an automated composting unit

Factor	Cost	Benefit
Equipment cost (EUR)	22 000	
Power supply[1] (EUR/yr)	135	
Savings on waste reduction[2] (EUR/yr)		2 100
Savings on purchase of plant nutrients (EUR/yr)		500
Simple payback time	9 yrs	

[1]Assumes EUR 0.15 / kWh
[2]Assumes EUR 115/tonne collection and disposal cost
Source: Ecotrans (2006); Foodwaste.ie (2010); Smartsoil (2011).

Driving forces for implementation

Driving forces for implementing organic waste separation and composting or collection for anaerobic digestion include:

- national targets to reduce biodegradable municipal waste disposed of in landfills, as required by Article 5 of the Landfill Directive (1999/31/EC)
- regulations regarding the treatment of animal by-products, including EC 1774/2002, preventing landfill and restricting small-scale composting
- environmental responsibility
- differentiated charges for collection of organic waste for anaerobic digestion and incineration or landfill (see above)
- avoided collection and disposal charges (on-site compsiting)
- voluntary EMS or ecolabel criteria
- environmental marketing – waste management is a visible demonstration of environmental commitment.

Reference organisations

Reference organisations providing examples of best practice are referred to throughout the above text. A few specific examples are compiled in Table 8.10.

Table 8.10: Examples of best practice in organic waste management

Organisation	Actions
Hilton Slussen hotel, Stockholm	This hotel has separated organic waste and sent it for biogas production since 1997. The residue is sent to farmers outside Stockholm for use on their fields.
The Hilton/Scandic hotel group	Many of these hotels send waste for anaerobic digestion, and an increasing number of company cars are run on biogas (Waste Management World, 2011).
Huerta Cinco Lunas, Cadiz, Spain	This small rural accommodation uses kitchen waste for chicken feed and composting, to produce organic fruit, vegetables and eggs on site for guest consumption (see section 8.1).
The Savoy, London	Aspects of the food waste programme being implemented at the five-star Savoy Hotel, London, are referred to throughout this section and in section 6.2 (recycling of used corks).
The Tower Hotel in Perthshire, Scotland	On-site composting using an automated composting system is described above.

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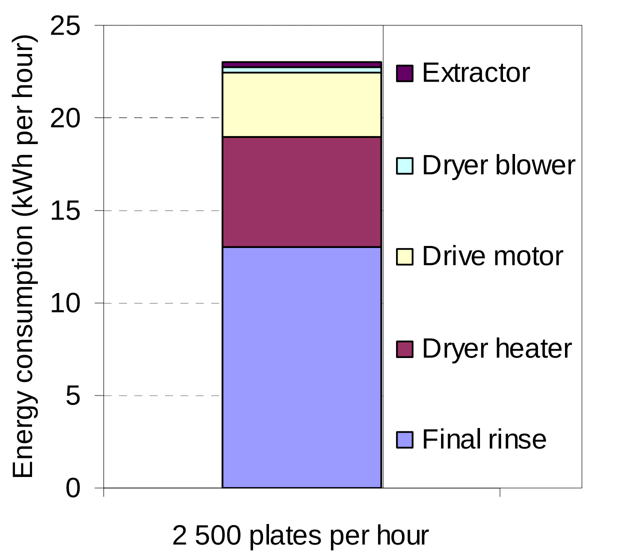
8.3 Optimised dish washing, cleaning and food preparation

Description

Dish washing is the most water-demanding process occurring in kitchens, accounting for approximately two-thirds of water consumption. Virtually all commercial kitchens use an automatic dishwasher appliances, and many use high pressure rinsing with pre-rinse spray valves (PRSVs) to remove large particles of food and grease off dishes, pots and pans before they are placed in the dishwasher. Standard PRSVs consume around 15 litres of water per minute, typically account for 30 % of kitchen water use, and can easily and cheaply be replaced with low-flow nozzles that produce a more efficient high-pressure spray pattern and use less than 6 L/min, saving up to 570 L hot water per day in a typical SME kitchen. Sensor- or trigger-activated PRSVs can also significantly reduce wastage by ensuring that water only flows when required to wash dishes.

Dishwashers use approximately 60 % less water than washing by hand. Nonetheless, commercial dishwashers are responsible for around one third of water consumption in kitchens, and a large portion of energy consumption. Average water use efficiency in commercial dishwashers has improved from 4.6 L per rack in the late 1990s to 3.8 L/rack in 2010, but varies considerably across types and models – the most efficient models use less than 2.0 L per rack (Alliance for Water Efficiency, 2011). Figure 8.16 displays a breakdown of energy consumption in an efficient modern conveyor-type machine suitable for hotel and restaurant kitchens (Meiko, 2011). Total energy consumption of 23 kWh per hour is dominated by heating of the final rinse water (56 %) and dryer air (26 %). Energy consumption is thus strongly related to water consumption (in this case 260 L per hour), and both are minimised through the following features:

- recycling of rinse water to wash and prewash cycles
- recovery of 20 % of wash water through filtration for rinsing
- optimised circulation of drying air
- recirculation of 65 % of drying air
- recovery of heat and moisture from vented drying air to preheat rinse water.



Source: Meiko (2011).

Figure 8.16: Operational energy consumption in an efficient dishwasher processing 2 500 plates per hour

Selection of an efficient and appropriately sized dishwasher can reduce water and energy consumption for dish washing by over 50 %, and is a key aspect of best environmental management practice in kitchens. Additional best practice measures related to the installation and operation of dishwashers include connection to the hot water supply, maximising loading rates, correct programme setting, and green procurement of chemicals. Table 8.11 summarises best practice measures to minimise water (and energy) consumption in kitchens.

Table 8.11: Important measure to reduce water (and energy) consumption across kitchen processes

Aspect	Measure	Description
Dish washing	Efficient pre-rinse spray valves	Install or retrofit PRSVs nozzles to produce a maximum flow of 6 L/min. Install or retrofit sensor- or trigger- activation.
	Efficient dishwashers	Select an appropriate size and type of efficient dishwasher with water consumption ≤2 L per rack (tunnel dishwasher).
	Heat recovery	Install heat-recovery.
	Optimised loading and programming	Maximise dishwasher loading, and set programmes to optimise water, chemical and energy consumption (e.g. avoid prewash).
	Green procurement of chemicals	Avoid environmentally harmful chemicals and select ecolabelled dishwasher chemicals.
Food preparation	Low flow sink taps	Install efficient taps, or retrofit with pressure regulators and/or aerators to achieve flow rates ≤12 L/min.
	Efficient food preparation techniques	Avoid use of continuously flowing water to defrost and wash food.
	Replace older boiler steam cooker and water-cooled wok ranges	Replace old boiler steam cooker with modern boilerless version using ≤8 L water per hour. Replace wok ranges that require water cooling.
Cleaning	Efficient floor cleaning	Avoid the use of hosepipes for floor cleaning (use a mop or water-broom).
	Efficient cleaning of food surfaces	Use correct dilution volumes and select ecolabelled cleaning products.
	Avoid tablecloths	Purchase tables with attractive wipe-down surface that can be used without tablecloths.

Fittings can be modified to reduce the scope for wastage. In particular, infrared sensors can be used to control sink taps according to requirements, and easy-to-operate triggers on PRSVs ensure water flows only on demand. Other equipment that can reduce water consumption includes:

- 'connectionless' or 'boilerless' steamers that recycle steam condensate in heated water reservoirs and that eliminate the need for condensate cooling water, reducing water consumption from over 100 to less than 10 L/hour
- mops or water brooms used instead of hosepipes to wash floors (Alliance for Water Efficiency, 2011)

- air-cooled rather than water-cooled ice makers (Smith et al., 2009).

Basic practice is to avoid water wastage through use of continuous flows to cool refrigeration condensors (Accor, 2007). The flow rate on automatic potato peelers should be minimised, and liquid organic waste disposal units avoided.

Staff training is critical to minimising water consumption in kitchens. Chefs often have little awareness on water or energy conservation, and small changes in food preparation can lead to significant reductions in water consumption. Examples of actions that can significantly reduce water consumption in kitchens include:

- avoiding the use of continuously flowing water to thaw food
- avoiding the use of continuously flowing water to wash food
- avoiding quenching and refreshing of partially cooked vegetables (can be removed from the pan just before they are done and placed directly onto plates for serving up).

Achieved environmental benefit

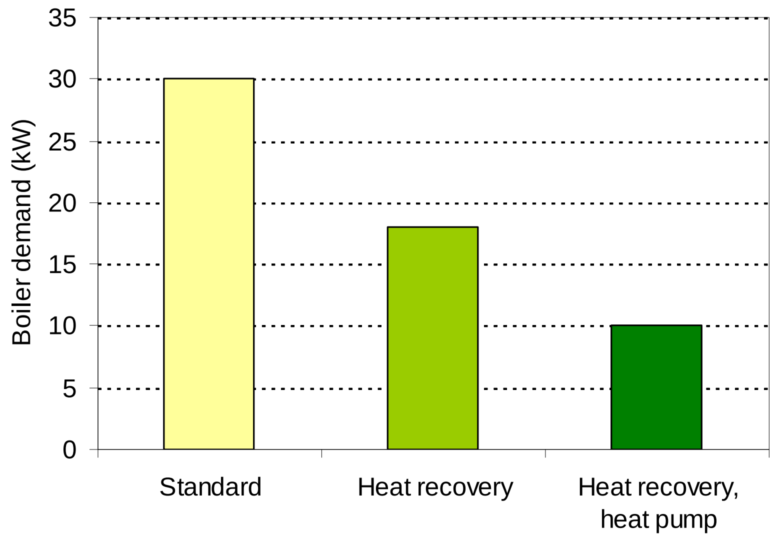
Achievable water savings are referred to in Table 8.12. Installing efficient PRSVs and dishwashers can achieve the greatest annual water savings. Replacing boiler steamers with boilerless steamers (where relevant) can also result in high annual water savings.

Table 8.12: Water savings achievable following implementation of best practice measures

Measure	Achievable reduction in specific consumption	Typical SME annual saving
Efficient PRSVs	67 % (from 15 to 5 L/min)	200 m^3
Efficient dishwasher	50 % (from 4 to 2 L/rack)	150 m^3
Low flow sink taps	40 % (from 20 to 12 L/min)	50 m^3
Efficient steam cookers	92 % (from 100 to 8 L/ hour)	200 m^3
Waterless thawing	100 % (from 10 hrs per week under running water)	10 m^3
Source: Smith et al. (2009); Alliance for Water Efficiency (2009; 2011); Karas (2005).		

Chemical dosing in dishwashers is based on water consumption, so that chemical consumption is proportionate to water consumption. Chemical-saving systems that use an extra prewash cycle and deionised water for rinsing can reduce chemical dosing by up to 80 %, equivalent to 400 litres per year for a water-efficient machine.

Machines incorporating heat recovery and heat pumps have considerably lower water-heating energy requirements compared with standard machines. Heat recovery can reduce energy consumption for water heating by around 40 %, and heat pumps by an additional 45 %, so that the most efficient machines consume two-thirds less energy for water heating than standard machines (Figure 8.17). Measures that reduce heating energy consumption during washing can also reduce the cooling demand in kitchens, thus reducing energy consumption in the HVAC system.



Source: Kromo (2011).

Figure 8.17: Energy savings from heat recovery and heat-pump on a flight-type dishwasher

Appropriate environmental indicator

Indicators

Table 8.13 lists relevant indicators of best practice to minimise water consumption in kitchen areas.

Table 8.13: Relevant indicators of best practice across environmental aspects

Aspect	Indicators of best practice
Monitoring	– Kitchen water consumption is monitored separately and recorded at least once per month(*)
Dish washing	– Waste grinders not used – PRSVs are fitted with trigger operation and have a maximum flow rate of ≤6 L/min – New stationary (under-counter or hood type) dishwashers have rated water consumption ≤3 L per rack – Tunnel dishwashers are installed with heat recovery and heat pump – Dishwashers are connected to hot water supply, or to a dedicated gas boiler in the case of tunnel washers – New conveyor dishwashers have rated water consumption of ≤2 L per rack equivalent – Dishwasher racks are filled before loading into the dishwasher
Food preparation	– Sink taps are installed with foot pedal or sensor operation and have maximum flow rate ≤12 L/min – Steam cookers consume ≤8 L water per hour of operation – Thawing under running water is avoided
Cleaning	– Use of hose to wash floor is avoided – Cleaning agents do not contain the following: alkylphenolethoxylates (APEO) and alkylphenol derivatives (APD), dialkyl dimethyl ammonium chloride (DADMAC), linear alkylbenzene sulphonates (LAS), reactive chlorine compounds (exemption if required by authorities for hygiene reasons(*) – At least 70% of the purchase volume of chemical cleaning products (excluding oven cleaners) for dish washing and cleaning are ecolabelled(*)
(*) Nordic Ecolabelling (2009) criteria.	

Benchmarks of excellence

Data on specific water consumption in kitchens are sparse. Business Link (2011) suggest 25 L per cover (dining guest) for a luxury catering facility, and 15 L per cover for buffets in function rooms, whilst ITP (2008) suggest 35 L per cover for luxury accommodation. Benchmarks from these sources have been found to be consistently high compared with benchmarks derived from best performers described in other techniques. Kitchen water consumption from two Scandic hotels (Scandic Hotels, 2011), representing the preparation of restaurant meals and breakfasts, translate into kitchen water consumption of approximately 13 L per cover, if breakfast is assumed equal to one cover. A preliminary benchmark of achievable performance is therefore total kitchen water consumption ≤13 L per cover.

However, in light of low data availability on kitchen water consumption, the following benchmarks of excellence are proposed in the first instance:

BM: implementation of a kitchen water management plan that includes monitoring and reporting of total kitchen water consumption normalised per dining guest, and the identification of priority measures to reduce water consumption.

BM: installation of efficient equipment and implementation of relevant efficient practices described in this document, as far as possible within demonstrated applicability and economic constraints.

BM: at least 70 % of the purchase volume of chemical cleaning products (excluding oven cleaners) for dish washing and cleaning are ecolabelled.

The benchmark for total chemical use in accommodation enterprises (see housekeeping section 5.3) is also applicable for this technique where kitchens are located on accommodation premises.

Cross-media effects

Measures that reduce water consumption also reduce energy consumption associated with water treatment and pumping, and water heating in the case of hot water. Low flow PRSVs, optimal loading of dishwashers, efficient food preparation and efficient cleaning are therefore not associated with cross-media-effects.

In terms of replacing older dishwasher machines, approximately 90 % of the lifecycle impact of white goods arises during operation, compared with 10 % during manufacture and disposal. Therefore, it is usually more environmentally responsible to replace an older dishwasher with a more efficient one rather than pay to have it repaired (Environment Agency, 2007).

In dishwasher selection and programming, there may be a trade-off between reducing energy and reducing chemical consumption. Low temperature dish washing can considerably reduce energy consumption but requires higher concentrations of detergent. Commercial systems available to minimise chemical consumption consume energy by: (i) incorporating an additional 'scouring' spay before the wash cycle; (ii) applying reverse osmosis to rinse water so that no rinse agent is required. However, the relative savings in chemicals (80 %) are high compared with the modest relative increase in energy consumption.

Operational data

Dishwasher selection

There are many types and sizes of dishwasher, including under-counter or over-counter stationary front-loaders, stationary and pass-through hood-type, rack conveyor machines and large flight type (continuous conveyor) machines that may employ single or multiple wash tanks and use hot water above 82 ºC (high-temp machines) or chemicals (low-temp machines) to achieve final rinse dish sanitisation.

In the first instance, it is important to decide on the machine capacity required. Machine capacities are usually expressed as the maximum number of 'baskets' or 'racks' that can be processed in one hour. One standard rack measures 500 mm by 500 mm, and can hold 18 standard plates, or the serving ware for 4 covers. A full wash cycle ranges from 1 minute in conveyor pass-through machines up to two hours in some under-counter machines (but commercial under-counter machines are available with cycles of a few minutes). Timing varies depending on the programme selected. Conveyor machines usually have at least two belt speed settings, for normal and dirty work: slower (more intensive) settings are typically designed to ensure a minimum contact time of 2 minutes with water at ≥82 ºC, as recommended in the German commercial dishwasher hygiene standard – DIN 10510. It is important to note that maximum quoted capacities are theoretical for the shortest programme times, and do not consider: (i) the time taken to load and unload machines (for door-type machines); (ii) typical incomplete rack filling; (iii) more intensive programmes (Dishwashers Direct, 2011). Compliance with the DIN 10510 standard can reduce capacity by 30 % to 50 % compared with maximum quoted capacity (Meiko, 2011). Selection of an appropriate type and size of machine depends on the peak washing demand and the maximum time available to work through this demand (assuming sufficient serving ware is available). Table 8.14 provides an approximate guide.

Table 8.14: Recommended dishwasher types for different meal serving rates

Meals per hour	Dishwasher type	Racks/hour
≤100	Under-counter	35
100 – 500	Hood	125
500 – 2000	Conveyor (rack)	450
2 000+	Conveyor flight (rackless)	1 000
Source: Restaurant Report (2011).		

For dish washing in smaller kitchens, hood-type dishwashers are appropriate. Older hood-type dishwashers typically have separate wash and rinse tanks, uninsulated hoods, are not configured for connection to hot-water supply pipes, and often require a manual prewash of dishes to remove debris. Newer hood-type dishwashers (Figure 8.18) have insulated hoods that guide steam away from operators when opened, and typically integrate additional systems such as water treatment, thermostat-controlled prewash functions, and drying functions.

Source: Meiko (2011).

Figure 8.18: A modern hood type dishwasher

Critical aspects to consider when selecting a new dishwasher include: (i) equipment lifetime; (ii) rated electricity (and other heat energy) consumption; (iii) rated water consumption; (iv) rated chemical consumption; (v) service and maintenance requirements. In terms of environmental performance, the primary indicator of a commercial dish washing machine efficiency is **water efficiency** as this is closely related to energy and chemical consumption (see Figure 8.16). Table 8.15 provides an indication of good performance for different types of dishwashers, in terms of idle energy (to keep tank water hot) and water use per rack. Energy Star criteria have not yet been developed for very large flight-type conveyor dishwashers, but Koeller et al. (2010) present data indicating that the most efficient quartile of such machines use the equivalent of 1.1 L/rack (single tank) and 0.76 L/rack (multiple tank).

Table 8.15: Energy star criteria (maximum idle energy and water consumption) for high temperature dishwashers

Dishwasher type	Idle energy rate(*)	Water use
Under counter	≤0.9 kW	3.8 L/rack
Stationary single tank	≤1.0 kW	3.4 L/rack
Single-tank conveyor	≤2.0 kW	2.6 L/rack
Multi-tank conveyor	≤2.6 kW	2.0 L/rack

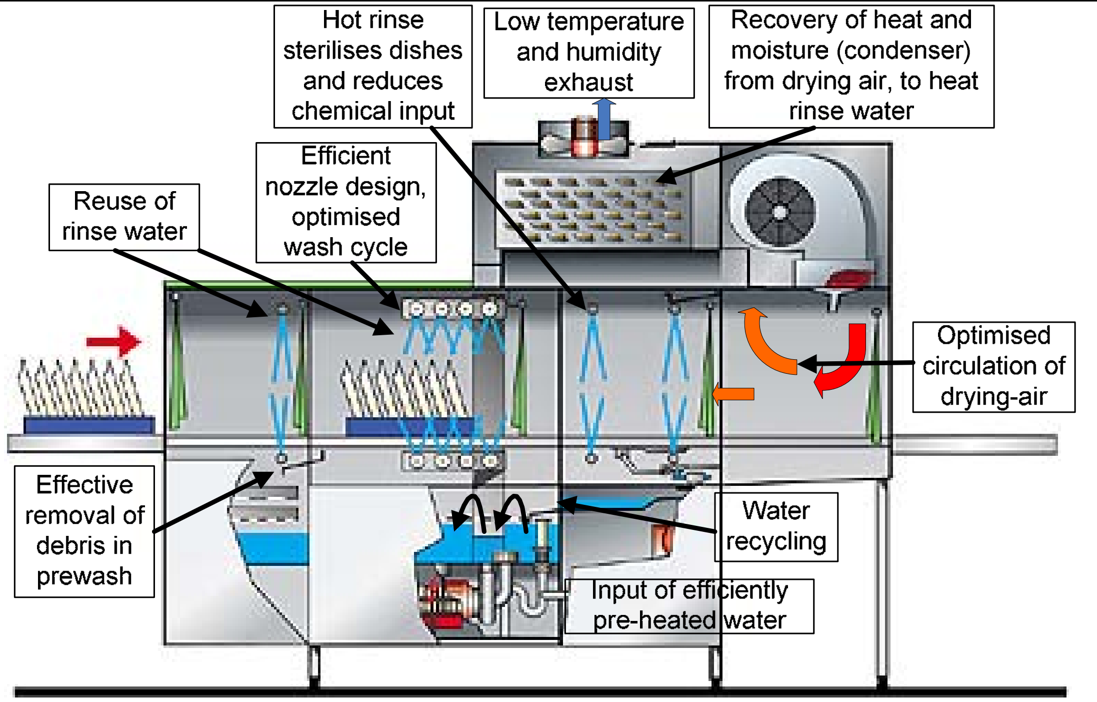
(*)energy used by tank heater only.
Source: Koeller et al. (2010).

The following specifications are highly recommended for commercial dishwashers:

- rinse-water recycling for wash and prewash (multiple tanks)
- rated water consumption ≤2.5 L per basket (tunnel type) or ≤3.5 L per basket (hood type)
- drying air heat recovery system
- at least 20 mm of insulation

- at least two speed settings for standard and dirty dishes (tunnel type dishwashers)
- automatic process control in response to loading (tunnel type dishwashers).

Figure 8.19 displays some key efficiency features for a rack-loaded tunnel-type dishwasher. Efficient machines recirculate 50 – 70 % of blower air following heat recovery and condensation to heat rinse water, and enabling direct venting of relatively cool and dry exhaust air at street level (e.g. Savoy Hotel, London). Recent design advancements include water filtration and recycling to the first rinse cycle, reducing water consumption by up to 20 %, or to a prewash 'scouring' cycle that considerably reduces detergent requirements in the wash zone. Additional considerations are the heat source and type of sterilisation system (heat- or chemical-ased). Commercial machines are available with electric, gas or steam heating options. Gas heating can reduce primary energy consumption by approximately 50 % compared with electric heating, except where the establishment generates or purchases genuine 'green' electricity (see section 7.6). Large conveyor machines are available with a heat pump that can reduce energy consumption for water heating by 50 %.



Source: Elaborated from Meiko (2011).

Figure 8.19: Schematic representation key efficiency features for a rack-loaded tunnel dishwasher

Many manufacturers of commercial dishwashers offer modular systems that enable close matching of installed equipment to requirements and user specifications. Smaller front-loading or hood-type machines may be installed to wash glasses, and hood-type machines to wash pots and pans. Similar selection criteria apply to these as to dishwashers described above. Various public agencies offer energy and water efficiency information to guide efficient procurement.

Figure 8.20: A conveyor-type dishwasher with heat recovery installed in The Savoy

<u>Optimised dishwasher installation and operation</u>
Some factors to consider when installing commercial dishwashers are elaborated below.

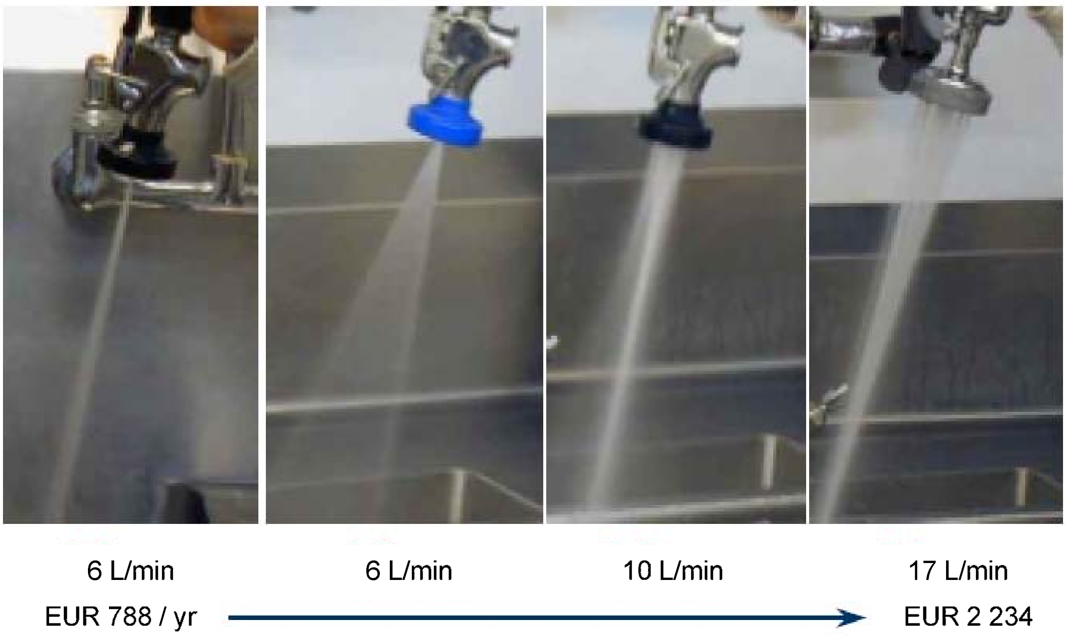
- For dishwashers that use electricity to heat the rinse water, it is preferable to connect the dishwasher to the hot water system, minimising top-up heating.
- Minerals dissolved in standard supply water leave an 'unclean' finish on washed dishes and glasses, and cause scaling (blockage of nozzles and filters) in dishwashers, leading to inefficient operation and high maintenance requirements. It is recommended that commercial dishwashers are either specified or retrofitted with built-in water softeners or supplied with water conditioned in centralised onsite equipment (section 5.1). Owing to the sensitivity of dish and glass washing to water mineral content, some hotels install a dedicated high-performance water conditioner for the kitchen water supply (e.g. Scandic Berlin, 2011).
- High temperature and humidity exhaust air must be vented outside, either at a minimum height above ground level or following condensation, according to various national regulations. Recovery of heat and moisture from exhaust air avoids the installation of long vent pipes or separate condensers.

Staff training to ensure correct loading of dishwashers is critical for efficient machine operation and effective washing. It is worth investing in sufficient serving ware to enable any stock-piling necessary to ensure full loading. Some key points for efficient dish washing are listed in Table 8.16. Food remains on all serving ware should be scraped off into appropriate organic recycling bins (section 8.2), and dishwasher racks loaded as fully as possible. The standard of washing required (e.g. DIN 10510) may dictate the wash programme (conveyor speed) in the first instance. Commercial machines use automated dosing systems, and typically consume 3 ml of detergent per litre water, and 0.3 g rinse aid per litre water (Meiko, 2011). Monitoring of chemical use can help to identify any problems with these systems, and is required to report and benchmark overall chemical consumption (see Fig. 6.x in section 5.3). Similarly, it is important to monitor and check water and energy consumption for early indications of problems, and to inspect dishwashers for correct fill levels (detergents, rinse agents, ion-exchange salts, etc.), functioning instrumentation (thermometers, pressure gauges), and leaks. Water contained in wash tanks should be dumped at intervals specified in manufacturer instructions.

Table 8.16: Some key points to ensure efficient operation of dishwashers

Stage	Key points
Prewash	– Modern dishwashers do not require manual prewashing of serving ware (simply scrape plate contents into appropriate bins: see section 8.2) – pots and pans should be prewashed by soaking and application of high-pressure sprays – collect the serving ware into large batches with similar wash requirements – fill baskets/racks completely
Wash	– where possible in small kitchens, time dishwashers to operate during off-peak electricity demand times (at lower tariffs) – ensure that the dishwasher settings are optimised in relation to how dirty the serving ware is – ensure that the correct chemical dosing is applied
After wash	– if there is a long time between wash intervals, turn the dishwasher off – check the filters and check if there is salt in the machine if there is not a reverse osmosis unit installed – for hood-type dishwashers, ensure that the hood is fully closed to minimise heat loss – check for leaks – regularly check rinse nozzles for wear

Where pots, pans and other utensils are washed in a standard dishwasher, it is necessary to prewash them by soaking in water to soften residues and by using a PRSV. Modern efficient PRSVs use one-third of the flow of older versions, and achieve effective residue removal through high-pressure single-jet spray patterns (Figure 8.21). Trigger operation ensures water flows only when required. Waste grinders should be avoided, and can be replaced with simple mesh baskets that fit inside sinks and capture solid waste materials. These can be emptied directly into organic waste bins.



Source: Modified from Fisher (2006).

Figure 8.21: Examples of PRSV spray patterns and flow rates, and associated annual operating costs assuming three hours per day operation

Food preparation and cooking

Water consumption during food preparation can be reduced through the installation of efficient equipment, in particular sink taps with a maximum flow rate of 12 L/min and operated by foot pedals or sensors (e.g. passive infrared sensors). Flow rates can be reduced without changing tap fittings, through installation of pressure regulators and/or aerators (see section 5.2). Leaks are a common problem in kitchen sink areas, and rubber seals in tap fittings can be replaced with inexpensive ceramic valve retrofits to reduce the occurrence of leaks (O'Neill, 2002).

Staff training is important to reduce water used during washing, although the potential for bad practice can be reduced through the installation of appropriate fittings, especially trigger-activated PRSVs and pedal- or sensor-operated taps. It is important to check that such systems are not being by-passed, for example by jamming PRSV triggers.

Thawing frozen food under running water should be avoided. Thawing food on the bottom shelf of the refrigerator has the added benefit of increasing the operational efficiency of the refrigeration unit. Care must be taken to avoid cross-contamination that can occur by, for example, placing frozen food above ready-to-eat food. Dedicated thawing units thaw food five times faster than a refrigerator, and are appropriate where quicker thawing times are required (Travel Foundation, 2011).

Where old boiler steam cookers are installed, it is worth investing in new boilerless versions that use considerably less water and energy (see 'Economics' section, below). Well insulated wok ranges do not require cooling water. Basic good practice is to avoid or replace wok ranges that require water cooling and can use up to 1 850 L water per day (Energy Star, 2011).

Cleaning

Best practice in kitchen cleaning is similar to best practice in room cleaning described in section 5.3. Key points are to

- avoid use of water hoses to clean floors (use mop or alternative such as a water-broom);
- ensure correct cleaning chemical dilution ratios (display clear instructions and use automatic dosing machines);
- monitor and report all chemical use on a monthly basis;
- avoid environmentally damaging chemicals as defined by Nordic Swan (2009):
    - alkylphenolethoxylates (APEO) and alkylphenol derivatives (APD);
    - dialkyl dimethyl ammonium chloride (DADMAC);
    - linear alkylbenzene sulphonates (LAS);
    - reactive chlorine compounds (exemption if required by authorities for hygiene reasons);
- purchase ecolabelled chemicals where possible.

Applicability

Installation of water-efficient fittings, such as trigger-operated low-flow PRSVs and pressure restrictors or aerators, and water-efficient cooking devices such as boilerless steamers, is universally applicable. Optimised dishwasher loading and maintenance is also universally applicable.

Hood-type dishwashers are suitable for small to medium-sized restaurants, tunnel dishwashers are suitable for large kitchens. Green procurement is usually implemented when replacing an old dishwasher. It may be cost effective to replace older dishwashers before they reach the end of their working life: consider the cost savings of replacing any machines over 15 years old (Carbon Trust, 2007).

Economics

PRSVs and taps

Good quality efficient PRSVs can be retrofitted for less than EUR 50, and have a lifetime of 5 years. Annual savings range from hundreds to thousands of euro (Figure 8.21), resulting in payback times of a few months.

The installation of pressure regulators and aerators is associated with very short payback periods of months, and the installation of new tap fittings and sensor controllers is associated with relatively short payback periods of a few years (see section 5.2).

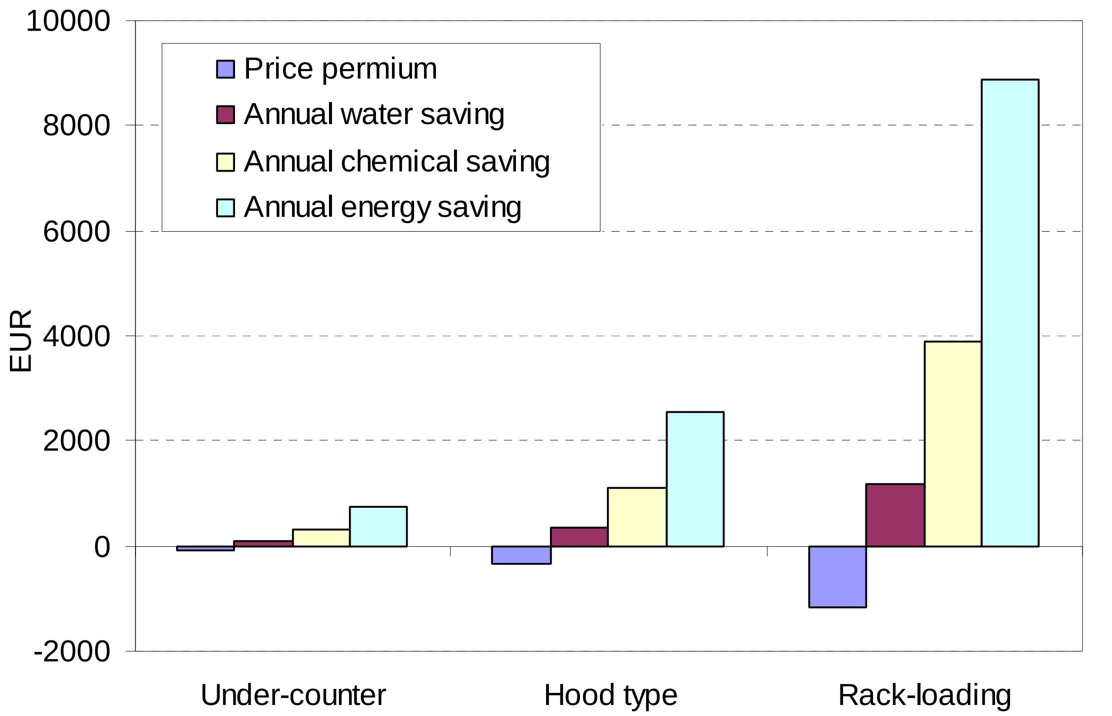
Dishwashers

The life expectancy of commercial dishwashers ranges from around 10 years for small under-counter types to over 20 years for large conveyor-types (Koeller et al., 2010). Prices vary widely depending on specifications, capacity and manufacturer. Table 8.17 displays the cost range for low- and high-end machines. Durability and reliability are important factors that have a significant effect on capital depreciation and maintenance costs, and can justify considerable price premiums.

Table 8.17: Example purchase prices for different types and sizes of dishwasher

Type	Capacity	Price range
	Plates (racks) per hour	EUR
Front-loading	60 – 540	1 500 – 5 000
Hood-type	720 (40) – 2 160 (120)(*)	2 500 – 22 000(*)
Rack-conveyor	1 440 (80) – 2 700 (150)	7 500 – 70 000
Flight-type conveyor	1 400 – 7 200	20 000 – 125 000
(*)Pass-through hood type. *Source:* Meiko UK (2011); Warewashers (2011).		

The price premium for efficient models is highly variable. Koeller et al. (2010) quote dishwasher prices for machines in the US at the low end of prices quoted in Table 8.17, and refer to price premiums in the region of 20 % for the most efficient machines that qualify for Energy Star rating. Water savings associated with such machines, compared with average dishwasher water consumption, would lead to a payback time of a one to two years. Assuming that water savings result in an energy saving equivalent to heating the same quantity of water to 90 ºC, payback times are months (Figure 8.22). In addition to water, energy and chemical savings, efficient machines may be associated with reduced labour costs.



NB: Price premium, annual loading rates and water savings derived from Koeller et al. (2010) as difference between Energy Star and average dishwashers; energy savings based on avoided water heating to 90 ºC; water price of EUR 2/m^3, chemical price of EUR 2/L, and energy price of EUR 0.10/kWh.

Figure 8.22: Price premium and annual water/chemical/energy savings associated with efficient dishwashers

Table 8.18 presents cost and payback data for optional modules that enhance energy and chemical use efficiency on high-end dishwashers. Simple payback periods range from 1.3 to 6.8 years depending on chemical and energy prices. Figure 8.23 provides an example of shorter payback times of 14 to 18 months for energy saving features on a different make of dishwasher.

Table 8.18: An example of cost and payback period for optional modules on a large (150 rack-per-hour) tunnel dishwasher, assuming 6 hour per day 365 day per year operation

Module	Cost (EUR)	Consumption saving	Consumable price in EUR	Annual saving (EUR)	Payback period (yrs)
Heat recovery condensing unit	3 500	6 kWh/hour	0.10/kWh	1 314	2.7
			0.20/kWh	2 628	1.3
Additional spray and reverse osmosis to reduce detergent	14 500	0.79 L/hr chemicals	2/L	3 469	4.2
			3/L	5 203	2.8
Heat pump	10 500	7 kWh/hour	0.10/kWh	1 533	6.8
			0.20/kWh	3 066	3.4
	20 500	18 kWh/hour	0.10/kWh	3 942	5.2
			0.20/kWh	7 884	2.6

Source: Meiko UK (2011).

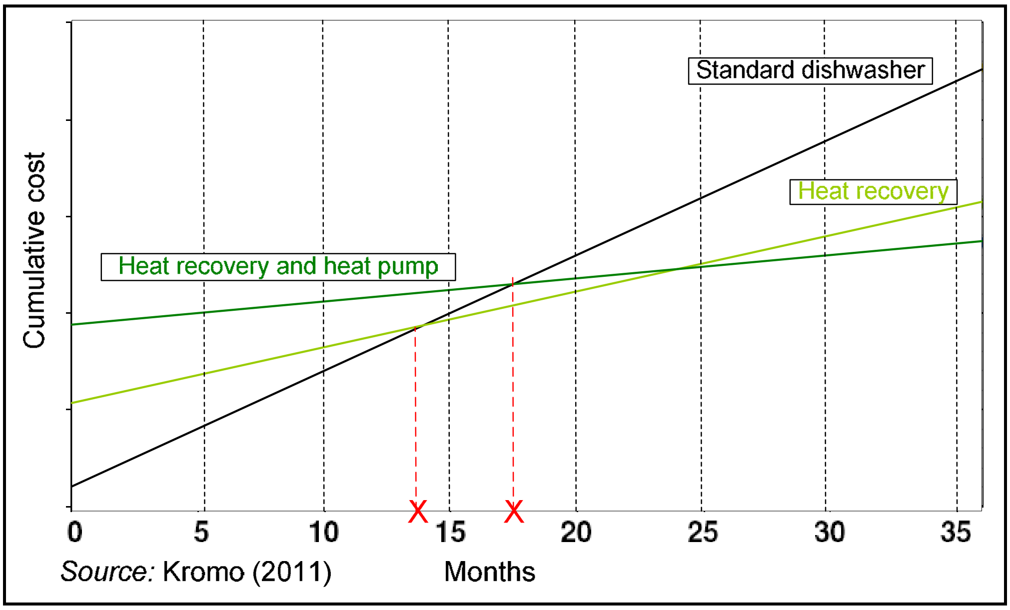


Figure 8.23: Payback time for heat recovery and heat pump components of a large flight-type dishwasher compared with standard boiler specification

For tunnel dishwashers with a heating energy demand greater than 5 kW, installation of a dedicated gas boiler to supply hot water can considerably reduce energy costs. Installation costs start at around EUR 2 000 for a 6 kW boiler, and pay back in as little as one year (Meiko, 2011).

<u>Steam cookers</u>
Replacing an old boiler steamer with a new boilerless steamer can reduce annual water and energy costs by EUR 403 and EUR 767, respectively (at a water price of EUR 2/L and an electricity price of EUR 0.10/kWh). Maintenance cleaning costs will also be reduced, resulting in a maximum basic payback of three to four years on the entire purchase price of around EUR 4 000.

<u>Chemicals and laundry</u>
As for housekeeping (section 5.3), green procurement of chemicals incurs a price premium in the region of 20 %, but this is relatively small compared with other costs such as labour, and can be more than offset by ensuring efficient dishwasher operation and training staff in efficient cleaning methods.

Strattons Hotel and Restaurant in the UK bought tables made from FSC-certified oak wood, and set these tables for meals without tablecloths. Estimated savings in laundry costs are over EUR 2 000 per year for this small premises (Envirowise, 2008). Similarly, Scandic Berlin do not use table cloths (see Figure 6.7 in section 6.1)

Driving force for implementation
Installation of efficient PRSVs with trigger activation, sink taps with pedal- or sensor-ctivation, and efficient new dishwashers can considerably reduce operational costs and pay back quickly (see above). In addition, these measures can improve working conditions and increase productivity.

Green procurement of ecolabelled detergents and cleaning chemicals is driven by CSR and worker safety considerations.

Reference organisations
The Savoy, London; Scandic Berlin hotel; Strattons hotel, Norfolk.

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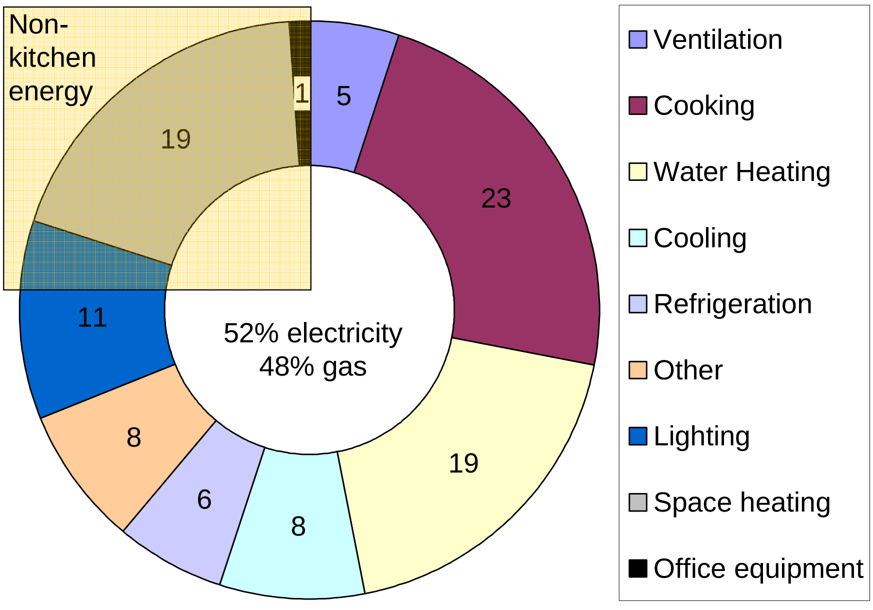
8.4 Optimised cooking, ventilation and refrigeration

Description

Water and energy efficiency measures have therefore traditionally been a low priority for kitchen managers. Operational optimisation is usually focussed on delivering service quality (Carbon Trust, 2011). Conseuently, as little as 40 % of the energy consumed in kitchens goes into useful processes such as cooking, food storage and washing: much of the remainder is lost as waste heat (Carbon Trust, 2007). Therefore, there is considerable scope for improvement in the energy efficiency of kitchens serving stand alone restaurants or hotel guests. Figure 8.24 shows that, excluding processes attributable to the dining area, the main energy consuming processes in kitchens are:

- cooking
- water heating
- cooling and ventilation
- refrigeration
- lighting.



Source: Data from Carbon Trust (2011).

Figure 8.24: Breakdown of energy consumption in a catering business

Other energy users include electric motors and control systems, for example those installed in dishwashers. The main measures associated with efficient energy management in kitchens are summarised in Table 8.19. There is considerable overlap with other BEMP techniques described elsewhere in this document. Most water heating is dedicated to dish washing, and this process is addressed in the previous section (section 8.3). A considerable amount of heat is generated in kitchens, which consequently have a high specific cooling demand per m^2. This heat may be directed to other parts of the building or recovered in a centralised heat-exchanger prior to external venting, as described in section 7.3 that addresses optimisation of building HVAC systems. Efficient lighting installation and control is addressed in section 7.5.

The focus of this BEMP technique is on the following measures referred to in Table 8.19 that are specific to kitchens:

- installation of efficient cookers
- efficient cooking techniques
- efficient ventilation control
- installation of efficient refrigeration systems
- efficient maintenance and operation of refrigeration systems.

Installation of efficient equipment can save a considerable amount of energy, especially over equipment lifetimes of ca. 20 years. For example, gas flame hobs, or induction hobs that induce heating of ferrous pots and pans through electromagnetism, consume considerably less energy than standard electric hobs. Training kitchen staff in efficient management practices is an integral component of best practice that can reduce catering energy consumption by up to 25 % (Carbon Trust, 2007).

Table 8.19: Best environmental management practice measures to reduce kitchen energy consumption

Aspect	Measures	Description
Management	Appoint kitchen energy champion	– An appropriate person working in the kitchen may be appointed as an 'energy champion' with responsibility for monitoring energy consumption and ensuring continuous implementation of energy efficiency measures.
Cooking	Install efficient cookers	– Installation of induction or gas hob cookers. Installation of boilerless steamers (section 8.3).
	Efficient cooking techniques	– Correct sizes of pots and pans used and matched to hobs – Careful planning of food preparation – Avoid unnecessary use of quenching.
Water heating	Install efficient dishwashers and use efficiently	– Installation of appropriately sized efficient dishwashers that recycle rinse water, recover heat from drying air and wastewater, and use heap pumps or gas. Optimum loading (section 8.3).
	Efficient water heating source	– Use of heat pumps (section7.4) or renewable energy sources (Section 7.6).
Cooling and ventilation	Optimised HVAC system	– Heat recovery and efficient distribution within centralised building HVAC systems (section 7.3). – Appropriate temperature control.
	Efficient ventilation control	– Variable speed fans controlled by air management system, and insulated hoods.
Refrigeration	Installation of efficient refrigeration system	– Appropriate sizing and positioning of refrigeration storage. – Adequate installation and air-tightness. – Correct capacity compressors and efficient motors. – Heat recovery. – Use of low global warming potential refrigerants.
	Efficient maintenance and operation	– Regular maintenance and seasonal adjustment of compressors, careful temperature control, efficient stocking and use (e.g. not leaving doors open)
Lighting	Efficient fittings	– Installation of correct lighting capacity (lumens) provided by low-energy sources (florescent tubes and LEDs in kitchen) (section 7.5).
	Lighting control	– Use of motion sensors to control lighting in areas such as walk-in refrigeration, and efficient control by staff.

Achieved environmental benefit

Cooking equipment and operations

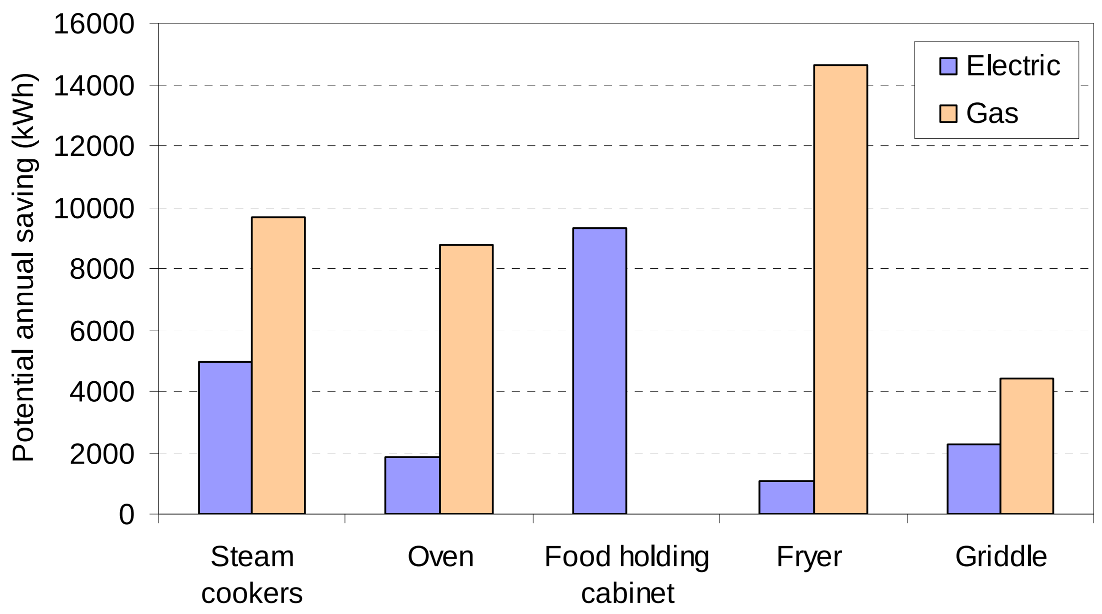
Table 8.20 lists the energy savings achievable from the implementation of key measures to improve the efficiency of cooking. In commercial kitchens where hobs are often left on continuously, the automatic cut-out function of induction hobs and installation of gas hobs with pot sensors can result in large savings (Tyson, 2010).

Table 8.20: Environmental benefits achievable for key efficient cooking measures

Measure	Environmental benefit
Replace electric hob with induction hob	15 – 20 % reduction in cooking energy 50-80 % reduction in total energy consumption(*)
Replace electric hob with gas hob (optimised burners)	30 % reduction in primary energy consumption
Replace gas hobs with new hobs controlled by pot sensors	50 – 80 % reduction in total energy consumption(*)
Replace uninsulated food heating unit with insulated model	70 % reduction in energy
Replace conventional oven with convection oven	30 %reduction in energy consumption
Use a combi oven or pressure cooker instead of conventional oven	50 – 70 % reduction in energy consumption
Use microwave instead of oven or hob to (re)heat food	70 – 90 % reduction in energy consumption
(*)In commercial kitchens where hobs typically not switched off between uses by operatives *Source:* USDE (1997); Fisher (2006); Tyson (2010); EC (2011).	

Figure 8.25 indicates annual energy savings achievable by selecting the most efficient (Energy Star labelled) models of kitchen equipment. Potential savings are higher for gas appliances owing to a greater performance differential across these appliances, and reach up to 14 000 kWh per year per appliance for a gas fyer.

Of additional note, high savings have been reported for induction cookers, owing to their efficiency and the fact they automatically switch off when no pot is detected. Restaurant Le Premier in Århus (Denmark) reduced energy consumption by 90 % following the replacement of hotplates with induction cookers, from 7 MWh to 0.7 MWh per year (Horesta, 2000).



NB: Based on difference between average performance of existing appliances in US and performance of Energy Star appliances.

Source: Energy Star (2011).

Figure 8.25: Potential annual energy savings achievable by purchasing an efficient oven compared with average performance of existing appliances in the US

Ventilation

Halving the fan speed can reduce motor energy consumption by 87 % (Carbon Trust, 2011d). Variable speed processor-controlled fans can reduce ventilation energy consumption by approximately 60 % (Fisher, 2006; Green Hotelier, 2011). Replacing conventional pole fan motors with electronically commutated motors can reduce motor energy consumption by up to 65 % (Carbon Trust, 2011d).

Refrigeration

Table 8.21 lists the energy savings achievable from implementation of key measures to improve the efficiency of refrigeration operations. These are maximum achievable benefits: actual savings are strongly dependent on specific circumstances, and some measures are only applicable only under certain conditions.

An annual leakage rate of 20 % has been reported for refrigeration systems in the UK, associated with an 11 % loss in system efficiency. For a system using 5 kg of R404a refrigerant, refrigerant leakage of 20 % would equate to GHG emissions of 3 260 kg CO_2 eq. per year (see Figure 8.27 below). Good leak detection and prevention can reduce leakage rates to almost zero, saving considerable GHG emissions and additional energy consumption (Table 8.21).

Energy saved by heat recovery depends on the size of the refrigeration system, the efficiency of the heat recovery, and the heating energy displaced, but can be significant. For example, if heat recovery from refrigeration pre-heats incoming water by 15 °C on average, the heating energy required to reach a water temperature of 60 °C will be reduced by 30 %.

Table 8.21: Environmental benefits achievable by measures to improve refrigeration performance

Measure	Achievable environmental benefit
Installation of system that uses hydrocarbon or natural refrigerants	Up to 30 % reduction in carbon footprint of refrigeration(*)
Installation of strip curtains in cold room entrance	Up to 25 % reduction in energy
Installation of oversized compressors	Up to 10 % reduction in energy consumption
Installation of heat recovery	Up to 10 % of system energy recovered (benefit depends on displaced energy source)
Installation of intelligent defrost controls	Up to 9 % reduction in energy consumption
Installation of electronically commutated fan motors	Up to 5 % reduction in energy
Regular inspection and maintenance to detect and repair refrigerant leaks	Up to 37 % reduction in carbon footprint of refrigeration(*), including 11 % reduction in energy consumption
Careful control of refrigeration temperature	Up to 10 % reduction in energy consumption (2 % saving for every one degree rise)
Maintenance and cleaning of condensers and evaporators	10 % reduction in energy consumption
Adjusting the condensing temperature during cooler periods	10 % reduction in annual compressor energy consumption (up to 30 % during cool periods)
(*)Assumes refrigerant leakage can account for 30 % of system carbon footprint *Source:* Carbon Trust, (2007; 2009; 2011b; 2011c; 2011d).	

Appropriate environmental indicator

<u>Cooker selection</u>

Comparing the efficiency of cooking appliances is complicated as there are no widely accepted standardised measurement methods relevant for different types of cookers and food. Ultimately, cooking efficiency relates to the quantity of energy absorbed by the substance being cooked divided by primary energy consumed, but this is not readily measurable. For hob cookers, primary energy efficiency depends on: (i) the energy source (primarily electricity or gas) and the electricity generation process; (ii) transfer efficiency from energy source to pot or pan; (iii) heat loss from pot or pan; (iv) standby or pilot light consumption; (v) user control. These features are determined by a combination of:

- cooker type and design (selection)
- energy source
- user behaviour.

Table 8.22 provides a summary of typical characteristics of different types of hob oven. Whilst energy consumption for given tasks, or for equivalent oven capacity, is the most convenient indicator of oven efficiency, the carbon footprint of one kWh delivered heating energy is the most appropriate indicator to compare the environmental performance of gas and electric powered cookers under specific conditions owing to a wide variation in the source and carbon footprint of electricity.

DEFRA (2011) calculate that lifecycle emissions for consumed electricity in the UK average 0.59 kg CO_2 eq./kWh. Natural gas combustion lifecycle emissions are 0.22 kg/kWh net energy content. Applying these values to standard electric, induction and gas hob heat transfer efficiencies results in emission factors of 0.79, 0.66 and 0.44 kg CO_2 eq./kWh heating, respectively, indicating that gas hobs would be the preferred choice from an environmental perspective. However, in countries where electricity has a small carbon footprint, or where genuine green electricity is consumed (section7.6), induction hobs may be the preferred choice from an environmental perspective (Table 8.22; Figure 8.26).

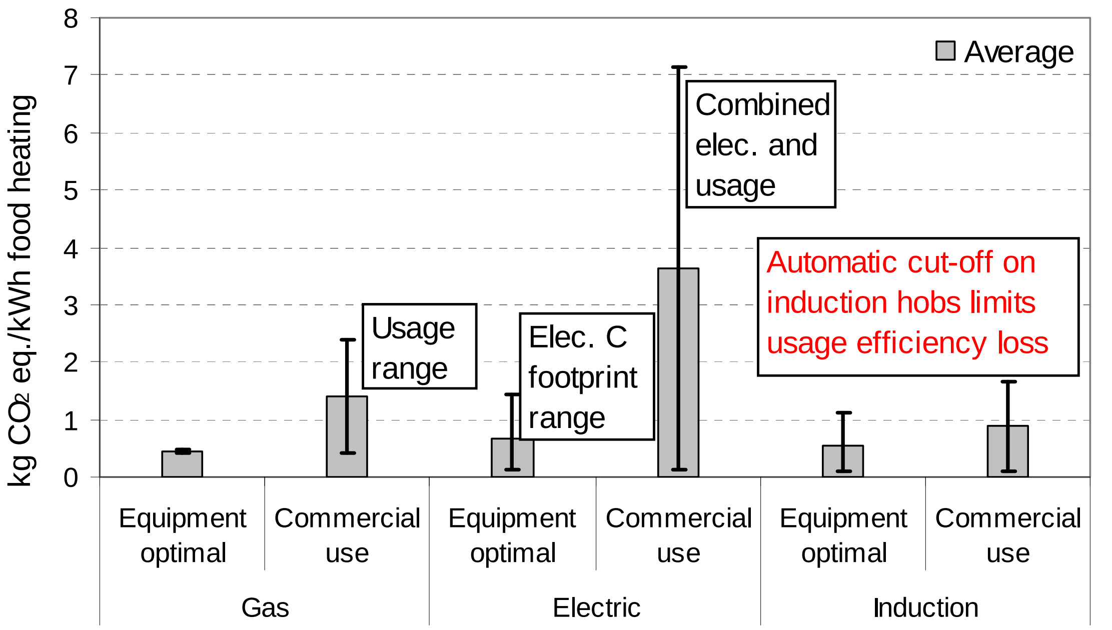
Table 8.22: Typical efficiency characteristics of different types of hob oven

	Gas hob	Electric hob	Induction hob
Heat transfer efficiency	50 %	75 %	90 %
Primary energy ratio	1.1	2.5	2.5
CO_2 eq. factor (kg/kWh heating)	0.44	0.13 – 1.33(*)	0.11 – 1.11(*)

NB: Electricity from coal-fired power stations has a carbon footprint of 0.80 – 1.00 kg CO_2 eq. per kWh, electricity from combined cycle gas power stations has a carbon footprint of approximately 0.5 kg CO_2 eq. per kWh, whilst electricity from nuclear power stations or renewable (e.g. wind) sources has a carbon footprint <0.10 kg CO_2 eq. per kWh.

Source: CEC (2011); CESA (2011); DEFRA (2011).

An important consideration is user behaviour. Fisher (2006) note that whilst the heat transfer efficiency of a gas hob ranges from 20 % to 60 %, utilisation efficiency typically ranges from 5 % to 15 %. Induction hobs automatically switch off when no pot is present, potentially saving a large amount of energy in commercial kitchens where hobs may be left on continuously with low utilisation rates (Figure 8.26).



NB: Based on values displayed in Table 8.22, and average electricity carbon footprint of 0.5 kg CO_2 eq./kWh. Commercial use ranges based on 100 % and 25 % utilisation rates, except for induction hobs.

Figure 8.26: Carbon footprint per kWh heating delivered to the pot from different types of hub, under optimal and average commercial use conditions

In the US, the Energy Star label is awarded to more energy efficient appliances (typically the top 25 % of performers). Energy Star eligibility criteria for commercial kitchen equipment provides an indication of good performance levels (Table 8.23).

Table 8.23: Energy Star eligibility criteria for cooking appliances

Appliance	Energy source	Idle energy rate	Cooking efficiency	Test method
Steam cookers (6 pan or larger)(*)	Electric	≤0.8 kW	≥50 %	
	Gas	≤3.7 kW	≥38 %	
Ovens	Electric (half size)	≤1.0 kW	≥70 %	ASTM 1496
	Gas	≤3.8 kW	≥44 %	
Convection ovens		≤1.6 kW	≥70 %	ASTM F1496
Food holding cabinets	Electric	0.14 kW/L		
Fryers (standard)	Electric	≤1.0 kW	≥80 %	ASTM F1361-07
	Gas	≤2.6 kW	≥50 %	
Fryers (large vat)	Electric	≤1.1 kW	≥80 %	ASTM F2144-09
	Gas	≤3.5 kW	≥50 %	
Griddles	Electric	3.44 kW/ m^2	≥70 %	ASTM F1275
	Gas	8.26 kW/m^2	≥38 %	ASTM F1605
(*)Described in section 8.3 in relation to water consumption *Source:* Energy Star (2011).				

Best environmental management practice for the selection of new cooking equipment is to:

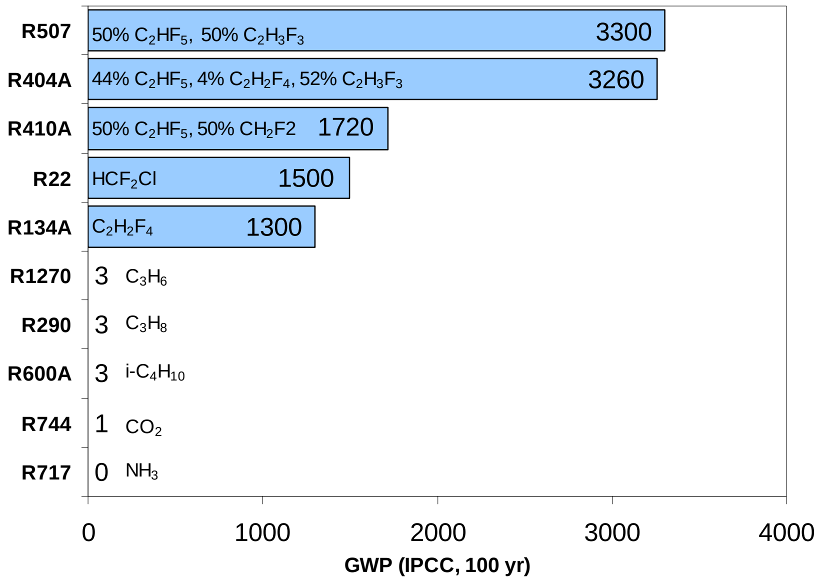
- select the most efficient available options based on the: (i) rated cooking (heat transfer) efficiency (%); (ii) idle energy consumption rate (kW); (iii) carbon footprint (kg CO_2 eq./kWh heat transfer) calculated from the most relevant available electricity carbon footprint data.

Specifically, in the case of new hob ovens, best practice is to:

- select either: (i) induction hobs; or (ii) gas flame hobs with pot sensor control.

<u>Refrigeration systems</u>

Refrigerant leakage contributes significantly to the environmental impact of refrigeration systems owing to the high global warming potential (GWP) of traditional CHFC refrigerant gases. The appropriate environmental indicator to assess the impact of the refrigeration system, and to select the most environmentally sound refrigerant, is the GWP per kg (Figure 8.27). Leakage (top-up) rates of refrigerants can be multiplied by their GWP, and added to the carbon footprint of electricity consumed by the refrigeration equipment where these data are available, to calculate the annual carbon footprint of refrigeration systems.



N.B: CHFCs include R507, R404A, R410A, R134A; HCFCs include R22; hydrocarbons include R1270, R290, R600A and natural refrigerants include CO_2 and NH_3.

Source: EC (2011).

Figure 8.27: Global warming potential of different types of commercial refrigerant

The EU Energy label for domestic appliances calculates energy consumption per unit capacity of fridges and freezers, accounting for additional functions, but is not applicable to commercial equipment. The US Energy Star calculates maximum energy consumption (minimum efficiency) thresholds for commercial fridges and freezers expressed as daily consumption for different capacity ranges (Energy Star, 2011). For solid door upright cabinets of 1.4 m^3 capacity or greater, these translate into energy consumption limits of:

- ≤1.14 kWh/L/yr for fridges
- ≤3.6 kWh/L/yr for freezers.

Best environmental management practice for the selection of new refrigeration equipment is to:

- select the most efficient available options based on the specific energy consumption, measured in kWh/L/yr.

In the case of cold room installation, best environmental management practice is to:

- install a system that uses hydrocarbons, ammonia or carbon dioxide refrigerants
- install an efficient system considering: (i) rated energy consumption (kWh/m^3yr); (ii) operation carbon footprint (kg CO_2 eq./m^3/yr) based on refrigerant leakage GWP and the most relevant available carbon footprint data for electricity consumption.

Best practice for measuring the performance of refrigeration systems is to:

- monitor and report at least annually: (i) energy consumption (kWh/m^3yr); (ii) refrigerant leakage rate (kg and % per year); (iii) carbon footprint (kg CO_2 eq./m^3yr) of refrigeration systems.

<u>Benchmarks of excellence</u>
Energy consumption will vary considerably depending on the type of food prepared and the type of establishment. ITP (2008) propose an 'excellent' benchmark of less than 4 kWh per cover for total energy consumption. Catering for a sustainable future group (CSFG, 2006a;b) propose a 'good practice' benchmark for operational (kitchen process) energy consumption of

6.1 kWh per cover in fine-dining restaurants, and 1.9 kWh per cover in cafeteria restaurants. Electricity data from hotels in Germany and the UK indicate electricity consumption of 1.2 and 3.1 kWh per cover, whilst Farrou et al. (2009) suggest average additional energy consumption of 1.2 kWh per meal in Mediterranean hotels.

There are insufficient data available to derive a robust benchmark of excellence for specific energy consumption in kitchens, although as a guide final energy consumption of less than 1.5 kWh per cover appears achievable across mid-range accommodation kitchens. The benchmarks of excellence proposed for this technique are:

BM: implementation of a kitchen energy management plan that includes monitoring and reporting of total kitchen energy consumption normalised per dining guest, and the identification of priority measures to reduce energy consumption.

BM: installation of efficient equipment and implementation of efficient practices described in this technique, including: (i) induction hobs or gas flame hobs with pot sensor control; (ii) commercial fridges and freezers with specific energy consumption of ≤1.14 and ≤3.6 kWh per L volume per yr, respectively.

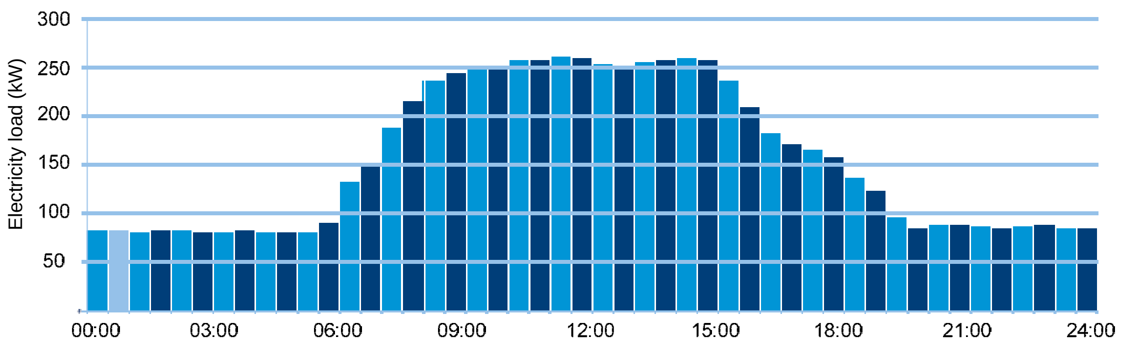
Cross-media effects

Reducing primary energy consumption and lifecycle CO_2 emissions by selecting gas instead of electric ovens leads to indoor air emissions of nitrogen oxides. The concentration can be kept below harmful levels through appropriate extraction.

Operational data

Monitoring and ventilation control

Energy consumption needs to be monitored if it is to be effectively controlled. Unnecessary consumption can be detected by continuous monitoring systems. For example, extraction, lighting and heating systems should shut off outside operating hours. Failure to do this, and leaving large equipment switched on or on standby, can elevate off hours 'baseline' energy consumption. Figure 8.28 provides an example of a daily consumption pattern for a catering establishment.



Source: Carbon Trust (2011a).

Figure 8.28: Daily pattern of electricity consumption in a catering establishment

Centralised building management systems continuously record electricity consumption in different areas and provide the detailed type of daily electricity use data shown in Figure 8.28 for restaurants, or restaurant and kitchen areas within hotels. Similar data can also be obtained more simply through installation of a data logger at the electricity meter. Data loggers may be directly attached to a computer, or information may be periodically downloaded from them on to a laptop or memory storage device and transferred to a computer.

The most simple electricity monitoring applicable to small enterprises involves recording monthly energy consumption data from electricity and other fuel bills, expressed in kWh. Data may be provided for daytime and night-time electricity where this is charged at different rates (Table 8.24), providing some insight into the sources of electricity demand: night-time consumption indicates baseline consumption by refrigeration systems and machines on standby (also dishwashers if these are programmed to work overnight); daytime consumption includes cooking, dish washing, ventilation and lighting consumption. Monthly or annual aggregated electricity consumption can be divided by the number of cover meals served to benchmark performance (Table 8.24).

It may be worth installing individual energy meters and data loggers on large energy-consuming equipment, such as dishwashers and ovens, to monitor performance and identify maintenance requirements or opportunities for savings.

Table 8.24: An example of monthly energy consumption data for the restaurant area of a hotel

Month	kWh day	kWh night	Covers(*)	kWh / cover
March	21 148	6 707	7 750	**3.6**
April	16 873	6 160	7 500	**3.1**
May	17 358	6 642	7 750	**3.1**
(*)estimated 250 cover per day				

<u>Selecting efficient cookers</u>
Food safety and quality are the two main priorities for catering enterprises, and kitchen staff should be consulted on equipment selection – kitchen staff will have a good understanding of equipment requirements. Kitchen staff may also be able to provide advice on where savings are possible, or they may be resistant to change. It is important to clearly describe the reasons and (efficiency) benefits of new equipment selection (Green Hotelier, 2011).

Hobs
Six-hob ovens (hobs and oven combined) are the common workhorse of commercial kitchens. Ovens are responsible for up to 25 % of kitchen energy consumption (Horesta, 2000; Figure 8.24), and typically have a 20-year lifetime. It is important to select the right oven in terms of food quality, convenience, lifetime energy consumption and costs, and also lifecycle environmental performance. The most efficient types of hob oven are: (i) gas flame; (ii) induction. Table 8.25 highlights some key characteristics of these two options. New commercial gas hobs must comply with minimum efficiency and safety criteria specified in the EN203-2-1 standard (EC, 2009).

Table 8.25: Characteristics of gas, standard electric and induction hob ovens

	Gas hob	Induction hob
Advantages	– Quick heat-up – Low equipment cost – Gas cheaper than electricity – Gas has low primary energy demand compared with electricity	– Quick heat-up and good controllability – No power draw when pots removed – Few installation requirements – No indoor air quality issues or precautions – No hot surfaces
Disadvantages	– Pilot lights use up to 6 kWh per hob per day – Indoor air emissions (NO_x, CO) – Requires gas supply – Requires additional cooling and ventilation – Low output settings limited	– High equipment cost – Electricity more expensive than gas – Electricity associated with high primary energy demand – Requires iron-based cooking pots and pans (e.g. stainless steel)

The lifecycle environmental efficiency of different oven types can be compared using a basic carbon footprint method – for induction ovens based on the carbon footprint of consumed electricity provided by electricity suppliers or estimated from national statistics (see 'Appropriate environmental indicator' section and Table 8.22, above). Electronic ignition systems for commercial gas hobs have yet to be proven under commercial operations, so the consumption of gas pilot lights (up to 6 kWh per day) should be accounted for.

A general rule is that gas hobs are the preferred environmental option where grid electricity is sourced largely from fossil fuels, but induction cookers are the preferred environmental option where electricity is from renewable sources.

If selecting a gas hob, best practice is to specify a model with built-in sensors that cut-off the flame heating when a pot is removed and relight when a pot returns, achieving a similar benefit to the induction hob automatic cut-off function.

Ovens

As with hobs, gas ovens are generally more efficient than electric ovens. Some other features relevant to the selection of an efficient oven are:

- appropriate sizing – oversized ovens should be avoided;
- convection ovens use a fan to circulate warm air evenly throughout the oven, reducing energy consumption by 30 %;
- variable speed fans that cut out when the door is opened reduce energy consumption;
- 'combi' ovens offer convection, steam and a combination of the two to cook food using up to 50 % less energy;
- combi-ovens are available with heat recovery from exhaust air to incoming water;
- good insulation of casing, solid doors, triple-glazing of viewing windows, and robust door seals can reduce energy consumption by around 40 %.

As referred to in section 8.3, boilerless steamers are considerably more energy and water efficient than boiler steamers. Forced convection and high levels of insulation are important features. Energy performance standards established for commercial kitchen equipment by the US EPA for the award of the front-runner Energy Star label may provide guidance on good performance when selecting an oven (see Table 8.23 under 'Appropriate environmental indicators' above).

Grills and griddles
In busy commercial kitchens, grills are often left on full power continuously. Grills are available that detect when food is placed underneath and start up automatically. Grills with short start-up times may be gas powered or powered by infrared elements. Automatic grill control combined with fast heat-up can offer energy savings of over 70 % (Green Hotelier, 2011). Bright chromium-plated steel and various coatings reduce radiative heat losses from grill surfaces, saving up to 30 % energy compared with dark surfaces (EC, 2011). Grills with multiple heat zones offer greater opportunities to match the heating area in use with varying cooking requirements. Energy Star minimum energy performance criteria are referred to in Table 8.23.

Fryers
Fryers are available with highly insulated pans, efficient burner and heat-exchanger designs, and filtration units combined with usage monitors that extend oil life and signal the appropriate time for oil changes. Energy Star minimum energy performance criteria are referred to in Table 8.23.

<u>Efficient cooking techniques</u>
Compliance with relevant food safety regulations are paramount. According to UK food safety regulations (UK Government, 1995), hot food should be held for service (or displayed) above a temperature of 63 ºC unless a risk assessment has determined that a lower temperature poses no risk to health.

Within food safety and quality parameters, there is considerable scope for energy reduction by appropriate operation and maintenance. Oven usage in commercial kitchens has a greater impact on cooking efficiency than equipment efficiency (Fisher, 2006) – although some equipment features such as hob sensor control can mitigate bad practice by operators. Staff **liaison and training** is essential.

In the first instance, it is important to plan for requirements. For example, for kitchens serving breakfast in hotels, if 100 people are anticipated, prepare food for the first 40, the next 20 and so on, in order to avoid unnecessary cooking of excess food (important for waste avoidance: section 8.2), and to avoid unnecessary maintenance heating for large quantities of cooked food.

Keys points to reduce energy consumption during cooking are listed below (Green Hotelier, 2011; Carbon Trust, 2011a; CEC, 2011).

- Where appropriate for heating or reheating small quantities of food, a microwave uses 70 – 90 % less energy than a conventional oven.
- Where relevant, use a combi oven or a pressure cooker to reduce cooking time and energy use by 50 to 75 %.
- Use the correct equipment for the job – utensils, pots and pans must be appropriately sized for the heating ring or oven used. A 15 cm pan on a 20 cm burner will waste over 40 percent of the energy.
- Avoid over-filling saucepans and kettles and use lids to retain heat.
- When pans are used to boil liquids, turn hobs down to the minimum to simmer.
- Switch off grills, fryers and hobs immediately after use. Electric hobs can be switched off before cooking is finished.
- Make a note of cooking equipment preheat times and keep these on display. Preheat only where necessary.
- Keep hot storage of cooked food to a minimum, both to reduce energy use and to retain the quality of the food.
- Switch on equipment only when necessary – discourage staff from routinely switching **all** equipment on at the start of a shift irrespective of whether it is necessary.

- Avoid opening oven doors unless absolutely necessary – every time an oven door is opened the temperature drops by approximately 14 ºC.
- Switch off extraction fans when they are not being used.
- Periodically check oven door seals for damage, and replace where necessary.
- Check thermostats on all equipment and replace where false readings are given.
- A blue flame indicates that a gas oven is operating efficiently. A yellowish flame indicates an adjustment is needed.

Ventilation control

Firstly, heating and cooling energy consumption in kitchen and dining areas can be minimised through optimisation of the HVAC system (section 7.3) and ensuring that temperature settings are adjusted correctly to meet the requirements of distinct zones. Carbon Trust (2007) recommend setting thermostats to 16 – 18 ºC in kitchens and 22 – 24 ºC in dining areas. It is important to reduce or shut down heating or cooling during periods when kitchen and dining areas are not in use.

Ventilation fans often operate continuously at full capacity. The installation of variable speed fans controlled by a micro-processor connected to air quality and temperature sensors is simple, inexpensive and associated with a short payback time (see 'Economics'). Air quality sensors and fans should be located close to main emission sources (hobs and fryers). The replacement of conventional fans with electronically commutated fans (with brushless motor, transforming AC to DC current for motor operation) can result in further energy savings.

Installation of efficient refrigeration system

It is important to zone kitchen and storage areas into warm and cool areas. Refrigerators and freezers should not be placed close to heat sources such as cookers, dishwashers, radiators or windows, or in cool rooms where heat from the compressors will warm the room.

Stand alone units

When selecting stand-alone refrigeration units, it is important to ensure the size is sufficient to cope with peak storage demands without restricting air circulation, but not excessively large so that unnecessary cooling energy is consumed. Features such as high levels of insulation (50 mm thickness), durable and effective door seals, and electronically controlled evaporator valves and condenser fan motors can reduce energy consumption by 30 % compared with less efficient models (US EPA, 2010). Cabinets may be selected with multiple compartments and doors: matching these options with typical use requirements can save energy by minimising heat loss through open doors. As an indicator of more efficient fridge cabinet performance, the US Energy Star is awarded to solid door upright fridge cabinets with annual energy consumption of ≤1.14 kWh per litre capacity (for cabinets of 1.4 m3 capacity or greater). The equivalent figure for freezer cabinets is 3.7 kWh per litre capacity (Energy Star, 2011).

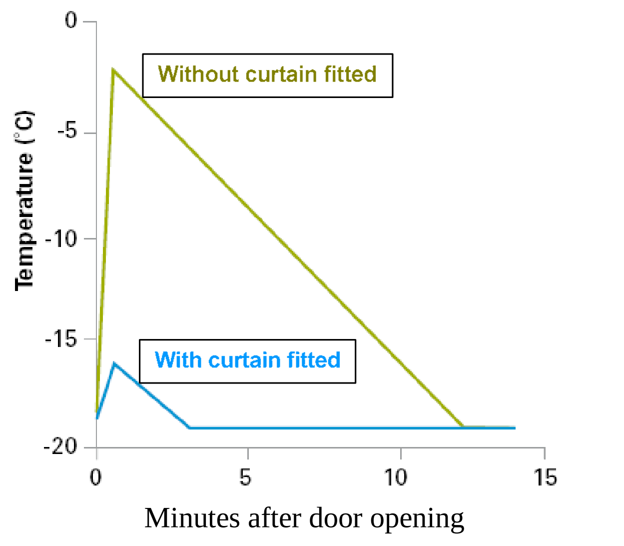
Cold rooms

In larger restaurants and hotels, cold rooms may be used for storage of chilled and frozen foods. Compared with stand-alone refrigeration units, cold rooms require additional attention and maintenance. Table 8.26 summarises best practice measures for cold rooms.

Table 8.26: Best practice measures to reduce energy consumption in cold rooms

Energy loss	Best practice measures
Open doors are responsible for approximately 30 % of heat gain in cold rooms.	Install plastic strip curtains. Fit automatic doors or self-closing doors, or train staff to minimise door opening. Inspect and maintain door seals.
Heat gain through the insulated envelope and air flow through gaps are responsible for approximately 20 % of heat gain.	Ensure high quality insulation is installed in walls, ceiling and floors. Ensure insulation envelope is airtight, and has a good vapour seal on the outside.
Evaporator fans are responsible for approximately 15 % of heat gain.	Replace conventional fan motors with electronically commutated motors.
Evaporator defrost is responsible for approximately 15 % of heat gain.	Fit defrost-on-demand controller.
Lights are responsible for approximately 10 % of heat gain.	Install motion sensors to control lights and ensure low energy LED lights are fitted.
Occupants and associated equipment are responsible for approximately 10 % of heat gain.	Train staff to plan stacking and food retrieval from cold rooms, and minimise time in the cold room.
Source: Carbon Trust (2011d).	

One of the most simple and effective ways to reduce heat gain in cold rooms, and associated energy demand, is to install strip curtains (Figure 8.29).



Source: Carbon Trust (2011d).

Figure 8.29: Effect of a strip curtain fitted to cold room entrance

Practical considerations for implementation are detailed below.

- When installing strip curtains, consider investing in thicker insulated curtains for freezer rooms. Ensure there is good overlap between strips and that there are no gaps to the sides or at the bottom of the entrance.
- Regularly check door seals for damage. Also, check for ice accumulation within the store room, which can indicate warm moist air is entering.

- When deciding whether to fit electronically commutated motors, check the type, capacity and usage rate of existing evaporator motors in order to ascertain the potential energy saving. If the existing motor is single speed and demand is variable, there will be additional efficiency benefits from installation of a variable speed motor in conjunction with a controller. Depending on the condition of the fan assembly, it may be worth replacing this too in order to maximise the efficiency gain (Carbon Trust, 2011d).
- When installing condensers, it is important to balance installation cost against lifetime energy costs. Installing a condenser 30 % larger than necessary for a cold room can reduce energy consumption by 10 %.

Alternative refrigerants

Use of environmentally preferable hydrocarbon or ammonia refrigerants requires the installation of systems with indirect cycles owing to the flammability and toxicity, respectively, of these refrigerant types. The coefficient of performance, COP, of the ammonia refrigeration cycle is usually higher than from that of other refrigerants, resulting in additional energy savings.

Carbon dioxide refrigeration systems operate at high pressure, over 100 bar (10 times higher than the pressure range of other refrigerants) for medium temperature systems, but cycle smaller refrigerant volumes. In addition, at heat sink temperatures above 25 °C, CO_2 refrigerant performance becomes transcritical and the COP is reduced for medium temperature (plus cooling) systems, potentially limiting the application of CO_2 as a refrigerant for such systems in warm climates. Use of carbon dioxide systems for low temperature (freezer) systems is not constrained in this way, and is energy efficient (EC, 2011).

Heat recovery

Heat can be recovered from condensed refrigerant and transferred to the building's HVAC system. Recovery of low grade (20 ºC to 40 ºC) from compressors can be achieved simply by ducting the warm compressor cooling air into the HVAC system exhaust (prior to heat exchanger where it heats incoming air). Recovery of high grade (60 ºC to 90 ºC) heat can be achieved by inserting a heat exchanger into the refrigerant line between the compressor and the condenser to heat water for use in the restaurant/hotel – following top-up heating if required (Figure 8.30).

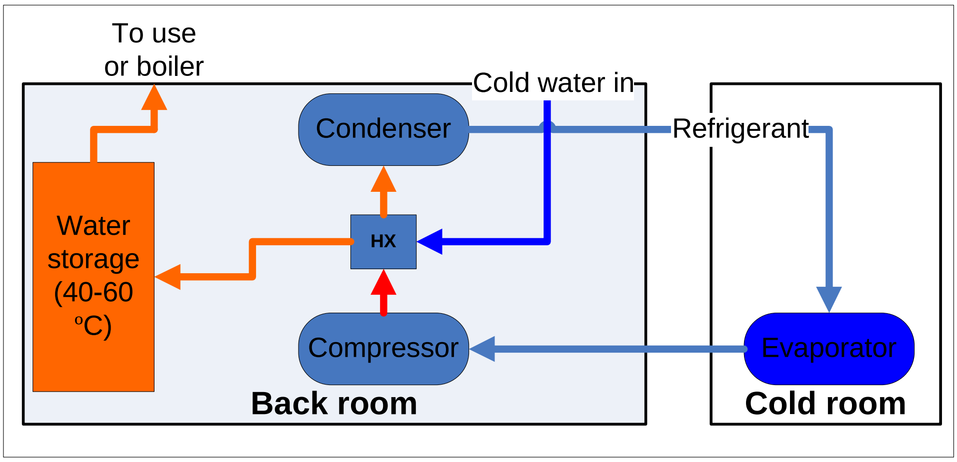


Figure 8.30: High-grade heat recovery from refrigerant between compressor and condenser

Retrofitting high grade heat recovery systems is more expensive than installing them during initial refrigeration system installation. A compressor electric load of 30 kW or more is required to achieve an acceptable payback for retrofitting (Carbon Trust, 2009). The Savoy recently installed such a system, although no energy data are available for it yet (Figure 8.23).

Condensing temperature should be set to optimise refrigeration system COP (see above), not to increase water heating.

Table 8.27: Centralised refrigeration compressors (left) and heat exchange from high temperature refrigerant exiting the compressors to the hot water system (right) in The Savoy

Maintenance and operation of refrigeration

Maintenance of refrigeration equipment by trained technical staff is essential to achieve and maintain efficient operations. Important maintenance procedures requiring technical personnel are listed below.

- Check systems have the correct amount of refrigerant and inspect for leaks. EC Regulation 842/2006 requires operators of cooling systems containing fluorinated gases to take precautions against leakage, including recovery of gases during servicing and maintenance, regular checks by qualified personnel, and installation of automatic leak detection on very large systems (above 300 kg refrigerant). EC Regulation 1005/2009 is aimed at phasing out the use of ozone-depleting substances, and applies to HCFC refrigerants such as R22. It includes stringent rules on the detection of leaks, and bans the use of virgin HCFCs for maintenance of refrigeration systems from January 2010.
- Compressors and condensers should be inspected annually and pipework should be checked to ensure it is secure and insulated. Condensers may be cleaned thoroughly during inspection (removing dirt from between the fins). Consider fitting a removable screen to condenser units to protect condenser fins from airborne dirt – these can be periodically removed and washed.
- Seasonal control of condensing temperature. Every degree reduction in temperature lift between the evaporator and condenser reduces compressor energy consumption by around 4 % for plus cooling (chill) systems, and 2 % for minus cooling (freezer) systems. Systems are often set to run all year at a maximum temperature specified to cope with the warmest summer conditions. Where this is the case, significant compressor energy savings can be made by requesting a technician to reduce the condensing temperature during cooler conditions (Carbon Trust, 2011b).

Kitchen staff can take a number of measures to minimise refrigeration system energy consumption. It is of paramount importance to maintain food at temperatures (and in conditions) specified by food suppliers and set out in food safety regulation (e.g. UK Government, 2005). General UK guidelines for the storage of food and drink requiring chilling are summarised in Table 8.28. Wastage of perishable food incurs a large environmental burden owing to high inputs and environmental impacts arising during food production (see section 8.1), and therefore should be minimised. However, it is often possible to reduce energy consumption for refrigeration by precisely adjusting the temperature to the required level in order to avoid over-cooling. Maintaining a temperature just 1°C lower than needed can increase cooling costs by 2 % (Carbon Trust, 2007).

Table 8.28: UK guidelines for food storage temperature

Temperature code	Products	Storage temperature
L1	Ice cream and frozen foods	– 18 ºC
L2	Frozen foods	– 18 ºC
M0	Poultry and meat	+1 ºC to +4 ºC
M1	Meat and dairy	+1 ºC to + 5 ºC
M2	Processed meat and dairy	+1 ºC to + 7 ºC
H1	Produce, canned and bottled drinks	+1 ºC to + 10 ºC
H2	Canned and bottled drinks	–1 ºC to + 10 ºC
Source: Carbon Trust (2007).		

Some key points for food storage are listed below (Carbon Trust, 2011c).

- Keep non-perishables such as canned drinks cool (e.g. away from direct sunlight) and place in refrigerator to chill prior to serving.
- Do not overfill refrigerators (there has to be room for the cool air to circulate) and keep doors closed.
- Ensure that defrost procedures are followed, at least every two months.
- Check door seals on cold rooms, fridges and frozen food stores and replace if damaged.
- Keep evaporator coils clean and free of dust.

Applicability

Most of the measures described above are applicable to all commercial kitchens, except measures to reduce energy consumption in cold rooms, which are applicable only to large restaurants and hotels. Selecting efficient new equipment is applicable when installing new equipment, and may also inform decisions on the timing of equipment replacement. Table 8.29 summarises the applicability of measures to reduce kitchen energy consumption.

Table 8.29: Conditions relating to the applicability of energy-saving measures, and relevance for SMEs

Measures	Conditions	SMEs
Install efficient cooking equipment	Applicable to all enterprises when selecting new equipment (may bring forward replacement of older equipment). Consider electricity carbon footprint and typical use patterns when comparing alternatives.	Yes
Efficient use of cooking equipment	Applicable to all enterprises.	Yes
Installation of variable-speed ventilation fans	Applicable to all enterprises.	

Select efficient refrigeration cabinets	Applicable to all enterprises when selecting new equipment (may bring forward replacement of older equipment).	Yes
Install efficient cold room systems	Applicable to large restaurants or hotels when installing or replacing cold rooms and associated refrigeration systems.	No
Use hydrocarbon or natural refrigerants	Applicable to large restaurants or hotels when installing or replacing refrigeration systems.	No
Install heat refrigeration system recovery	Applicable to large restaurants or hotels at any time, though cheaper if fitted when installing or replacing refrigeration systems.	Yes
Maintenance and efficient use of refrigeration equipment	Applicable to all enterprises.	Yes

Economics

Energy consumption accounts for 4 – 6 % of operating costs for caterers, approximately equivalent to typical profit margins (Carbon Trust, 2011a). Modest reductions in energy costs can therefore significantly improve profitability. There has so far been relatively little attention on energy efficiency in commercial kitchens, and there are many opportunities to reduce energy consumption in the average kitchen, sometimes with minimum financial investment.

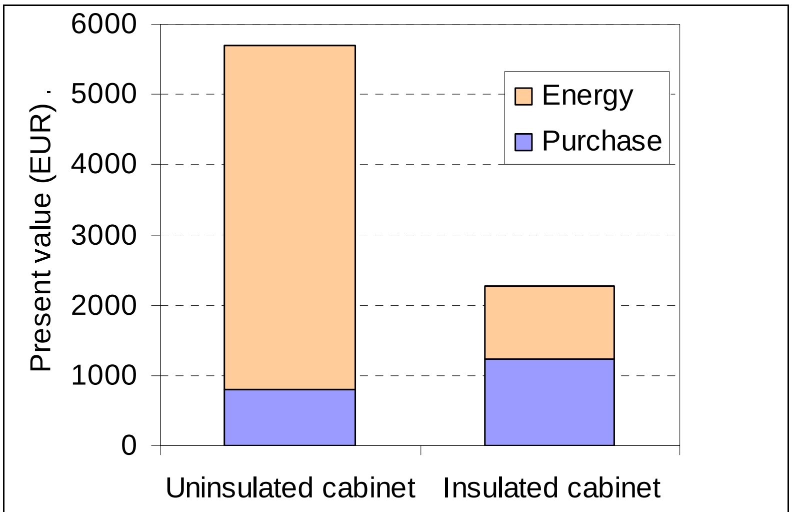
For larger investments in new efficient equipment, government financial assistance may be available. The UK Enhanced Capital Allowance scheme allows businesses to deduct the capital cost of energy-saving equipment from taxable profit in the year of purchase (http://etl.decc.gov.uk/). Refrigeration equipment such as evaporative condensers and refrigeration control systems are included in this scheme.

Monitoring

A good multifunction electricity meter costs EUR 330 to purchase (Carbon Trust, 2011a), and this can be paid back within a few months through the identification and implementation of energy saving opportunities typical to most commercial kitchens.

Cooking equipment

The cost of energy consumption over equipment lifetime is usually considerably higher than the purchase cost, and selecting equipment with the lowest purchase price often results in high costs over time (Figure 8.31).



EUR 0.10/kWh energy cost, 5 year lifetime, 3 % discount rate.
Source: Modified from Fisher (2006).

Figure 8.31: Lifetime purchase and energy costs for an uninsulated and insulated hot food holding cabinet

Despite lower efficiency at the point of use and higher idle energy use rates, energy prices typically favour gas over electric cookers. The unit cost of electricity is up to 3.4 times the cost of gas (Carbon Trust, 2011a). Lifetime cost comparisons between gas and electric ovens (including induction hobs) should account for the factors such as additional cooling and ventilation requirements (installation and operating costs) for gas heat sources. For example, Clarkes restaurant in Peterborough decided to fit an induction cooker because fitting a new canopy and interlock to bring the extraction system up to the current Corgi gas specification was going to cost the same as buying the new induction suite (Control Induction, 2011).

Cooking techniques

Efficient cooking techniques and use of appropriate equipment can result in savings equivalent to, or even greater than, savings achievable through the selection of efficient equipment. Although such techniques can be virtually free to implement, they are more likely to be implemented with regular, high-quality staff training.

Ventilation

Installation of a kitchen ventilation unit with processor control of a variable speed fan in the Hotel des Indes, The Hague, reduced ventilation energy consumption by 60 % and had a payback of 1.3 years (Green Hotelier, 2011). Savings of 62 %, equivalent to 76 285 kWh per year, and a payback period of less than one year, were also quoted for the installation of variable-speed processor-controlled fans in a large hotel kitchen by Fisher (2006).

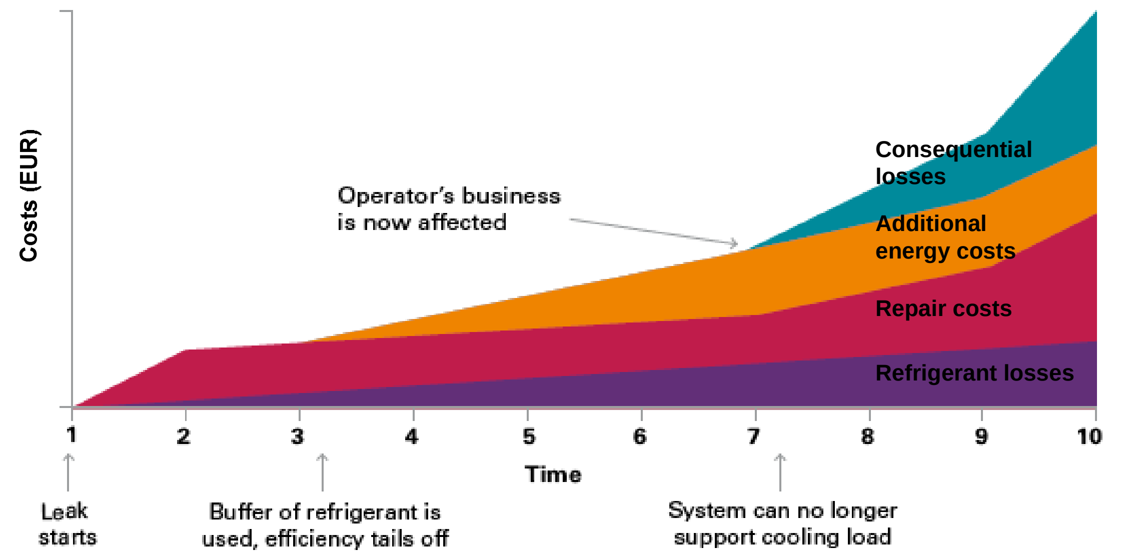
Refrigeration

As with cooking appliances, investing extra to purchase more efficient models always pays back over the equipment lifetime, and often within a few years.

Basic measures such as installation of strip curtains in cold room entrances and installation of electronically commutable evaporator fan motors pay back over a few months to a few years. For example, adjusting compressors to reduce temperature lift between evaporator and condensers will cost a few hours' labour for a technician (Carbon Trust, 2011b).

Installing a high performance heat recovery plant in the refrigeration system of a large restaurant or hotel costs in the region of EUR 2 200 to 4 400 and has a payback time of three to five years (Carbon Trust, 2011b).

Refrigerant leakage incurs significant costs over time through reduced system operating efficiency and effectiveness (Figure 8.32). Leak detection and repair costs (typically a few hundred up to a thousand euro depending on the size of the system) are paid back with a few years for small leaks, and within one year for large leaks (Carbon Trust, 2011b).



Source: Carbon Trust (2011b).

Figure 8.32: Costs incurred over time as a consequence of an unrepaired refrigerant leak

Driving force for implementation

Measures to reduce energy consumption in kitchens are driven by economic efficiency factors (see above), and uncertainty over future energy prices.

Investment in efficient new equipment may be encouraged or brought forward by various government-funded incentive schemes, such as the Enhanced Capital Allowance scheme in the UK.

Installation of refrigeration systems that use hydrocarbon or natural refrigerants is being driven by European regulation phasing out the use of fluorinated gases in refrigeration equipment.

Reference organisations

Two example organisations that implement best practice are:

- The Scarlet Hotel in Cornwall UK (induction hobs, efficient dishwasher)
- Le Premier Restaurant in Århus, Denmark.

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9 CAMPSITE BEST ENVIRONMENTAL MANAGEMENT PRACTICES

Definition of 'campsites'

This section refers to campsites, broadly defined here to range from basic camping grounds comprising simply of pitches where guests can pitch their tents, to luxury campsites offering private bathrooms and a wide range of amenities and services including restaurants and swimming pools. Many campsites include pitches for both tents and caravans or motorhomes. All types of campsite are covered by this section.

Environmental impacts

Campsites are typically associated with considerably lower environmental impact per guest-night than other types of accommodations. Indoor heated and cooled areas are small relative to the number of guests, compared with built accommodations such as hostels, guest houses and hotels. Camping establishments are not directly responsible for laundering bedclothes and towels, although camping guests may use on-site laundry machines in which case some aspects of best practice in small-scale laundries (section 5.4) apply to campsite managers.

The main environmental impacts of camping holidays arise from transport to and from campsites, and from visitor disturbance of biodiversity in the local (usually rural) area. Energy, GHG emissions and air pollution associated with transport to the campsite can be significant, especially in the case of motor homes. These impacts are primarily related to: (i) distance travelled; (ii) vehicle type and efficiency; (iii) vehicle occupancy. Such factors are largely outside the control of campsite managers, and therefore the scope of this document, but may be influenced somewhat by guest education (section 9.1). On average, camping holidays occur much closer to the point of origin and involve multiple persons, therefore incurring significantly lower transport impacts than flight holidays (see Figure 4.13 in section 4.4). Owing to the relatively large green areas occupied by campsites, and the introduction of many guests into potentially ecologically sensitive areas, campsites can generate significant biodiversity impacts (directly and indirectly). However, the rural setting of many campsites presents an ideal opportunity for nature education that can potentially increase tourist awareness of environmental issues and have a lasting influence on tourist behaviour.

Chapter scope

This chapter describes BEMPs particularly relevant to campsites, but that may also be relevant to other target subsectors of this document, in particular serviced accommodation, such as environmental education and green area management. This chapter also describes BEMP for aspects such as energy efficiency, water efficiency and waste that are addressed elsewhere in this document for serviced accommodation and kitchens. BEMP descriptions in this chapter compile the most important elements and specificities for campsites, using relevant case studies of best practice. Cross-references are made to other sections where relevant, and elements of other sections are repeated where necessary for clarity.

Table 9.1: Key features of best practice for campsites and overlap with best practice described in other sections of this document for other actors (serviced accommodation and kitchens)

Aspect	Key features of best practice	Sections
Environmental education	– Provision of information and activities on local biodiversity – Provision of local low carbon transport options (bicycles, electric vehicles, etc.)	9.1
Green area management	– Plant native species – Install green walls and roofs – Use natural green barriers – Install controlled irrigation systems and use greywater or wastewater for irrigation – Install low impact lighting	9.2 (also section 5.7 and 7.5)
Energy efficiency	– Implement an energy management system/plan (section 7.1) – Build or retrofit efficient building envelopes (section 7.2) – Ensure optimised HVAC system design and operation (section 7.3) – Install efficient, automated low-energy lighting systems (section 7.5) – Use heat pumps and renewable energy options (section 7.4 and section 7.6)	9.3 (also Chapter 7)
Water efficiency	– Implement a water management plan (section 5.1) – Install efficient water fittings (section 5.2), with a focus on show and tap timing devices – Install efficient kitchen and laundry equipment (section 8.3 and section 5.4) – Reuse greywater for toilet flushing (section 5.7)	9.4 (also Chapter 5)
Waste minimisation	– Implement a waste management plan and avoid waste wherever possible for campsite operations (section 7.1 and section 8.2) – Separate all waste generated by campsite operations into recyclable fractions (section 6.2) – Send organic waste for anaerobic digestion where available, or alternatively use or send for composting, and send used cooking oil for biodiesel production (section 8.2) – Provide facilities for collection and convenient separation of guest waste	9.5 (also Chapter 6 and section 8.2)
Natural pools	– Installation of a new pool, or retrofitting of an existing pool, with a system using natural filtration mechanisms in place of conventional disinfection methods	9.6
Wastewater management	– Send wastewater to a municipal wastewater treatment plant providing at least secondary treatment (section 3.3) – Install an on-site wastewater treatment plant providing at least secondary treatment (section 6.3)	6.3

9.1 Environmental education of guests

Description

People are often more receptive to learning about new topics, such as nature and environmental protection, when on holiday. This is particulalry true if those topics are presented in an engaging and interactive format. Campsites provide a form of accommodation that is closer to nature than other types of accommodation, and represent an ideal setting for nature and environmental education, hence the description of this BEMP technique within the chapter addressing campsites. On-site biodiversity can provide a useful and convenient context for on-site nature education, so that best practice in green area management to maximise on-site biodiversity (section 9.2) is also important.

Nonetheless, environmental education may be provided by all types of accommodations, from rural agri-tourisms to urban conference hotels, relating to all aspects of environmental management. This BEMP section is therefore applicable to all accommodation managers and tour operators, and overlaps with many other sections of this document. The main themes of guest environmental education are:

- transport and mobility
- biodiversity and conservation
- energy efficiency and renewable energy (RE)
- water efficiency and recycling
- waste prevention and recycling.

Figure 9.1 summarises the themes of BEMP for guest education and where there are overlaps with other sections of this document. Environmental education may be 'passive', based on simple observance of energy and water and waste management features, or 'active', for example provided through courses on nature (Figure 9.1). Best practices across energy, water and waste management, and green sourcing techniques include elements relevant to guest education. In particular, asking guests to reuse towels and to take showers instead of baths (section 4.5 and 5.3), and other aspects encouraging more sustainable tourist behaviour (section 4.5) overlap with this technique. The main focus of this section is biodiversity and nature conservation, and transport and mobility. Accommodation managers can have a strong influence over the latter theme through incentives for the use of public transport and provision of low carbon local transport options.

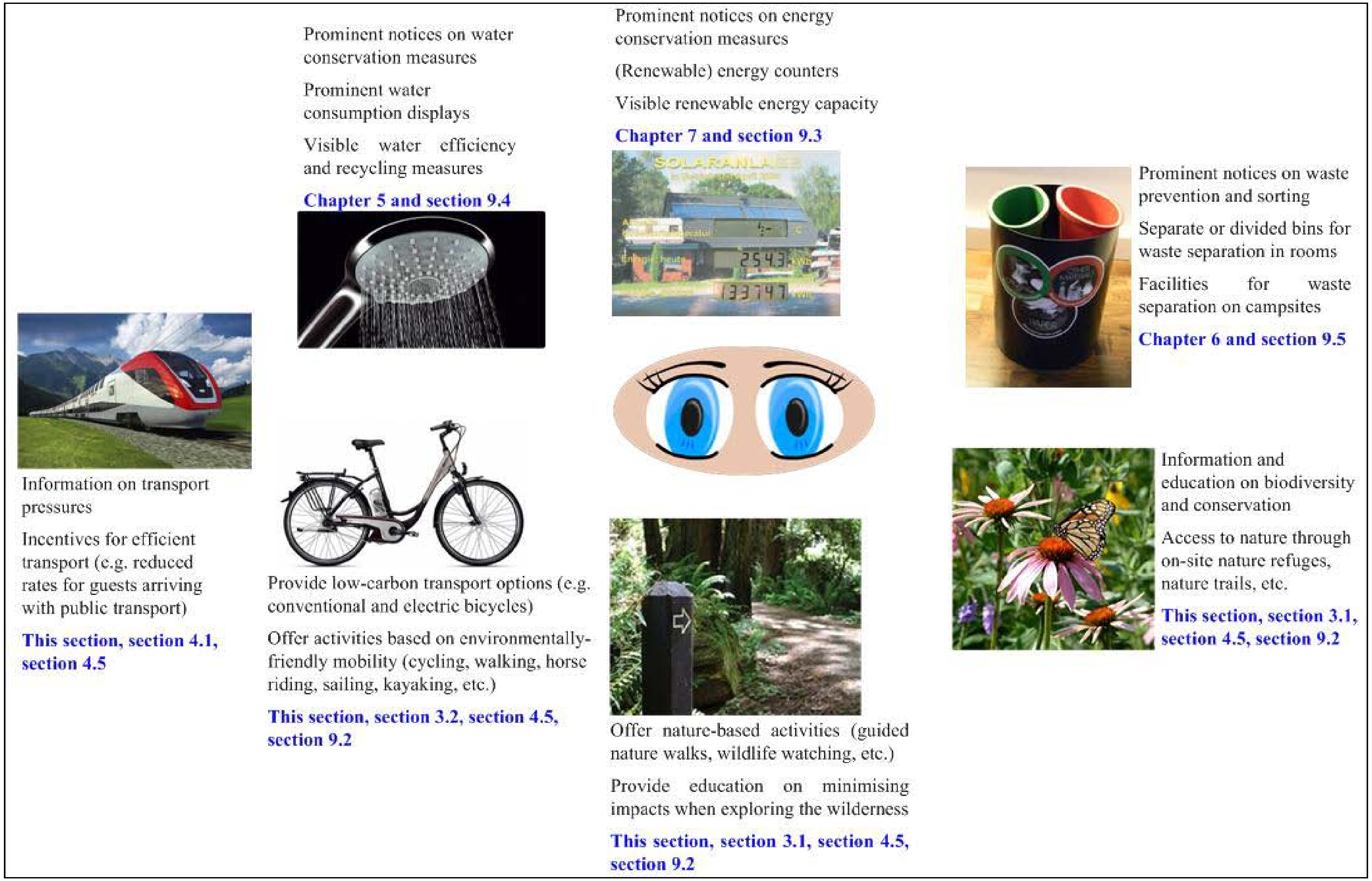


Figure 9.1: Aspects of environmental education for guests in campsites and other accommodation types, and sections of this document addressing them

Achieved environmental benefit

The main benefits arising from environmental education are indirect, off-site and behaviour-related, and are therefore difficult to quantify. Environmental education may improve guests' understanding of nature and increase their motivation to behave in a more environmentally responsible manner. Potentially, this can have significant positive outcomes across a range of environmental pressures. For example, guests may increase their recycling efforts, reduce energy and water consumption and waste generation in their homes, install RE systems, reduce their car use, and select more environmentally responsible products. Even if a small minority of guests adopt some of these actions, the long-term environmental benefits may be large compared with the direct environmental burden of their stay.

Appropriate environmental indicator

Indicators

Table 9.2 lists criteria related to guest environmental education contained in the EU Flower for accommodation. In addition to these criteria, another important indicator of best practice is:

- the number of courses offered in environment-related subjects.

Table 9.2: EU Flower Ecolabel criteria for accommodations and campsites relating to environmental education

- The tourist accommodation shall provide environmental communication and education notices on local biodiversity, landscape and nature conservation measures to guests.
- Guest entertainment includes elements of environmental education.
- Bicycles shall be made available to guests (at least 3 bikes for every 50 rooms).
- The tourist accommodation shall offer guests travelling with public transport pick up service at arrival with environmentally friendly means of transportation such as electric cars or horse sleds.
- Information shall be made easily available to the guests and staff on how to use public transportation to and from the campsite through its main means of communication. Where no appropriate public transport exists, information on other environmentally preferable means of transport shall also be provided.
- The campsite shall provide information to the guests, including conference participants, on its environmental policy, including safety and fire safety aspects, inviting them to contribute to its implementation. The information conveyed to the guests shall refer to the actions taken on behalf of its environmental policy and provide information about the Community ecolabel. This information shall be actively given to the guests at the reception, together with a questionnaire covering their views about the environmental aspects of the campsite.
- Notices inviting guests to support the environmental objectives shall be visible to the guests, especially in the common areas and the rental accommodation.
- Where applicable, inform guests on switching off heating/air conditioning and lights.
- In the sanitary areas and bathrooms there shall be adequate information to the guest on how to help the campsite to save water.
- Guests shall be informed about the necessities and obligations of correct disposal of the wastewater from their mobile means of lodging.
- The guest shall be informed about the waste reduction policy of the campsite and the use of quality product alternatives to disposable and single portion products, and should be encouraged to use non-disposable products, in case where any legislation requires the use of disposable products.
- They shall be informed how and where they can separate waste according to local or national systems within the areas belonging to the campsite and where to dispose of their hazardous substances.

Benchmark of excellence

The following benchmark of excellence is proposed:

BM: the accommodation enterprise encourages and facilitates environmentally responsible behaviour and activities, and provides environmental education for guests through on-site activities and courses.

Cross-media effects

There are no major cross-media effects associated with the provision of information and education to guests. Resource consumption (paper, ink and electricity for information presentation, wood, metal and stone for nature trails and play areas) represents a small environmental burden compared with daily operations on accommodation premises and guest activities. Even small influences on the behaviour of a minority of guests would more than offset these effects.

Appropriate species selection and maintenance techniques (e.g. mulching, use of greywater for irrigation) can minimise any pressures arising from green area management (see section 9,2).

Operational data

Transport to accommodation

The most effective way for campsite and accommodation managers to encourage efficient transport is to offer discounts to guests arriving with public transport, and to provide a pick-up service for these guests. Campsites may also provide dedicated pitches for people arriving with public transport and bicycles, away from noisier car and caravan zones (Figure 9.2, left).

Figure 9.2: Teepee area dedicated to guests arriving by public transport or bicycle at the Uhlenköper campsite

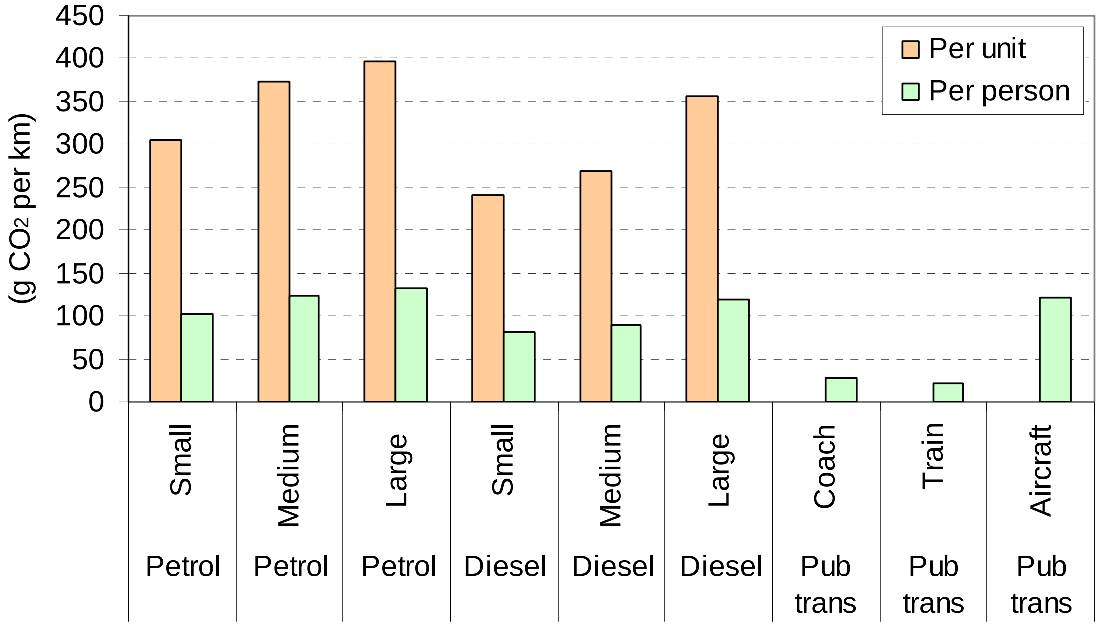
In addition to this, the provision of clear information to guests regarding the efficiency of different forms of transport (e.g. Figure 9.3 and Figure 4.4 in section 4.1) may be useful in influencing behaviour. The most effective locations for such information are brochures and booking websites, to advise guests before they travel, but guests may also be receptive to on-site information that may influence future travel plans.

The main messages to include in transport information are:

- if possible, plan fewer, longer duration trips
- check for appealing destinations closer to home
- use public transport (train, coach, bus) wherever possible

- if using a car, maximise the number of passengers (e.g. car share)
- use a caravan only when necessary (e.g. a tent may suffice for a weekend camping trip)
- if using a caravan, follow best practice advice (see below).

Figure 9.3 presents carbon intensity factors for various car-caravan combinations compared with public transport options. Assuming three persons in a car-caravan unit, emissions range from 80 to 132 grams CO_2 per passenger km travelled – lower than flying but significantly higher than bus or train transport. All of these carbon intensities are highly dependent on occupancy factors. A single person driving a caravan emits up to 396 grams CO_2 per passenger-km. Meanwhile, the carbon footprint of different transport options depends on the distance travelled – caravan journies are on average considerably shorter than flight journies. Table 9.3 lists best practice advice for caravan travel, taken from Green Caravanning (2012).



NB: Assumes 3 persons travelling in each car-caravan unit.

Source: Green Caravaning (2012); UNWTO et al. (2008).

Figure 9.3: Carbon intensity per km and passenger-km travelled of different car-caravan combinations (petrol and diesel cars, small car – small caravan to large car – large caravan)

Table 9.3: Advice to caravan owners to reduce the environmental impact of travel

Issue	Advice
Car-caravan match	Chose a towcar that is the right match for your caravan so you are not constantly changing gear. There are outfit-matching programmes used by caravan dealers to assist with this.
Speed	Towing at 60 kph, where appropriate, will use much less fuel than when towing at 80 kph or more.
Weight	The more weight that you carry the more you have to accelerate and brake when changing speed.
Bicycle racks	Cycling when on holiday is a virtually zero emission way of getting around. But irregular-shaped items, such as bicycles, on a roof rack increases wind drag. Rear-mounted carriers are more energy efficient (but do not place a bicycle rack at the front of the caravan as this might adversely affect noseweight and balance).
Roof boxes	The use of a profiled roofbox may enhance the aerodynamic properties of the towcar–caravan combination and reduce fuel consumption. Remove roof bars when not in use to avoid unnecessary fuel consumption.
Journey planning	Try to travel at less busy times. If caught in a traffic jam or causing a tailback, try to leave the road and allow the flow to stabilise. The ability to pull up and take time out is one of the major advantages for a caravanner and a goodwill gesture to other road users.
Switch off	Switch off your engine if there is clearly no movement ahead.
Traffic driving	In a long tailback, drive slowly forwards in a low gear to reduce the frequency of accelerating and braking.
Maintenance	Ensure that your car and caravan are serviced regularly, so that both are in optimum condition.
Tyre pressures	Check tyre pressures regularly – correct tyre pressures on your car and caravan reduce fuel consumption and prevent adverse tyre wear and handling problems.

Source: Green Caravaning (2012).

<u>Local transport and mobility</u>

The provision of low-carbon local transport options for guests to use at no or low cost on site and/or in the local area can encourage guests to use such forms of transport more regularly. Accommodation managers may provide bicycles and electric bikes or other electric vehicles, or kayaks and row boats for water bodies. Interesting options such as multi-person bicycles may be particularly attractive for tourists (Figure 9.4).

Figure 9.4: A seven-seat conference bicycle at the Uhlenköper campsite

The use of such transport on site can be further encouraged by establishing exclusion zones or times for motorised transport, and setting low speed limits.

Nature and environmental education

Best practice in on-site nature education overlaps with best practice in section 9.2 on the management of on-site biodiversity. The creation of refuges for animals, such as butterfly gardens, and play areas made of natural materials and set amongst indigenous plants can help sensitise campsite guests to nature (Figure 9.5).

Local nature-based activities such as cycling or walking tours may also be organised or promoted to guests in campsites and other accommodations (see section 4.4 and section 4.5). Nature information tours and courses may be provided or organised on site. A case study on Denmark Farm in Wales, described under 'Reference organisations' below, outlines best practice in the provision of nature and environmental education. Courses range from organic gardening to RE generation.

Source: Ecocamping (2011).

Figure 9.5: Examples of a small sensory garden trail (above) and a play area in natural surroundings (below) in campsite grounds

<u>Minimising impacts when exploring the wilderness</u>
Tourists may cause significant damage to wilderness areas when exploring (e.g. camping expiditions). Campsites (and tourist offices) provide a relevant base from which to offer information and education courses on how to minimise such impacts. The Leave No Trace campaign provides useful information, and may be used to support education programmes. The seven principles or Leave No Trace are summarised in Table 9.4.

Table 9.4: Good practice principles and measures for trekking and camping in the wilderness promoted by the Leave No Trace campaign

Principle	Good practice measures
Plan ahead and prepare	– Know the regulations and special concerns for the area you wll visit. – Prepare for extreme weather, hazards, and emergencies. – Schedule your trip to avoid times of high use. – Visit in small groups when possible. Consider splitting larger groups into smaller groups. – Repackage food to minimise waste. – Use a map and compass to eliminate the use of marking paint, rock cairns or flagging.
Travel and camp on durable surfaces	– Durable surfaces include established trails and campsites, rock, gravel, dry grasses or snow. – Protect riparian areas by camping at least 60 metres from lakes and streams. – Good campsites are found, not made. Altering a site is not necessary. **In popular areas:** – Concentrate use on existing trails and campsites. – Walk single file in the middle of the trail, even when wet or muddy. – Keep campsites small. Focus activity in areas where vegetation is absent. **In pristine areas:** – Disperse use to prevent the creation of campsites and trails. – Avoid places where impacts are just beginning.
Dispose of waste properly	– Pack it in, pack it out. Inspect your campsite and rest areas for trash or spilled foods. Pack out all trash, leftover food, and litter. – Deposit solid human waste in catholes dug 15 to 20 cm deep at least 60 metres from water, camp, and trails. Cover and disguise the cathole when finished. – Pack out toilet paper and hygiene products. – To wash yourself or your dishes, carry water 60 metres away from streams or lakes and use small amounts of biodegradable soap. Scatter strained dishwater.
Leave what you find	– Preserve the past: examine, but do not touch, cultural or historic structures and artifacts. – Leave rocks, plants and other natural objects as you find them. – Avoid introducing or transporting non-native species. – Do not build structures, furniture, or dig trenches.
Minimise campfire impacts	– Campfires can cause lasting impacts to the backcountry. Use a lightweight stove for cooking and enjoy a candle lantern for light. – Where fires are permitted, use established fire rings, fire pans, or mound fires. – Keep fires small. Only use sticks from the ground that can be broken by hand. – Burn all wood and coals to ash, put out campfires completely, then scatter cool ashes.

Principle	Good practice measures
Respect wildlife	– Observe wildlife from a distance. Do not follow or approach them. – Never feed animals. Feeding wildlife damages their health, alters natural behaviors, and exposes them to predators and other dangers. – Protect wildlife and your food by storing rations and trash securely. – Control pets at all times, or leave them at home. – Avoid wildlife during sensitive times: mating, nesting, raising young, or winter.
Be considerate of other visitors	– Respect other visitors and protect the quality of their experience. – Be courteous. Yield to other users on the trail. – Step to the downhill side of the trail when encountering pack stock. – Take breaks and camp away from trails and other visitors. – Let nature's sounds prevail. Avoid loud voices and noises.
Source: Leave No Trace (2012).	

Applicability

Any type of accommodation can provide environmental education to guests. Rural accommodations such as campsites are ideally placed to offer nature-based activities and education.

Economics

Provision of environmental education courses, environmentally-friendly and nature-based activities may be part of rural accommodation tourism packages, and are therefore driven primarily by business objectives. Offering such services can increase the attractiveness of rural accommodation packages, especially for families, and may be a direct source of additional revenue.

Some aspects of BEMP, such as provision of information on transport and bicycles for use locally are associated with low costs and may be provided free at the point of use. On-site education courses may be provided in association with education centres that receive public funding, or may be supported by government grants.

Driving force for implementation

Providing environmental education and nature-based activities can generate extra revenue directly, add value and facilitate marketing, as described above. Environmental responsibility on the part of accommodation/campsite managers is also a major driving force.

Reference companies

An example of best practice in environmental education is provided by Denmark Farm, a conservation centre and campsite in rural west Wales. The Shared Earth Trust established Denmark Farm as a conservation centre in 1987, replacing intensive grazing on low biodiversity rye grass fields by more traditional cattle grazing and haymaking, blocking field drains, halting most fertiliser inputs and fencing off overgrazed hedgerows, streams and ditches. Since then, the number of bird species on the 16 hecatre farm has increased from 15 to 45, and the most diverse meadow contains 100 species, including flowers, grasses and sedges. A small campsite accommodating up to 10 tents is located within the 16 hecatre gounds.

Figure 9.6: A high biodiversity meadow on Denmark Farm

Denmark Farm conservation centre runs conservation and sustainability courses across a diverse range of topics, from organic gardening to RE generation, many in partnership with the School of Education and Lifelong Learning in Aberystwyth University. Courses are targeted at all age groups. A list of courses offered in 2012 is presented in Table 9.5.

Table 9.5: Nature and sustainability educational courses offered at Denmark Farm conservation centre

Course titles	
– Food for Life – Up-Cycled Textiles – March Shave Horse Making Workshop – Organic Vegetable Growing from Scratch – Bird Identification (SELL) – Introduction to Renewable Energy – Spring Wild Food: Pick, Cook & Eat – Field Survey Techniques (SELL) – Understanding British Mammals I: Gnawers, Nibblers & Insect Crunchers (SELL) – Identifying Flowering Plants (SELL) – Identifying Grasses, Sedges & Rushes (SELL) – Entomology – The Larger Insects of Wales (SELL) – Discovering Bumblebees – Sustainable Beekeeping – Ecology 1 (SELL) – Discovering Fungi (SELL)	– Natural Festive Crafts – Make Your Own Herbal Cosmetics Understanding British Mammals II: Predators & Hunters (SELL) – Plant Diversity (SELL) – Understanding British Bats: An Introduction (SELL) – Extending the season – Organic Vegetable Growing in Winter – Wool Dyeing with Natural Dyes – Make Your Own Pole Lathe – Patchwork Quilts (3 part course) – Pond & Stream Invertebrates (SELL) – Phase 1 Habitat Survey – Reading the Landscape – Feel Like Felt? Learn In a Day (Beginners) – Soft Shoe Shuffle – Felt to Fit Slippers – Identifying Mosses, Liverworts & Lichens (SELL)
NB: 'SELL' = courses run by the School of Education and Lifelong Learning, Aberystwyth University. *Source:* Denmark Farm (2012).	

The Wern Watkins bunkhouse referred to as a case study in section 9.1 is also provides a base for outdoor field activities and educational courses (see Table 9.11).

Reference literature

- Denmark Farm, homepage accessed March 2012: http://www.denmarkfarm.org.uk/
- EC, *Commission Decision of 9 July 2009 establishing the ecological criteria for the award of the Community ecolabel for tourist accommodation service (2009/578/EC)*, OJEU, L 198/57.
- EC, *Commission Decision of 9 July 2009 establishing the ecological criteria for the award of the Community ecolabel for campsite service (2009/564/EC)*, OJEU, L 196/36.
- Ecocamping, *Ecology and Economy in Harmony: How to establish sustainability on campsites*, Ecocamping, 2011, presentation made in Zadar.
- Green Caravaning, *Technical information page*, accessed February 2012: http://www.greencaravanning.co.uk/technical-info.php
- Leave No Trace, *Programmes and priciples webpage*, accessed March 2012: http://www.lnt.org/programs/principles.php
- UNWTO, UNEP and WMO, *Climate Change and Tourism: Responding to Global Challenges*, UNWTO, 2008, Madrid.

9.2 Environmental management of outdoor areas

Description
Campsites and other types of tourist accommodation such as resort hotels and agri-tourisms often have large outdoor areas. Development of buildings and infrastructure related to tourism removes and fragments natural habitats, leading to high biodiversity losses in high nature value (HNV) areas where tourism is often concentrated. In the first instance, it is important that tourism development is properly controlled to minimise biodiversity loss (sections 3.1 and 3.2), and intensively manicured outdoor areas should be kept to a minimum.

Landscaping, lighting and noise generation can significantly impact upon biodiversity in rural and coastal, especially HNV, areas. During the design and maintenance of accommodation sites, there are many measures that can be taken to reduce biodiversity loss, or even to increase biodiversity, centered on good design and management of outdoor areas. This BEMP technique focuses on accommodation in rural areas, but also applies to accommodation in urban areas, where brown or green walls and roofs may provide valuable refuges and biotope corridors for some species.

Figure 9.7 shows the extent of artificial lighting within Europe visible from space at night. Light and noise pollution can disorientate and deter various species. Migrating birds, nocturnal moths, and sea turtle hatchlings are among the animals known to be disoriented by excessive illumination, sometimes leading to death. At least 4 million to 5 million birds per year are estimated to die due to collisions caused by light pollution (Hub pages, 2012). In addition, excessive exposure to nightime light has detrimental effects on human health and wellbeing.

Source: Hub pages (2012).

Figure 9.7: Light pollution over Europe at night

Bohdanowicz and Martinac (2007) found that the area of irrigated landscaped grounds in Hilton hotels across Europe was the most important factor influencing total hotel water consumption (followed by guest-nights, floor area and food covers sold). Restricting landscaped area, native planting, mulching, controlled irrigation and use of recycled (greywater or treated black water) can minimise water consumption in outdoor areas.

Table 9.7 summarises best practice measures for outdoor areas, for which relevant operational data are presented below.

Table 9.6: Portfolio of best practice measures for outdoor management

Aspect	Measures	Descriptions
Biodiversity	– Minimise landscaped area – Low input management – Plant native species – Create rufuges – Use natural barriers – Install brown/green roofs and walls	Outdoor areas can be planned to incorporate native or artificial habitats that support native biodiversity, including non-landscaped areas, barriers formed of plants, wood or stone, green or brown roofs. These areas may serve both conservation and guest education purposes.
Water conservation	– Measures above – Mulching – Controlled, efficient irrigation systems – Rainwater / greywater irrigation – Minimise impermeable surface area	Planting native species and mulching reduce irrigation requirements, whilst installation of controlled, efficient (e.g. drip-feed) irrigation systems and recycling of greywater minimises freshwater consumption and potential water stress.
Minimise lighting impact	– Sodium lighting – Appropriate capacity and direction installed – Sensor/timer control	Installation of carefully directed, spaced and sized lamps, controlled by timers and/or sensors, minimises electricity consumption and unnecessary lighting. Use of sodium lamps where appropriate reduces energy consumption and interference with insects and animals.
Minimise noise impacts	– Soundproofing of noisy areas – Curfew for outdoor entertainment	Adequate sound installation should be installed in buildings hosting noisy equipment or events. Sound barriers may be installed to reduce noise pollution from outdoor events, and strict curfew rules should be enforced for such events.

Green and brown roofs are a widely applicable and important aspect of best practice in outdoor area management that can also be applied in urban areas. Green roofs incorporating grass and a rooting substrate provide aesthetic, sound and temperature insulation and water attenuation benefits. Brown roofs extend these benefits by supporting a range of native plant and animal species. The main difference between construction of a green and brown roof is the choice of growing medium, which is usually locally sourced rubble, gravel or spoil for brown roofs, mixed with other lightweight subtrates to meet the specific biodiversity objective (Bauder, 2012). Detailed information on the construction of green and brown roofs is provided in EC (2012). Some summary information is provided in this section.

Achieved environmental benefit

Table 9.7 summarises the main environmental benefits associated with best environmental management practice measures for outdoor areas.

Table 9.7: Environmental benefits of best practice measures for outdoor areas

Measure	Environmental benefits
– Native planting – Low input management – Native habitat refuges	– Directly maintain or increase local biodiversity – Support local ecosystems by providing biotope corridors – Reduced water stress (reduced irrigation requirements)
– Brown/green roofs and walls	– Directly maintain or increase local biodiversity – Support local ecosystems by providing biotope corridors – Water attenuation and reduced peak run-off during storm events – Reduced heating and cooling requirements – Reduced pollution
– Drivable grass parking areas	– Water attenuation and reduced peak run-off during storm events
– Mulching – Controlled irrigation – Greywater irrigation	– Reduced risk of soil salination and structural degradation – Reduced water consumption and local water stress
– Low impact lighting	– Reduced electricity consumption and associated impacts – Reduced light trespassing, glare, light clutter and skyglow – Reduced interference with animals' diurnal cycles
– Noise control	– Reduced interference with animals' diurnal cycles

Green and brown roofs are associated with a range of environmental benefits that are difficult to fully quantify. They help to conserve biodiversity by providing new habitats, especially in areas of deficiency (urban areas), and can contribute to the formation of green corridors through urban areas that can reduce the impact of habitat fragmentation. Green and brown roofs also contribute to drainage management by providing water attenuation during rainfall events, and can act as filters for pollution, especially particulate matter, in urban areas. Green and brown roofs may also reduce temperature fluctuations, through insulation, evapotranspiration and albedo effects.

Data from Scandic and Hilton hotels analysed by Bohdanowicz and Martinac (2007) indicate that, on average, each m^2 of irrigated landscaped groud consumes 88 litres of potable water per year, but this can increase to hundreds of litres per m^2 in drier areas. Appropriate species planting can therefore save hundreds of litres per m^2. Meanwhile, efficient irrigation techniques can reduce water consumption by more than half. The timing of watering alone can lead to significant savings: watering in the early morning or evening reduces water loss through evaporation, resulting in approximately 25 % less consumption for the same irrigation effect (Smith et al., 2010).

Appropriate environmental indicator

<u>Indicators</u>

Table 9.8 summarises relevant indicators to measure performance with respect to onsite biodiversity, water efficiency and light and noise pollution.

Table 9.8: Relevant indicators for best practice

Aspect	Relevant indicators
Biodiversity	– Number of species of plants and animals on site (biodiversity surveys – could be compared with nearby (semi-) natural sites) – Percentage of species on site that are native
Irrigation consumption	– Specific irrigation consumption, L/m^2 per year – Specific irrigation consumption of non-recycled water, L/m^2 per year – Specific irrigation consumption of potable water per guest-night (L/guest-night) – comparable with water indicators in Chapter 5
Lighting energy consumption	– Lighting efficieny (lumens per Watt) – Specific consumption per outdoor lighted area (kWh/m^2 per year) – Specific consumption per indoor heated and cooled area (kWh/m^2 per year) – comparable with energy indicators in Chapter 7
Lighting impact	– Lighting efficieny (lumens per Watt) – Light direction (avoid upward lighting) – Light flux, lumens/m^2
Noise impact	– dB noise at perimeter of accommodation premises after 21:00

Ecolabel criteria

Selected relevant mandatory and points criteria for the award of the EU Flower Ecolabel to accommodations and campsite enterprises provide a useful indicator set for best environmental management of outdoor areas (Table 9.9).

Table 9.9: EU Flower Ecolabel mandatory and optional criteria for accommodation and campsites and relating to management of outdoor areas

- Where the campsite is connected to a septic tank, the waste from chemical toilets shall be separately or otherwise correctly collected and treated. Where the site is connected to the public sewage system, a special sink or disposal unit aimed at avoiding spillage shall be sufficient.
- Where de-icing of roads is necessary, mechanical means or sand/gravel shall be used in order to make roads on the tourist accommodation premises safe in case of ice/snow.
- Outside areas shall be managed either without any use of pesticides or according to organic farming principles, as laid down in Council Regulation (EC) No 834/2007, or as laid down in national law or recognised national organic schemes.
- At least 50 % of the tourist accommodation building(s) which have suitable roofs (flat roofs or roofs with a small angle of inclination) and are not used for other purposes, shall be grassed or planted.
- If chemical de-icing is used, substances which do not contain more than 1 % chloride ion (Cl-) or de-icers that have been awarded the Community ecolabel or other national or regional ISO type I ecolabels shall be used.
- Car washing shall not be allowed, or shall be allowed only in areas which are specially equipped to collect the water and detergents used and channel them to the sewerage system.
- Oil and similar run-off from vehicles on the car park shall be collected and correctly disposed of.
- All traffic (guests and maintenance/transport) inside the camp ground shall be limited to defined hours and areas.
- The campsite shall not use combustion motor vehicles for transport and maintenance on the campground.

– For transportation of luggage and shopping on the site, trolleys or other non-motorised means of transport shall be at guests' disposal free of charge. – At least 90 % of the campsite area surface is not covered with asphalt/cement or other sealing materials, which hinder proper drainage and airing of the soil.
Source: EC (2009).

Benchmarks of excellence

The following benchmarks of excellence are proposed:

BM: maintain or increase on-site biodiversity by planting native species, creating refuges for local animal species, and installing green or brown roofs where possible, and by minimising chemical inputs, light and noise pollution.

BM: minimise light pollution and wildlife disturbance by installing timer- or sensor-controlled, efficient, and appropriately angled luminaries producing zero-uplight.

BM: minimise water consumption by planting native species and mulching, and by installing controlled irrigation systems fed with greywater where possible.

Cross-media effects

Plants used for outdoor and green roof planting should be obtained from reputable sources who avoid (unsustainably harvested) wild plants.

The impact associated with the production of additional steel and concrete required to support intensive green roofs is likely to be relatively minor when calculated over the building lifecycle, especially where they are recycled at the end of the building lifetime. Local and recycled materials should be used for green and brown roof substrate, filtration and drainage layers.

Greywater (and treated blackwater where appropriate) should be tested for concentrations of contaminants and salts that could accumulate in the soil and cause degradation through eco-toxicity or salination effects.

Operational data

Native planting

Factsheet 12 within the IUCN (2008) guide for biodiversity management by hotels lists information on selection and procurement of plant species. Trustworthy plant suppliers should be sought and only nursery-reared or sustainably harvested wild plants should be purchased (where possible, wild harvested plants should be avoided). Planting native species avoids the risk of introducing invasive species that may pose a serious weed threat, and is associated with other benefits such as providing familiar habitats for local biodiversity, and reducing maintenance requirements. However, IUCN (2008) note that it is not necessary or realistic to avoid all non-native species. Care should be taken and advice sought to avoid potentially invasive species. Two useful global websites provide information on invasive species:

- the global invasive species database – www.issg.org/database/
- the Global Invasive Species Programme – www.gisp.org

In particular, it is recommended that the following plants be avoided:

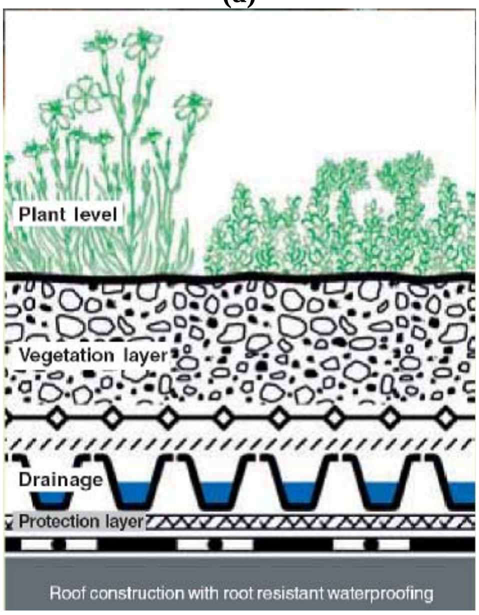
- all non-native aquatic plants, especially water hyacinth (*Eichhornia crassipies*), giant salvinia (*Salvinia molesta*) and water cabbage (*Limnocharis flava*);

- terrestrial ornamentals such as Lantana, giant mimosa (*Mimosa pigra*), kudzu vine (*Pueraria montana*), tamarisk (*Tamarix*), chinaberry (*Melia azedarach*), castor oil plant (*Ricinus communis*), privets (*Ligustrum*), Japanese honeysuckle (*Lonicera japonica*), Brazilian peppertree (*Schinus terebinthifolius*), Japanese cherry (*Hovenia dulcis*), prickly pears (*Opuntia*), Japanese knotweed (*Fallopia japonica*), and brooms (notably *Spartium junceum*, *Cytisus scoparius* and *Genista monspessulana*).

<u>Green and brown roofs</u>

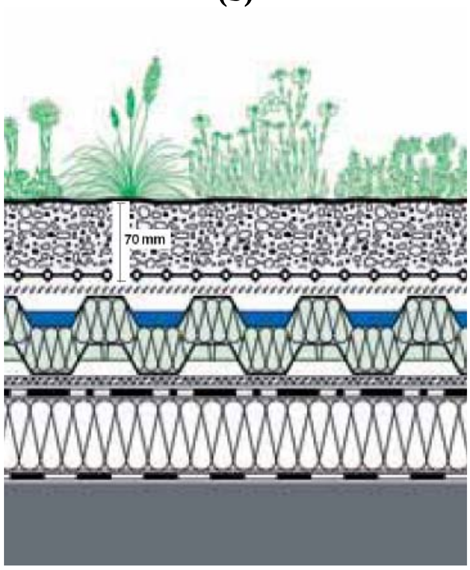
A green roof comprises a waterproofing layer laid onto the underlying roof structure. Then a perforated drainage layer with reservoir capability is constructed, followed by a filter layer including soil loading and plantings (Figure 9.8).

(a)



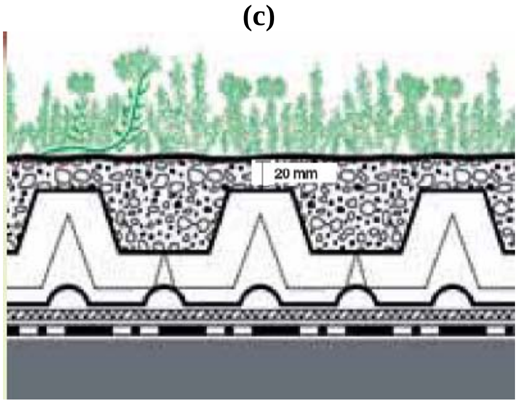
Total build-up height: 100 mm
Weight (saturated): 108 kg/m^2
Water storage capacity: 36 L/m^2
Run-off coefficient C: 0.34

(b)



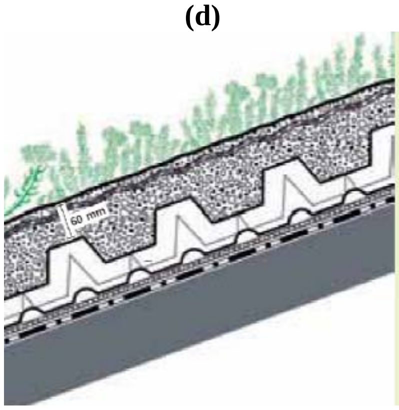
Total build-up height: 130 – 180 mm
Weight (saturated): 108 kg/m^2
Water storage capacity: 36 L/m^2
Run-off coefficient C: 0.34

(c)



Total build-up height: 100 mm
Weight (saturated): 60 kg/m^2
Water storage capacity: 21 L/m^2

(d)



Total built-up height: 140 mm
Weight (saturated): 130 kg/m^2
Water storage capacity: 36 L/m^2

Source: Zinco (2011) and EC (2012).

Figure 9.8: Green roof designs for: (a) normal extensive, rock-type plants; (b) combined with thermal insulation; (c) low weight option; (d) pitched roof (from EC, 2012)

Brown roofs comprise the following layers (EC, 2012).

- The substrate layer consists of a varied range of growing mediums (local soil and spoil, aggregates etc.), usually selected to maximise biodiversity.
- The filter layer consists of a geotextile filter sheet and prevents fine particles from the substrate collecting in the drainage layer.
- The drainage layer often consists of plastic sheets embossed with a pattern of water-retaining cups and therefore controls the water-retention properties of the brown roof in combination with the substrate layer. Excess water is able to percolate through.
- The waterproofing layer can be of any type suitable for flat roof applications. Ideally, the waterproofing layer will also act as a root barrier. If it does not, a separate root barrier layer will be needed.

The vegetation selected should be suitable to support the differing biodiversity species the roof is designed for. Whilst natural colonisation by plants was initially favoured for brown roofs, the need to provide the correct plants to meet the specific biodiversity requirement for the site has led to a variety of vegetation mixes being used. Dependent on the target species, the rooftop could contain plants indigenous to the area, water pools, wetland areas for the establishment of mosses and lichens, logs to provide a habitat for insects invertebrates, boulders and stones, land forms created to provide different landscape levels, seeding of indigenous plants etc. (Brown Roof, 2010). Various companies offer plugs of wild plant species, classified into different categories so that appropriate indigenous plant types can be selected, that can be established on green roofs to increase on-site biodiversity.

Natural areas and barriers

For large outdoor areas, natural habitat may be left intact or encouraged to regenerate through low input management practices. Areas of natural habitat may be integrated into landscape plans, and provide a feature for guests. Such areas may be made accessible by building paths around or through them for guests to enjoy. The most appropriate design of natural areas and barriers should be informed by the local environment, especially widely available materials and suitable refuges for local species. Some exmples are provided in Figure 9.9.

Minimising chemical inputs to landscaped areas is also beneficial for biodiversity and can increase the number of natural refuges on site. Organic gardening methods may be followed, including use of natural fertilisers such as manure, mulching of soils to reduce weeds, and mechanical rather than chemical weed removal.


Natural barriers supporting biodiversity, formed of dead wood (left) and local stone (right)


Examples of bat (left) and insect (right) refuges


A grass supporting driveway (left) and a butterfly garden (right)

Source: Ecocamping (2011).

Figure 9.9: Visual examples of best practice measures to increase on-site biodiversity and drainage management

<u>Irrigation</u>

There are numerous measures that can be taken to reduce irrigation requirements, especially at the design stage of outdoor areas. These include minimising intensively landscaped areas and planting native and climate-suitable species, including drought-tolerant gardens in dry areas (Figure 9.10). Where pots and planters are used, they should be impermeable (e.g. glazed or painted clay) or lined with impermeable lining to minimise water loss. Plants should be grouped according to watering needs.

Figure 9.10: A xeric garden in a desert (left) and a drip-irrigation emitter (right)

With respect to irrigation systems, hose or sprinkler watering should be avoided where possible. Best practice for shrubs and trees is to use drip-irrigation systems that are controlled to deliver the necessary amount of water to the plant roots, with a tyical efficiency of 90 % (Irrigation Tutorials, 2012). Irrigation specialists should be consulted to design an appropriate system based on water supply and irrigation area characteristics. Drip irrigation systems require a water supply pressure of at least 3 bars to work effectively (Table 9.10) – a pump may be needed to provide sufficient pressure from e.g. rainwater or greywater collection tanks. Main and lateral line length should not exceed 120 m from the water supply valve, whilst drip tube length should not exceed 120 m in total, and 60 m from the point at which the water enters the tube from lateral lines. Standard emitter flow rates are 2, 4 and 8 litres per hour.

Table 9.10: Main components and associated pressure drop for drip-irrigation systems

Component	Pressure drop (bars)
Valve Backflow Preventer	0.4
Pressure Regulator	0.0
Filter	0.2
Main and lateral lines	0.4
Drip tube	0.2
Emitters	1.0

NB: Based on 0.4 L/s flow from a 20 mm valve and 0.9 L/s flow from a 25 mm valve.
Source: Irrigation Tutorials (2012).

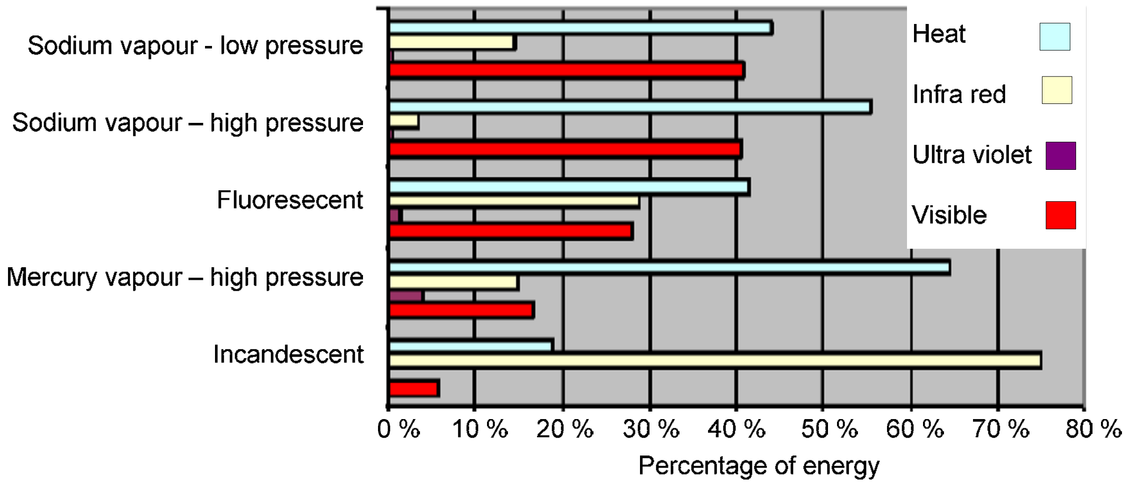
Where required for lawns, sprinkler systems producing larger drops are more efficient, with lower evaporative losses than sprinkler systems producing smaller drops. Watering should be undertaken in the early morning or evening, and at the longest possible intervals to encourage deep root growth. It is important to control irrigation systems, manually or automatically, to ensure activation at appropriate times and to deactivate following significant precipitation.

Where possible, irrigation systems should be fed by collected rainwater or greywater from kitchens, bathrooms and laundries (see section 5.7). In areas of extreme water stress, filtered black water may also be used for irrigation of grass and shrubs.

Other management practices to reduce irrigation requirements are to mulch flower beds, to remove weeds, to leave grass clippings on the lawn, not to cut grass too short, and to condition soils to hold more water (possibly with compost from on site: section 8. 2).

Lighting

The human eye only perceives light with a wavelength between 440 and 780 nm. A much wider range of wavelengths are produced by different types of lighting, and can be detected by different types of animal, potentially interfering with their diurnal activity patterns. Sodium lamps are the most efficient lamp type in terms of converting electrical energy into visible light energy (Figure 9.11).



Source: Modified from Gustems (2009).

Figure 9.11: Relative outputs of different light wavelengths from different outdoor lamp types

High pressure sodium lamps generate 70 to 130 lumens per watt of electricity consumed, whilst low pressure sodium lamps generate 100 to 180 lumens per watt. In addition to energy efficiency advantages, this reduces pollution from light invisible to the human eye, especially UV light that disturbs insects and birds (Accor, 2007). Sodium lamps attract fewer insects, but are less effective than other lamp types at highlighting colour, possibly affecting their suitability for some outdoor applications. Sodium lamp lifetimes of approximately 23 000 hours are half those of LED lamps, but comparable with higher-pressure mercury and longer than for other lamp types (Gustems, 2009). ASHRAE (2009) recommend pulse-start metal halide, LED, fluorescent or compact fluorescent amalgam lamps with electronic ballasts as appropriate alternatives to sodium lamps for exterior lighting.

ASHRAE (2009) make the following recommendations regarding exterior lighting:

- coordinate lighting with landscape plantings so that tree growth does not block effective lighting from pole-mounted luminaries;
- ensure that ground (e.g. parking area) lighting is not significantly brighter than adjacent street lighting;
- ensure an adequate distribution of luminaries, to avoid excessive wattage and contrast from individual luminaries (limit luminaries in parking areas to a maximum of 320 watt pulse-start metal halide lamps at a maximum 6 m mounting height in urban and suburban areas or lower, in accordance with building height);
- avoid flood lights and non-cutoff wall-packs;
- use luminaries that produce 0 % uplight (full-cutoff fixtures) to eliminate light pollution;
- parking area luminaries should incorporate house side shielding and/or forward throw optics and should be located facing the property to help eliminate light trespass.
- use an astronomical time switch or a combination of a photo-sensor and a time switch for all exterior lighting (or integrate outdoor lighting into BMS);
- turn off exterior lighting not designated for security purposes when the building is unoccupied;
- avoid façade lighting in sensitive areas;
- limit any façade lighting to 1.6 W/m^2.

Applicability
Most of the best practice measures described above are widely applicable for accommodations with outdoor areas. Two major applicability restrictions are listed below.

- Whilst green roofs based on a thin substrate layer planted with grass can be applied to most roof types, intensive green and brown roofs can only be developed on well-supported flat or low-pitched roofs (unless significant structural modifications are made). Often, economic considerations restrict the installation of green and brown roofs to the initial construction phase, or during significant renovation.
- Greywater irrigation systems require a separate greywater collection system that can only be installed during initial construction or major renovations (section 5.7).
- Sodium lighting may not be appropriate where high colour definition or feature lighting is required.

Economics
It is diffuclt to quantify the (public) economic value of biodiversity management. The WBCSD (2011) provides a guide for corporate ecosystem valuation that can be used to rationalise expenditure on biodiversity protection measures.

Careful landscaping and selection of low-maintenance, native plant species do not necessarily incur additional investment costs, and can lead to significant annual cost savings for chemicals, irrigation and labour.

Rainwater harvesting requires little investment, but greywater harvesting can be associated with significant investment costs (section 5.7) – although it can be a relatively low cost option for campsite washrooms (section 9.4). Payback periods depend heavily on water pricing – typically 2 – 4 EUR per m^3 in Europe.

Additional costs for installing brown or green roofs should be balanced against the multiple potential economic benefits, including:

- possible provision of an attractive recreational area for guests
- reduced maintenance and replacement costs for the roof waterproofing layer (protection from UV radiation and temperature oscillations)
- reduced energy costs for heating and cooling
- reduced drainage system construction costs owing to roof water retention (if integrated into initial construction design).

Driving forces for implementation
The maintenance and protection of biodiversity is a cornerstone of sustainability, and critical to attract visitors to tourism destinations. Therefore, all tourism businesses have a strong long-term interest in good biodiversity management.

At a more basic level, other driving forces for the implementation of the above measures are:

- local regulations regarding the planting of native species
- regulations and planning conditions requiring the incorporation of green or brown roofs into new buildings
- regulations limiting maximum lighting intensities and timing may apply, especially in rural and protected areas
- maintaining attractive grounds
- green marketing

- carbon offsetting (tree planting)
- corporate social responsibility.

Reference organisations
Some examples of possible best practice are summarised in Table 9.11, below.

Table 9.11: Examples of good practice in outdoor area and biodiversity management

Example	Description
Denmark Farm	Denmark Farm, the conservation centre and campsite in rural west Wales desribed as an example of best practice for guest education in section 9.1 also provides an example of best practice in outdoor area management.
Ballynahinch Castle	One example of best practice in native species planting is Ballynahinch Castle hotel in Ireland. The hotel owners are undertaking a native woodland management programme involving the removal of invasive rhododendrons and the planting of over 2 500 hard wood trees. Hundreds of native oaks have been propgated and nutured from existing on-site trees. The hotel is also participating in a 30-year study with Trinity College Dublin on the effects of climate change on Irish hardwoods. In addition, guests can select a 'tree-planting break' for which they receive a certificate detailing a tree planted in their name in the hotel's Tree Ledger. Guests may request additional information to be included, such as a dedication in memory of a loved one or the celebration of the birth of a child.
Seehof Campsite	The Seehof Campsite in Germany is planting native species of trees to offset carbon emissions, and harvests dead wood from on-site woodlands to provide heating via an efficient gasifying log-fed boiler (section 9.3).
Wern Watkin Bunkhouse	The Wern Watkin bunkhouse is a 30 bed hostel located in the Brecon Beacons National Park, set directly within a 10 hectare protected area that includes a wetland, ancient hay meadow with late harvesting to encourage wild flowers, a semi-natural ancient woodland, a bat special area of conservation and a pond. Specific best practice measures include: – long term participation in agri-environment schemes Tir Gofal and Better Woodlands for Wales – design of tourism building includes bat roosts, nesting sites for swifts and swallows – re-institution of coppice management on marshy woodland including horse extraction to reduce erosion impacts. Involvement of local community in woodland work to access machinery and training through a small machinery ring – 2 000 trees planted to screen development – access tracks provided – extensive species recording using Brecknock recording centre (plants, insects, birds) – 50 bird boxes put up and woodland management includes habitat piles of scrub – conservation grazing – wildflower meadow managed by late hay making provides setting for bunkhouse – guests provided with home-made charcoal and wood and link made with the state of woodlands from using local product – extensive provision of guides etc. to bring guests into the story.

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9.3 Campsite energy efficiency and renewable energy installation

Description

Energy consumption on campsites is low compared with energy consumption in built tourist accommodation. Data from 99 German campsites within the Ecocamping network for 2009 indicate average total energy consumption of 8.1 kWh per guest-night, and average electricity consumption of 3.1 kWh per guest-night, equating to less than 18 % and 15 %, respectively, of energy and electricity consumption per guest-night in mid-range hotels (Figure 9.12). Ecotrans (2006) quote higher average energy consumption figures of 16.5 and 77.2 kWh per guest-night for 55 campsites and 292 hotels, and found campsite energy consumption to be broken down as follows:

- 40 % natural gas
- 30 % electricity
- 18 % liquefied gas
- 12 % heating oil.

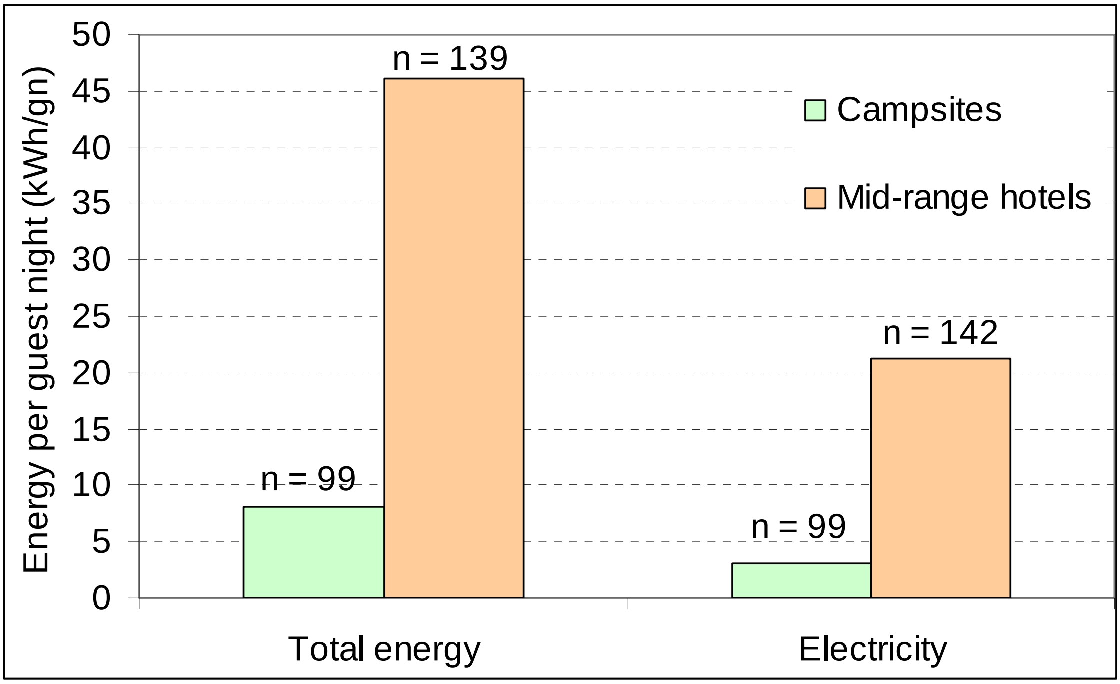


Figure 9.12: Mean total energy consumption and electricity consumption for a mid-range hotel chain and German campsites in the Ecocamping network

Indoor areas requiring HVAC can be relatively large for some campsites, especially high grade ones. Multiple wash room and recreation buildings may exceed 500 m^2 each, and restaurant areas are often greater than 200 m^2. The main sources of energy demand on campsites are:

- HVAC for buildings (restaurant, indoor activity area, shop, washrooms)
- heating of water for washrooms
- kitchen and food storage appliances
- electricity for lighting
- electricity supply points for guest use (e.g. to plug in motor homes).

In the first instance, a key aspect of best practice is to monitor energy consumption (Table 9.12). This should include all energy, from various sources such as electricity, natural gas, propane, etc, and should be combined with information on guest numbers and indoor areas to generate appropriate efficiency benchmarks (section 7.1). Sub-metering of energy consumption in specific areas, such as the kitchen, can provide opportunities for more detailed benchmarking.

Energy consumption can usually be reduced significantly through relatively simple actions, and there is considerable overlap with Chapter 7 that addresses the minimisation of energy consumption in accommodation buildings. For all new buildings, and wherever possible on existing buildings, it is important to minimise HVAC demand by installing thick insulation, high quality multi-pane windows, and minimising drafts (section 7.2). HVAC system efficiency can be maximised by ensuring appropriate air exchange rates and temperature control throughout zoned indoor areas of campsites (section 7.3). Hot water demand can be minimised by installing efficient fittings with control mechanisms (e.g. push-button timers) (section 5.2). Energy consumption related to food storage and preparation can be minimised in accordance with section 8.3 and section 8.4 directed at kitchens.

Heat pumps can maximise the efficiency of conventional energy (electricity) use (section 7.4), whilst wood boilers and solar heating are renewable energy (RE) options particularly well suited to campsites owing to wood supply and space availability. Heat pumps may be combined with greywater heat energy recovery, which is also well suited to campsites owing to the concentration of greywater generation in washrooms and laundry areas. Finally, campsite managers may install photovoltaic or wind turbine renewable electricity generators on site, or may contract genuine (additional) renewable electricity (section 7.6).

The main opportunities for energy saving on campsites arise from HVAC systems for indoor areas and water heating. Campsites are also well suited for the application of RE solutions. Therefore, this section focuses on efficient energy use for space and water heating, and application of RE technologies (Table 9.12). Readers are referred to other sections of this document for more detail on particular measures where relevant.

Table 9.12: Best practice measures for campsites to minimise energy consumption

Aspect	Best practice measures	Applicability	Location in document
Monitoring & maintenance	– Monitor energy consumption	All campsites.	Section 7.1
	– Maintain boiler systems, pipe-work and insulation	All campsites.	Section 5.1
Lighting	– Install low-energy indoor lighting with appropriate sensor- or timer-control	All campsites.	Section 7.5
	– Install low-energy and timed outdoor lighting	All campsites.	Section 9.1
Space heating	– Good building envelope	Building envelope should be optimised during the design stage, but can be significantly improved during renovations.	Section 7.2
	– Optimised HVAC system	Optimised HVAC systems may be installed to new buildings or during major renovations. Various improvements can usually be made in other cases.	Section 7.3
	– Heat pump and geothermal heating	Air-source heat pumps are not effective in winter in very cold climates. Geothermal heat pumps require appropriate underlying geology, whilst ground-source heat pumps require sufficient outdoor area.	Section 7.4 and this section
	– Wood boiler heating – Solar heating	Wood boilers are appropriate anywhere where there is a supply of suitable wood fuel (local or imported). Urban air-quality regulations that may pertain to the installation of wood boilers are unlikely to affect campsites.	Section 7.6 and this section
Hot water heating	– Install low-flow water fittings	Washrooms of all campsites (see section 9.3).	Section 5.2
	– Heat pump heating	See above.	Section 7.4 and this section
	– Solar heating – Wood heating	Solar collectors work effectively even in high latitudes and under diffuse light and significant cloud cover from spring to summer. Solar collectors should be installed on south, south-east or south-west facing roofs.	Section 7.6 and this section
	– Greywater heat recovery	Greywater heat recovery systems may be installed on new campsite washrooms, or during extensive renovations if the collection tank is located adjacent to (rather than underneath) the building.	This section
Renewable electricity	– Install wind and solar PV generating capacity on site – Invest in off-site RE generating capacity	Campsites are well-suited to the installation of solar PV panels and wind turbines. Any campsite may invest in off-site RE capacity (section 7.5).	Section 7.6

Achieved environmental benefit

Water efficient fittings

Installing low-flow basin and sink taps and low-flow showers with timers can considerably reduce hot water consumption (see Figure 9.21 in section 9.3). The estimated energy saving arising from the installation of efficient fittings in a 300-pitch campsite (see Figure 9.23) is 202 343 kWh. This equates to 2.2 kWh per guest-night, and 27 % of total energy consumption per guest-night across Ecocamping campsites (Figure 9.12).

Greywater heat recovery

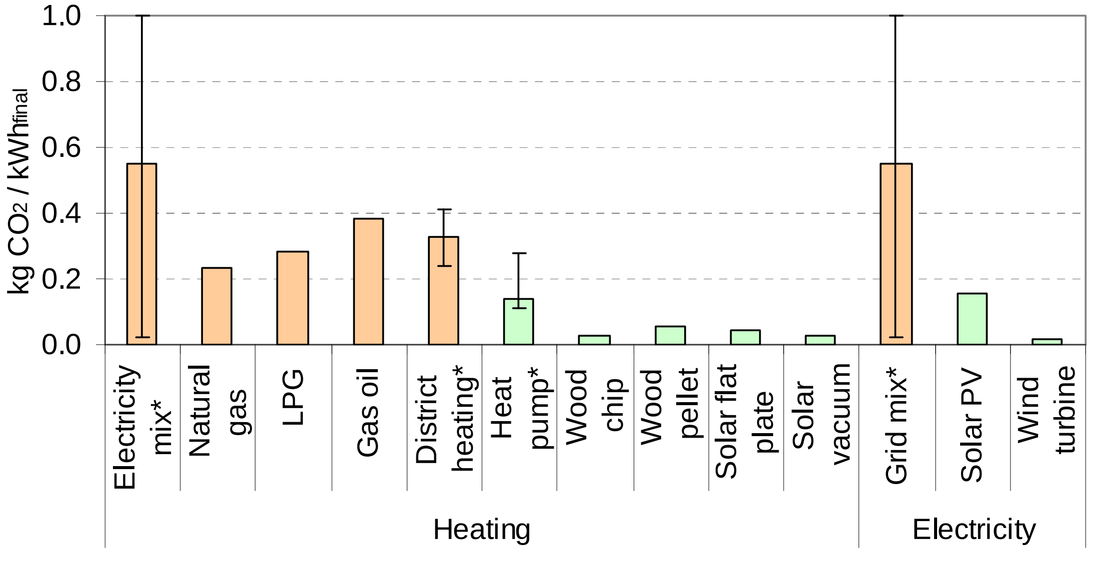
The greywater heat recovery system at the Kühlungsborn Camp, utilising an efficient heat pump, reduces gas consumption for water heating and associated GHG emissions by 40 %.

Renewable energy

Figure 9.13 indicates the lifecycle GHG emissions arising from the production of one kWh useful heat or electricity from various sources. There is considerable variation in the lifecycle GHG burden attributable to grid electricity and to district heating depending on the generating mix, and to heat pump delivered heating depending on their efficiency (and also the electricity generating mix). Nonetheless, heat pumps always achieve considerable savings compared with direct electric heating, and usually achieve significant GHG savings compared with oil and gas heating.

Lifecycle GHG emissions arising from wood heat depend in particular on the source of wood and the extent of processing, whist solar heating GHG emissions depend on system operating life, efficiency and location of the collectors. Nonetheless, wood boilers and solar collectors give rise to large GHG savings in most situations (Figure 9.13). Taking average values and comparing with an efficient gas heating system, the following percentage reductions in GHG emissions are achievable:

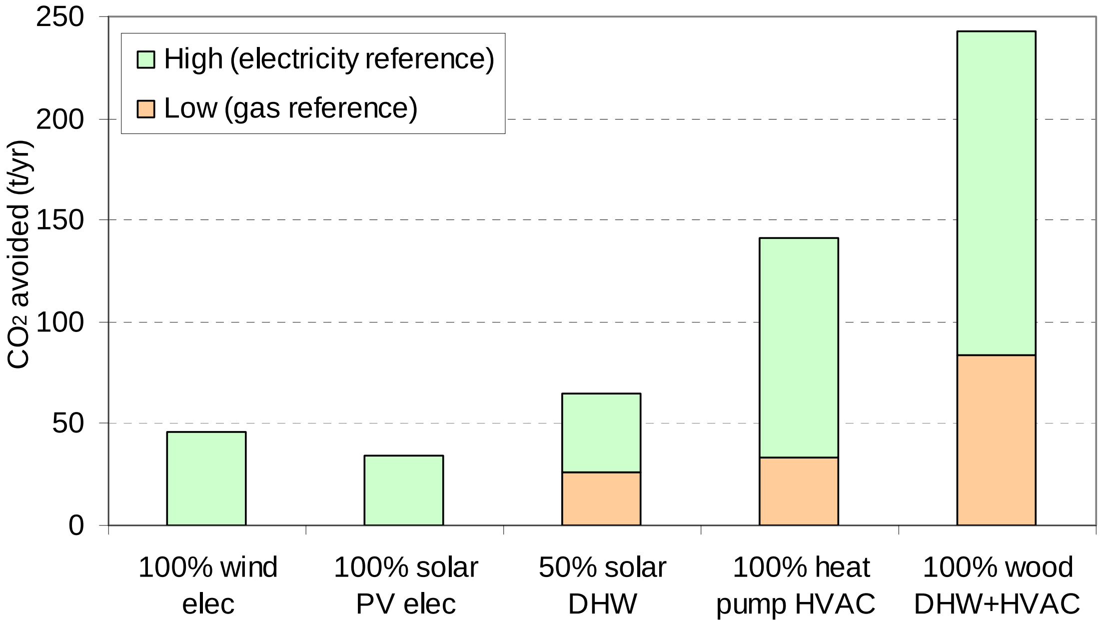
- heat pump heating 40 %
- wood chip heating 86 %
- wood pellet heating 72 %
- solar heating 77 % (flat plate) to 87 % (vacuum tube).



(*)Based on average mix (heat pump error bars reflect range of coefficient of performance at grid electricity average mix).

Figure 9.13: Lifecycle GHG emissions for conventional and RE options, expressed per kWh heat delivered (see Table 9.13)

Figure 9.14 provides an indication of the scale of GHG avoidance achievable through RE utilisation on an energy-efficient 300-pitch campsite. Summing up compatible electricity and heating RE options, total GHG avoidance could equate to 60 t CO2 per year where all electricity is from solar PV and 50 % of DHW is from solar flat plate collectors replacing gas heating to 289 t CO2 per year where all electricity is from wind turbines and all DHW and HVAC heat is provided by a wood ship boiler displacing electric heating.



NB: Assumes average of 500 guests over 186 days, with average electricity, DHW and HVAC demand of 3.1, 1.3 and 3.7 kWh per guest-night, respectively.

Figure 9.14: Indicative range of annual GHG avoidance achievable under different RE utilisation scenarios for a 300 pitch campsite with low energy consumption

Appropriate environmental indicator

Energy monitoring and management

The first indicator of best practice is the implementation of a site energy management plan based on energy monitoring at a process level where possible. The best plans extend to calculating primary energy demand and energy-related GHG emissions based on locally relevant data (e.g. from energy suppliers or national statistics) or from default values such as those presented in Table 9.13.

Primary energy ratios (PERs) enable a more complete comparison of energy efficiency across processes, sites and improvement options by accounting for upstream (off-site) energy consumption associated with each unit of on-site final energy consumption. Meanwhile, lifecycle GHG emissions, expressed per kWh heat or electricity consumed, provide a useful indication of energy performance often presented in sustainability reporting.

Table 9.13: Common units of energy delivered to campsites, and appropriate conversion factors to calculate final energy consumption, primary energy consumption and GHG emissions

Energy source	Common unit	Net calorifc value per unit (kWh_{final})	Primary energy ratio ($kWh_{primary}$/ kWh_{final})	CO_2 eq. (kg/kWh_{final})
Electricity mix(*)	kWh	1.0	2.7	0.550
Natural gas	m^3	7.4	1.1	0.184
LPG	kg	13.9	1.1	0.215
Gas oil	L	10.3	1.1	0.279
District heating(*)	Tonne steam	698	0.8 – 1.5	0.24 – 0.41
Wood log boiler (gasifying)	kg dried logs	3.0 – 4.0	0.08	0.028
Wood chip boiler	kg dried chips	2.5 – 3.5	0.08	0.028
Wood pellet boiler	kg pellets	4.8 – 5.0	0.18	0.056
Flat plate solar collector	kWh_{th}	1.0	0.14	0.046
Vacuum tube solar collector	kWh_{th}	1.0	0.10	0.026
Solar PV	kWh_e	1.0	0.48	0.154
Wind turbine	kWh_e	1.0	0.03	0.018

(*)Primary energy ratio and CO_2 emission factors vary depending on generation sources (average factors shown).
Source: GEMIS (2005); Carbon Trust (2008); ITP (2008); Passivehouse Institute (2010); DEFRA (2011).

Genuine renewable electricity

Attributing additionality to purchased 'renewable' electricity is a complex task for which a European methodology is being developed (EPED, 2012). According to the UK Publicly Available Specification (PAS) 2050 for the calculation of GHG emissions of goods and services (BSI, 2011), offsite RE generation can only be considered valid if the following conditions can be demonstrated:

- off-site energy generation is of the same form (e.g. heat or electricity) as that used on site;
- the generated RE has not been accounted for as RE consumption by another process or organisation and is excluded from the national average emission factor for electricity generation.

The PAS 2050 specification is primarily concerned with avoiding double accounting of RE consumption. However, the requirement for traceability and exclusive accounting of RE consumption provides a useful indication of additionality. Therefore, where accommodation enterprises can trace purchased RE to specific generation in accordance with the above conditions, such energy may be regarded as genuine off-site RE (see the second benchmark, below).

Accounting for RE use by heat pumps

According to the Renewable Energy Directive (2009/28/EC), aerothermal, geothermal or hydrothermal energy captured by heat pumps can be considered renewable and can be calculated according to the following formula:

$RE = Q_{final} \times (1 - 1/SPF)$
Where Q_{final} is the final useful energy delivered by the heat pumps and SPF is the estimated average seasonal performance factor (HSPF for heating and SEER for cooling in section 7.4).
NB: Only heat pumps for which $SPF > 1.15 \times 1/\eta$ shall be taken into account, where η is the ratio between gross electricity generation and the primary energy consumption for electricity generation according to the EU average taken from Eurostat.

Renewable energy captured by heat pumps may be included in the share of RE used by campsites, where total final energy consumption is recalculated to include the final energy delivered by the heat pump (Q_{final} above). Q_{final} may be estimated by multiplying energy consumed by the heat pump by the SPF calculated by the suppliers or installers. It is important to note that final energy consumption calculated in this way for campsites using heat pumps will be considerably higher than final energy consumption calculated as the sum of on-site fuel and electricity.

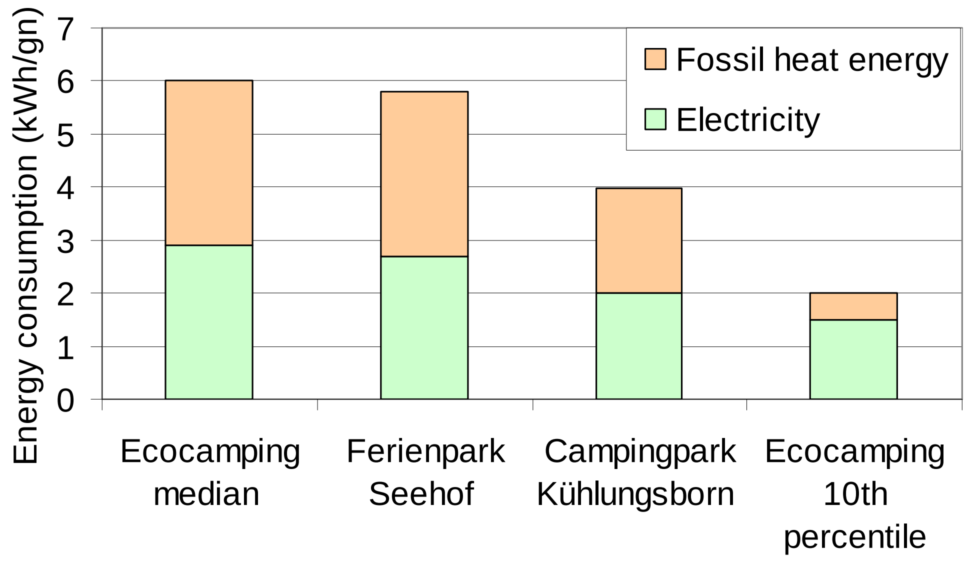
Performance indicators

Table 9.14 summarises the most relevant indicators of energy performance for campsites, based on readily available data relating to final consumption. The two most important indicators are total energy consumption per guest-night and the share of this energy that is generated from renewable sources.

Table 9.14: Some relevant indicators of environmental performance for campsites

Aspect	Indicator
Space heating energy consumption	kWh/m^2yr kWh/guest-night
Water heating energy consumption	kWh/guest-night
Electricity consumption	kWh/guest-night
Total energy consumption	kWh/guest-night
Total renewable energy generation	kWh/guest-night
Share renewable energy generation	%
Carbon footprint	kg CO_2/guest-night

The first four indicators in Table 9.14 may also be expressed based on non-RE consumption (e.g. Figure 9.15). Indicators for specific processes, such as efficient lighting (section 7.6) and kitchen energy consumption (section 8.4) are also relevant.



Source: Ecocamping (2011).

Figure 9.15: Non-RE consumption across Ecocamping campsites

<u>Benchmarks of excellence</u>

Ecotrans (2006) propose a benchmark for total energy consumption on campsites of ≤3.4 kWh per guest-night. Meanwhile, Figure 9.15 summarises average energy consumption per guest-night across Ecocamping campsites. The top ten percent of performers in the Ecocamping network achieved the following performance in 2009: (i) electricity consumption ≤1.5 kWh per guest-night; (ii) on-site fossil energy consumption ≤0.5 kWh per guest-night (Ecocamping, 2011). From these data, the following benchmark of excellence is proposed:

BM: on-site final fossil-energy and electricity consumption of ≤2.0 kWh per guest-night.

This benchmark credits on-site RE generation. An additional best practice measure is the purchase of genuine additional renewable electricity, as defined above. This can be reflected in the following benchmark:

BM: 100 % of electricity is from traceable renewable electricity sources not already accounted for by another organisation or in the national electricity average generating mix, or that is less than two years old.

Cross-media effects

<u>Energy demand reduction</u>

For campsite buildings, energy and resource consumption associated with the production of insulation and operation of optimised HVAC systems are minor compared with energy saved by these actions (section 7.2 and section 7.3). Reducing DHW demand through the installation of efficient water fittings is not associated with any significant cross-media effects. Installation of low energy CFL light bulbs results in the generation of hazardous waste containing small quantities of mercury (section 7.5).

<u>Alternative energy technologies</u>

The main cross-media effects associated with alternative energy sources, and options to mitigate them, are summarised in Table 9.15, below.

Table 9.15: Cross-media effects for different RE options

Technology	Cross-media effects	Mitigation options
Heat pumps	Operation of heat pumps containing hydrofluorocarbon refrigerants contributes to global warming via refrigerant leakage, partially offseting GHG emission savings attributable to reduced energy consumption. Air-source heat pumps also generate some noise.	Use of low GWP refrigerants. The EU Flower for heat pumps requires use of refrigerants with a GWP ≤2000.
Wood boilers	Wood burning emits CO, NO_x, hydrocarbons, particles and soot to air and produces bottom ash for disposal. These substances indicate incomplete combustion performance, and occur especially during start-up, shutdown and load variation. Wood chip boilers typically emit slightly more polluting gases than pellet boilers owing to lower fuel homogeneity, but emissions are low compared with other solid fuel boilers.	CO, hydrocarbons, soot and black carbon particles can be reduced by using continuously operating wood chip or wood pellet boilers with dry fuel. Gasifying and pellet boilers have the lowest emissions.
Solar thermal	Production of solar thermal collectors requires energy and materials, and emits gases such as CO_2. The energy embodied in solar thermal cells is typically paid back within two to three years of operation depending on site-specific application, so that energy produced over the remaining ~20 years operating lifetime creates a large positive balance. Ardente et al. (2005) estimate a worst-case scenario of four-year energy payback time.	Maximise output through optimised siting and installation (e.g. south orientation), and ensuring long operational lifetime.
Solar PV	As with solar collectors, the production of solar PV cells requires energy and materials and emits gases. Owing to lower conversion efficiencies and more complex production methods, energy payback times are estimated at three to four years against 30-year operating lifetimes (US NREL, 2004). It is expected that payback times will be reduced to approximately one year with anticipated thin-film technology.	As above.
Wind turbines	Embodied energy in wind turbines typically represents less than one year's electricity output over typical operating lifetimes of 20 years.	Maximise output through appropriate siting (e.g. in areas of high and consistent wind speeds).

Operational data

Lighting

Detailed information relating to the installation of low-energy CFL and LED lighting, intelligent lighting control, and use of natural lighting, is provided in section 7.5.

The Kühlungsborn Campsite provides an example on how to reduce artificial lighting requirements. Window panels were installed along the ridge of the washroom roof, letting natural light into in the attic area. A suspended ceiling above the wash area is composed of translucent panels that allow natural light to illuminate the area below (Figure 9.16). Also shown is the use of a retractable translucent roof, and outdoor LED lighting, at the luxury Jesolo International Campsite near Venice, Italy.

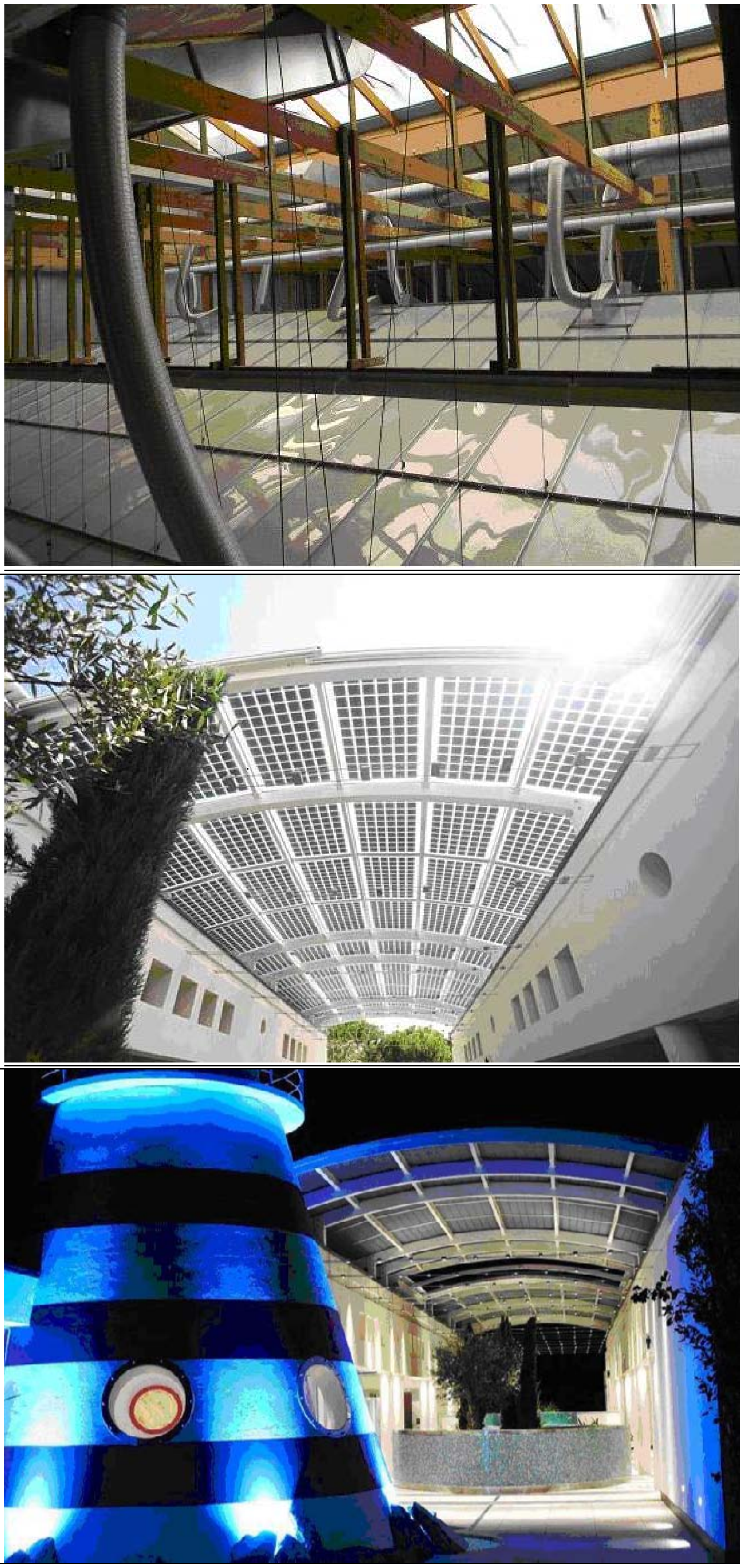


Figure 9.16: Window panels in the roof and suspended translucent ceiling allow natural light into the wash area of Kühlungsborn Campsite (above) and transluscent retractable roof of the wash area in the Jesolo International Campiste (below)

Solar heating

Solar collectors are well suited for application on campsites, such as on the roofs of wash rooms, and campsite hot water demand is strongly correlated with solar radiation throughout the year (Ecocamping, 2011). As described in section 7.6, evacuated tube collectors produce up to 25 % more heating than flat plate collectors per m^2 of aperture (light entry) area, but actual output is highly dependent on site-specific factors such as:

- annual quantity incident solar radiation (function of latitude and climate)
- orientation
- tilt angle
- temperature difference between heated water and outside air.

The ideal situation for solar panels is on a south-facing roof with a tilt angle of 30 º to 45 º. However, in typical mid- to high- latitude (40 º to 60 º N) European situations, output is reduced by just 5 % when oriented SE or SW, and solar panels function adequately on E- and W-oriented roofs. (e.g. Seehof Campsite example below). When selecting solar collectors, the European Solar Keymark provides assurance of compliance with European standards (ESTIF, 2011).

Situation-specific calculated heat output can be used to determine the optimum collector area, avoiding excessive redundancy during summer months. It is usually economically attractive to cover up to 60 % of hot water demand with solar heating, and a general guide for campsites in Germany is to install 0.1 to 0.2 m2 of flat-plate collector area per pitch (25 % less area required for evacuated tube collectors) (Ecocamping, 2011). Seasonal variations in water demand must also be considered. Notably for campsites, useful annual collector heat output may be confined to the annual period of opening (e.g. April to September).

Installed hot water storage capacity should be calculated according to the area of solar collectors, and be at minimum:

- 100L/m^2 flat-plate collector
- 133 L/m^2 evacuated tube collector (Ecocamping, 2011).

Larger storage tanks provide a useful energy store, and use of solar collectors to preheat larger volumes of water to a lower temperature results in higher operating efficiency than heating smaller volumes of water to a higher temperature. Storage tanks and all pipework should be insulated. A minimum of 50 mm insulation is recommended for storage tanks, preferably factory fitted, while pipe insulation should be of a thickness at least equivalent to the outer diameter of the pipes (SEIA, 2010).

It is important to install an expansion vessel and pressure release valve to protect the solar heating loop from overheating and excessive pressure during periods of high solar gain. A control system is required with sensors on the solar collectors and in the water tanks to switch on circulating pumps when sufficient solar radiation reaches the collectors and when water requires heating.

The example of solar water heating in Seehof Campsite provides further information on implementation. Forty one square metres of flat-plate solar panels installed on the east-facing roof of a washroom in Seehof Campsite have a capacity of 20 kW, and provide approximately 18 000 kWh of water heating per year (approximately 440 kWh/m^2yr). Maximum daily output varies from 5 – 10 kWh per day in winter months to 100 kWh per day in summer months (Figure 9.17). Water is heated to almost 100 ºC in summer, when just 11 kWh is provided by the gas boiler. Snow cover in winter can reduce output to zero. Flat-plate solar panels installed on the south facing roofs of two other wash rooms produce approximately 50 000 kWh per year, equivalent to between 15 % and 20 % more per m^2 than east-facing panels.

Water tanks store 4 500 litres of water, heated via a heat exchanger from the primary solar-collector loop and the gas boiler, used to supply domestic hot water to showers and taps. Heat from this water is also used to feed an under-floor heating circuit, via a second heat-exchanger. High efficiency pumps of just 8 W and 4 W capacity are sufficient for these systems owing to the installation of hydraulically-optimised piping. Although the solar collectors generate less water heating in winter months, their relative contribution can still be significant because water is only heated to 45 ºC (piping between heat source and taps contains less than 30 litres of water so heating to 60 ºC to kill legionella bacteria is not required by law).

Uhlenköper campsite provides an example of evacuated tube solar collectors. Just under 30 m^2 of evacuated tube collectors generated 93 500 kWh between April 2006 and October 2011, equivalent to approximately 550 kWh/m^2yr. Consumption of up to 9 kWh per m^2 per day has been recorded in mid-summer (Uhlenköper Campsite, 2011).

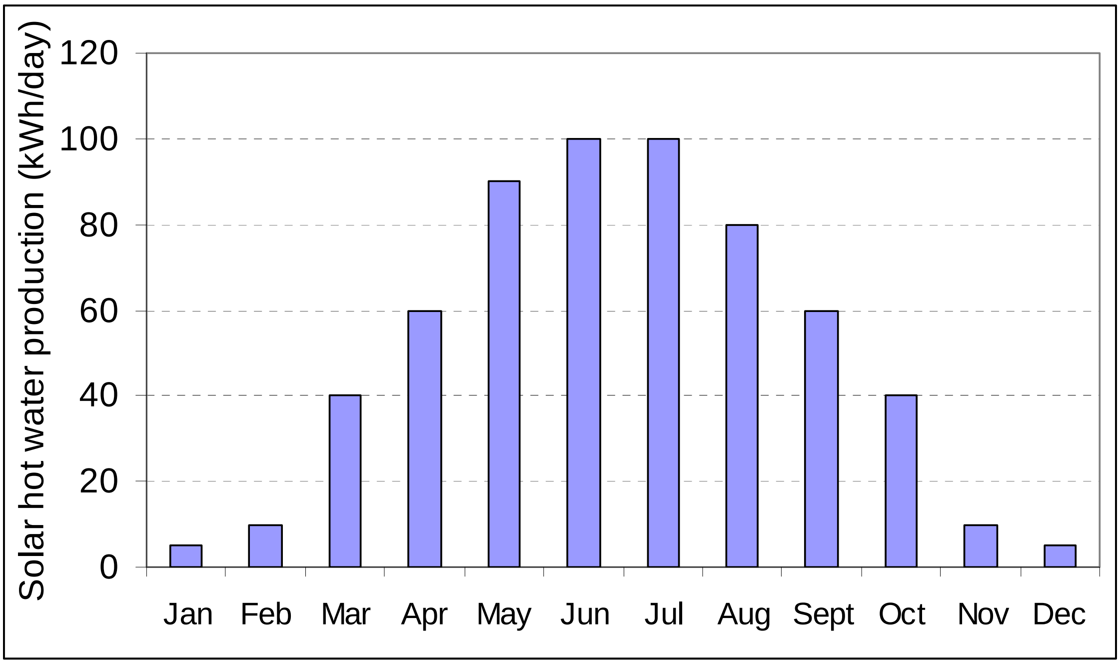


Figure 9.17: Maximum daily solar hot water production throughout the year for 41 m^2 of flat-plate solar panels installed on the east facing roof of a washroom in Seehof Campsite

Wood heating

In order to calculate on-site energy consumption, and to compare the price per unit energy of delivered fuel, information on the moisture content of wood fuel delivered for heating should be known as this is the primary factor affecting the net calorific value energy content of wood (dry value of ~18 MJ/kg). This information can be provided by suppliers, and should be certified for relatively homogeneous and standardised pellets. Table 9.16 provides indicative values for different wood fuel types.

Table 9.16: Typical moisture and energy contents of supplied wood fuel

	Dried logs	**Dried wood chip**	**Wood pellet**
Moisture content (% wet weight)	20 – 25	20 – 30	5 – 12
Energy content (kWh/kg)	3 – 4	2.5 – 3.5	4.8 – 5
Source: Carbon Trust (2008).			

Seehof Campsite also provides an example of best practice in wood heating. A 30 kW gasifying wood boiler was installed to heat the 500 m^2 recreational building (Table 9.17). Unlike wood pellet and wood chip boilers, the gasifying boiler enables larger pieces of wood to be fired – these can be placed directly into the gasification chamber – and has a rated efficiency of 93 %, with low ash production. The boiler requires manual filling on a daily basis when in operation, up to three times per day during the coldest periods (when -20 ºC outside), and ash is removed once per week in winter. About 30 m^3 of wood per year is sustainably sourced from the forest located on the 18 ha grounds: dead wood is removed and left to dry for two years. The boiler provides about 90 000 kWh per year of heating, displacing gas.

To maximise boiler efficiency, large hot water storage tanks of 3000 litres capacity were installed, and enable the boiler to run almost continuously at maximum efficiency.

Table 9.17: Images of the gasifying wood boiler installed at Seehof Campsite

	
30 kW wood gasifying boiler	Wood fuel
	
Gasification chamber, with holes for gas	Ash from one week of operation in winter

This wood boiler reduces gas consumption by 61 300 kWh per year, and GHG emissions by 11.26 tonnes per year. Consequently, it is estimated that the average carbon footprint per guest-night is 2.3 kg CO2, and this will decrease to 0.5 kg CO2 when a new green electricity contract comes into operation.

Heat recovery and heat pumps

Greywater generation in campsites is concentrated in washroom areas, facilitating the separate collection and storage of greywater for heat recovery. Heat from greywater may be recovered by passing greywater and incoming freshwater through a heat exchanger, such as for laundries (section 5.5), possibly via a secondary exchange loop. A separate drainage pipe network is required to carry greywater from showers, basins and possibly also laundry washing machines, to a storage tank. This needs to be installed during building or major refurbishment of the washrooms.

Operational information is provided by means of an example from a new 600 m^2 wash house in the Kühlungsborn Camp in Northern Germany (Figure 9.18).

1. Water from showers, basins and washing machines is collected in a 6 000 litre concrete tank built underneath the wash house.
2. From here, greywater is pumped up into a plate heat exchanger where the heat energy is transferred into clean water that circulates within a heat pump (this avoids the risk of dirty water damaging the heat pump). Following heat transfer, greywater is filtered and pumped out to irrigate the green area.
3. Following heat transfer from greywater, the heat pump extracts low-grade heat contained in the recirculating water (approximately 25 ºC) to heat incoming fresh water to over 60 ºC. The screw-type heat pump is rated for a theoretical COP efficiency of up 6 (i.e. 6 units of heat out per unit electricity in). Using waste heat from greywater is equivalent to increasing this COP to 10, thus reducing electricity consumption by 40 % per unit heat output.
4. Heated water is fed into the second of four hot water storage tanks in series, where it is maintained at 60 ºC using hot water from a gas boiler if necessary. Water is taken for use in showers and basins in order of priority from: (i) a solar-heated storage tank; (ii) the heat-pump heated storage tank; (iii) two gas-heated storage tanks.

During winter months, underfloor heating is operating using water heated by an air-to-water heat pump located in the attic directly above the shower area. This increases efficiency by enabling the heat pump to utilise warmed air and steam rising from the showers.

Figure 9.18: Plate heat exchanger (left) and heat pump (centre) used to extract and upgrade heat from washroom and laundry greywater to heat washroom water at Kühlungsborn Camp

Renewable electricity

Campsites often have sufficient space on building roofs or adjacent to pitch areas to install solar PV cells or wind turbines. Section 7.6 provides operational information on implementation of these technologies on-site. Figure 9.19, below, provides an example of solar PV cells integrated with a campsite building roof.

Figure 9.19: An example of solar PV cells integrated into a campsite building roof

Applicability

All campsites can implement energy efficiency measures, and there are usually fewer barriers to on-site RE installation on campsites than for other accommodation types. Table 9.12 above summarises applicability constraints for specific measures.

Economics

Water efficient fittings

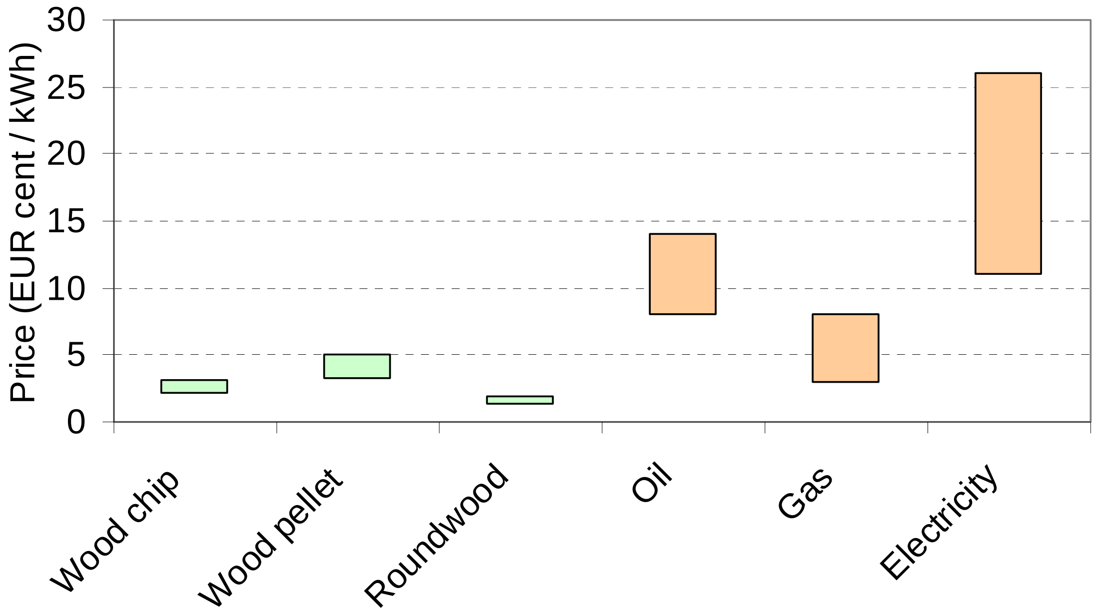
Installation of water efficient fittings is associated with short payback times (see section 9.3).

Solar heating

The retail cost of flat plate solar collectors in Germany is approximately EUR 400 per m^2, and the cost price EUR 170 to EUR 250 per m^2 (Seehof Camping, 2011). Seehof Campsite invested EUR 28 000 to install the solar heating system, of which over EUR 8 000 was refunded with a 30 % rebate from the German Green Bank. Payback time was calculated at 10 years.

Wood heating

Wood is a relatively cheap fuel source in terms of energy content (Figure 9.20), but utilisation requires installation of comparatively expensive wood boiler systems. The 30 kW gasifying boiler installed at Seehof Campsite to heat a 500 m^2 indoor recreational area cost EUR 12 000 compared with EUR 3 200 for a conventional gas boiler. Most of the additional system installation costs (EUR 22 000) would also have been required for a conventional system. The boiler saves EUR 5 400 per year in gas, and has a simple payback time of less than three years.



NB: Prices per delivered fuel, including taxes, and chipped/pelleted wood.
Source: Carbon Trust (2009); Energy.EU (2011).

Figure 9.20: Price range for wood fuel in UK, and price range for oil, gas and electricity across EU, expressed per kWh energy content

Greywater heat recovery

There is little information on the costs of greywater heat recovery systems. These costs are highly dependent on the type of system installed. In any case, installation of such systems is only economically viable during building or extensive renovation of wash houses. Cost-benefit assessment of such systems should also consider the value of using greywater for irrigation.

Driving force for implementation

The main driving forces for implementation of energy saving and RE measures are:

- economics (see above)
- environmental responsibility
- environmental accreditation (e.g. Ecocamping)
- marketing (campsite customers are receptive to green marketing).

Reference organisations

Jesolo International Campsite (IT); Kühlungsborn Campsite (DE); Seehof Campsite (DE).

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9.4 Campsite water efficiency

Description

Water consumption per guest-night is much lower on campsites than in hotels. Average consumption across 99 campsites within the Ecocamping network in 2009 was 103 litres per guest-night, compared with the average consumption of 197 litres per guest-night across 141 mid-range hotels in Europe for which data were made available. Ecotrans (2006) data for 55 campsites and 292 hotels indicate an average water consumption of 174 and 394 litres per guest-night, respectively. Nonetheless, there is high potential to reduce water consumption on campsites, especially higher grade campsites with extensive amenities.

Figure 9.21 presents results of modelled water consumption for an 'average' and 'good' campsite, based on bottom-up data relating to average and best practice consumption for major processes (Chapter 5). Implementation of best practice can reduce water consumption for core processes (i.e. excluding pool and irrigation) by almost 60 %. The main savings arise from the installation of efficient fittings on taps and showers, timing control on showers, and low-volume dual-flush toilets. Owing to the smaller number of water fittings per guest in campsites compared with hotels, leakages represent a smaller portion of water consumption (though still represent a significant and unnecessary waste of water and money). Where present, kitchens supplying campsite restaurants, swimming pools and irrigation can consume large quantities of water, and offer considerably scope for savings (Figure 9.21).

NB: Assumes campsite facilities used for all washing, etc. In reality, a significant portion of consumption will arise from motor home fittings connected to campsite supply.

Figure 9.21: Modelled water consumption for a hypothetical 300-pitch four star (ADAC classification) campsite based on average and good water management practices

Table 9.18 lists best practice measures to reduce water consumption on campsites. These measures are described in other sections of the document, to which readers are referred for detailed descriptions on operational data (see Table 9.18). However, the applicability and savings potential from some measures differ considerably on campsites compared with other accommodations such as hotels, owing to different circumstances or use patterns. In particular, the economics of installing efficient fittings are more favourable for campsites owing to higher use rates (even accounting for the stronger seasonality of business), and there is greater potential to separate and reuse greywater owing to the concentration of washing facilities in wash rooms on campsites. This section elaborates those measures associated with high campsite specificity; that is, measures related to wash rooms (Table 9.18).

Table 9.18: Best practice measures to reduce water consumption on campsites

Area	Best practice measures	Location in document
All	– Monitor and benchmark water consumption	Section 5.1
Wash rooms	– Installation or retrofitting low-flow showerheads or retrofitting pressure regulators and/or aerators – Installation of sensors or timers to control faucets and showers in public areas (toilets and changing rooms) – Installation of low-flow faucets and retrofitting with pressure regulators and/or aerators – Installation of low-flush and dual-flush toilets – Installation or retrofitting of controlled-flush or waterless urinals	Section 5.2 and this section
	– Use of rainwater or pool water for toilet flushing	Section 5.7 and section 9.6
Kitchen	– Installation or retrofitting of low-flow high pressure spray valves for prewashing – Installation or retrofitting of low-flow high pressure spray valves for prewashing – Green procurement of efficient dishwashers with water reuse and heat recovery – Implementation of efficient washing and cooking techniques	Section 8.3
Swimming pool	– Appropriate pool sizing – Optimisation of backwashing operations – Use of pool covers – Optimisations of pool management to maintain an appropriate temperature and reduce chemical consumption	Section 5.6
	– Installation of natural pool	Section 9.6
Irrigation	– Planting of green areas with indigenous species to minimise irrigation requirements – Installation and maintenance of efficient irrigation system – Use of greywater or wastewater for irrigation	Section 9.2
Laundry	– Green procurement of efficient washing machines	Section 5.4

Achieved environmental benefit

Potential water savings achievable through the implementation of best practice measures vary considerably depending on particular circumstances, such as whether or not irrigation is required and over what area, whether restaurant and laundry facilities are offered, the proportion of tents versus motor homes, etc. Campsite star rating has been found to be positively correlated with water consumption (Ecotrans, 2006). Furthermore, a significant portion of guests may use facilities in their own motor home rather than communal campsite facilities, in which case water savings per guest-night arising from more efficient fittings will be reduced. Within these constraints, Figure 9.22 indicates potential water savings across uses for a high-end campsite requiring significant irrigation. The total water saving amounts to 187 litres per guest-night, of which 118 litres per guest-night are savings achievable from essential uses (i.e. excluding pool and irrigation).

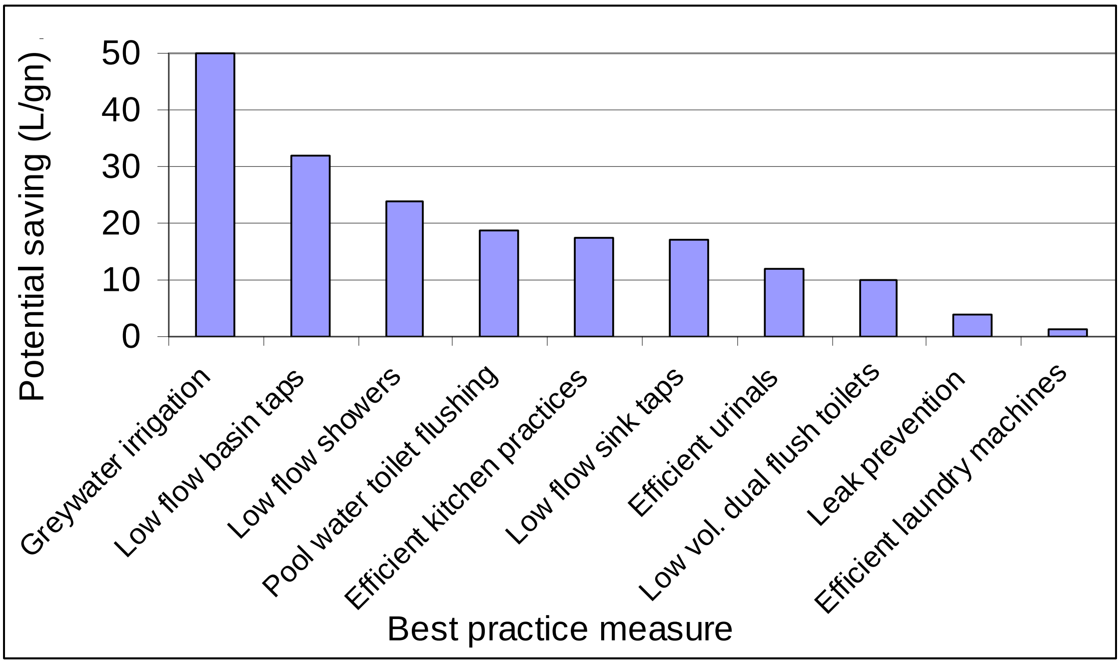
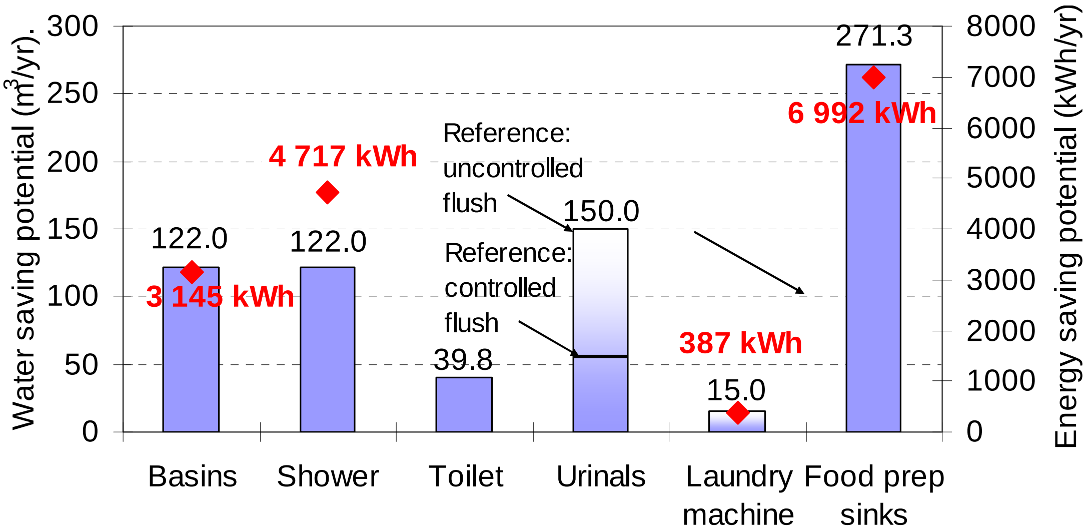


Figure 9.22: Potential water savings expressed per guest-night across best practice measures for a four-star (ADAC classification) campsite

In relation to targeting actions, the water savings achievable per fitting provide a useful guide, and determine the cost-benefit ratio for installing various fittings (see 'Economics', below). Figure 9.23 indicates that installation of low-flow taps in food preparation areas could be associated with the largest saving potential (271 m^3) per fitting per year. However, this value is heavily dependent on the frequency of use of these taps. On some campsites, a large amount of food preparation is likely to occur inside motor homes or using individual water stands on pitches, in which case savings per fitting will be lower.

However, all campsites can achieve large reductions in water use through installation of low-flow basin taps and showers, and shower timers. These actions, and efficient taps in sinks for dish washing, can also result in significant energy savings (Figure 9.23).



NB: estimated for a 300-pitch campsite with sanitary fitting-to-pitch ratios complying with German ADAC 4-star standards (ADAC, 2004). Assumes the following average number of guests per fitting throughout a six month season: basins, 21; shower, 28; toilet, 21; urinal, 31 (males); washing machines, 71; food preparation sinks, 83. Calculations based on implementation of best practice compared with average practice.

Figure 9.23: Estimated annual water savings (m^3) and energy savings (kWh) per fitting achievable by implementation of best practice on a 300-pitch campsite open 6 months per year

Appropriate environmental indicator

Benchmark of excellence

Water consumption on campsites is heavily dependent on the facilities offered, which will determine, for example, shower frequency and duration, on-site versus off-site eating (food preparation). Modelled good practice water consumption of 94 L per guest-night for a fully serviced campsite, presented in Figure 9.21 (above), corresponds well with benchmarks of 91 and 122 L/guest-night proposed for 4- and 5-star campsites, respectively, in the Ecotrans (2006) study. The five star Kühlungsborn and Seehof campsites in Mecklenburg-Vorpommern, Germany, fall within the good practice threshold for a fully serviced campsite, with recorded total water consumption of 91 and 84 litres per guest-night, respectively.

However, many campsites offer fewer services and should be able to achieve lower water consumption through good management. The best 10th percentile performers across the Ecocamping network achieved water consumption of ≤58 litres per guest-night in 2009.

Thus, the following differentiated benchmark of excellence is proposed:

BM: total water consumption of ≤94 litres per guest-night on fully serviced four- and five-star campsites, and water consumption of ≤58 litres per guest-night on all other campsites.

Operational data

Operational considerations for the various measures to reduce water consumption are described in other sections of this document, as indicated in Table 9.18. Measures particularly important for campsites include shower timers, installation of dual-flush toilets, and installation of waterless urinals (section 5.2). Table 9.19 lists the flow rates achievable for different types of low flow fittings, and Figure 9.24 demonstrates the application of a low-flow showerhead in a luxury campsite.

Table 9.19: Flow rate benchmarks for low-flow fittings

Aspect	Best practice	Quantitative benchmark
Shower fittings	Low-flow showerheads, aerators and flow-restrictors	Average shower flow rate ≤7 L/min
Retrofitted tap	Aerators and flow-restrictors	Average tap flow rate ≤6 L/min
New tap fittings(*)	Spray taps	Average flow rate ≤4 L/min
Toilet	Low-flush, dual-flush	Average effective flush ≤4.5 L
Urinal	Waterless urinals	Average urinal water use ≤2.5 L/person/day(**)
Guest information	Prominent notices in all washrooms on water-saving measures	NA
(*)Recent retrofit. (**)Based on average use rate.		

Source: Ecocamping (2011).

Figure 9.24: Example of a luxury low-flow rain-type showerhead installed in a luxury campsite, with a flow rate of 7 – 8 litres per minute

Economics

Installation of efficient fittings reduces water supply and disposal costs, and also energy costs where consumption of heated water is reduced (showers and basin taps).

Table 9.20 provides an overview of equipment costs and annual savings where average fittings are replaced by efficient fittings conforming to the benchmarks specified above. Labour costs associated with installation will vary depending on whether in-house maintenance staff or external plumbers carry out the tasks, and have been excluded from the calculations. Retrofitting options are simple and would typically require ten to 30 minutes labour per fitting.

It is important to note that attributing the entire cost of new fittings to water efficiency provides a **worst case indication of payback period** as efficient fittings will usually be specified when undertaking construction or renovation work, and the additional costs compared with less efficient fittings will be a fraction of the fitting prices quoted in Table 9.20. Accounting for these caveats, Table 9.20 highlights the following:

- all retrofit options offer short payback periods, ranging from two to 18 months
- selecting (or retrofitting) low-flow wash room taps, and timed, low-flow showers, can save over EUR 500 per year through reduced water and energy consumption
- selecting (or retrofitting) low-flush toilets and waterless urinals can save between EUR 99 and EUR 400 per year through reduced water consumption.

Table 9.20: Annual financial savings associated with water and energy reductions achievable following replacement of average fittings with widely available efficient fittings

Fitting	Cost	Saving			Payback
		Water	Heating (oil)(*)	Total	
	EUR	EUR/yr			Months
Low-flow basin taps(**)	100 – 200	305	252	**557**	**2 – 4**
Low-flow showerhead, timer	170 – 250	305	377	**682**	**3 – 4**
Low-flush toilets (**)	150	99	–	**99**	**18**
Toilet cistern displacement/dual-flush retrofit	20	99	–	**99**	**2**
Urinal flush control (from uncontrolled)	200	375	–	**375**	**7**
Waterless urinal (from controlled flush)	150	375	–	**375**	**5**
(*)For energy savings, it was assumed that water used in showers and taps has temperature elevated by, on average, 30 ºC and 20 ºC, respectively, fed by a 90 % efficient oil-fired boiler. (**)Cost of new fittings provides a worst case cost estimate where recently installed non-efficient fittings are replaced by efficient fittings. NB: Based on assumptions described in Figure 9.23.					

Driving force for implementation

The main driving force to minimise water consumption on campistes is to reduce water supply and disposal costs, and to reduce energy costs for excessive water heating (see 'economics', above). Visible water-efficiency features may also play a role in guest satisfaction and green marketing.

Additional driving forces may arise from national, regional or local government regulations and financial incentives (subsidies, tax breaks, low interest loans) to encourage installation of water efficient fittings. In the UK, the Enhanced Capital Allowance scheme allows business to deduct the capital cost of water-saving equipment from taxable profit in the year of purchase (http://etl.decc.gov.uk/). Equipment covered by the scheme relevant to this technique includes:

- flow controllers
- meters
- leakage detection
- pipe work insulation.

Reference companies

The Ecocamping network provides guidance and examples on best practice in water management on campsites. Among luxury fully-serviced campsites, the five star Kühlungsborn and Seehof campsites in Mecklenburg-Vorpommern, Germany, achieve good performance (see above).

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9.5 Campsite waste minimisation

Description

In contrast to energy and water consumption, waste generation on campsites is often higher than for built accommodations such as hotels. Figure 9.25 shows that median unsorted waste generation per guest-night for 99 campsites in the Ecocamping network is slightly higher than median unsorted waste generation per guest-night for 141 hotels in a mid-range chain (0.54 versus 0.46 kg). The top ten-percentile of camspites (in terms of waste minimisation) also produce more waste than the top ten-percentile of hotels (0.20 versus 0.16 kg per guest-night). This reflects the fact that campers are more likely to eat on site, to prepare their own meals, and to undertake various activities during the day on site, compared with hotel guests, resulting in higher waste generation (e.g. food and packaging waste) than for hotels.

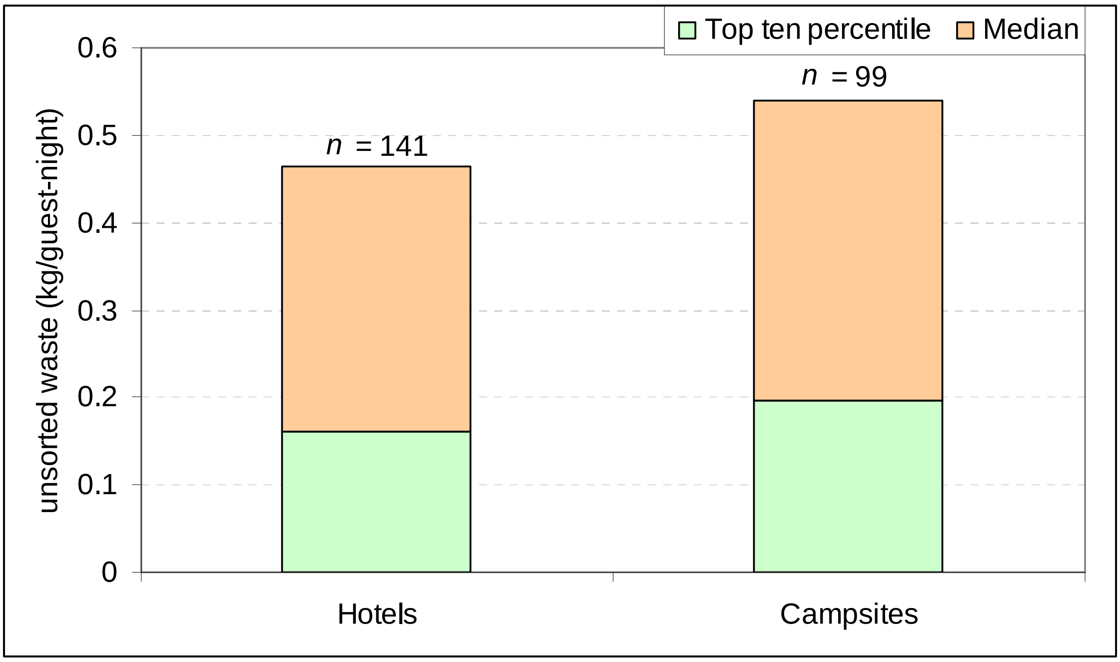


Figure 9.25: Median and top ten-percentile unsorted waste generation for good performing mid-range hotels and Ecocamping campsites

As described in section 6, waste minimisation requires implementation of a comprehensive waste management plan based on priorities defined in the waste management heirarchy (Figure 6.3 in section 6), summarised below.

1. Reduce: Avoid producing waste in the first place – implement green procurement, do not over order, select products with little packaging or returnable packaging.

2. Reuse: Consider where certain items can be reused, sold or donated to others that can use them.

3. Sort: Have a system in place for sorting everyday waste items such as bottles, cans, cardboard and paper for recycling. Consider what else might be recycled, taking into account local disposal possibilities.

4. Recycle: Send sorted waste for recycling.

Table 9.21 lists best practice measures applicable to campsites that are described in other sections of this document targeted at built accommodations and kitchens. In the first instance, waste generation can be minimised by considering packaging and waste generation as criteria for green procurement of food and consumable products (appropriately weighted against other lifecycle environmental performance factors for products, and food perishability). A waste management programme that includes all areas and staff is essential. Readers may cross-refer to relevant sections specified in Table 9.21 for more detailed information on the implementation of waste minimisation measures.

Table 9.21: Best practice measures to minimise waste on campsites

Department	Measure	Description	Section
All (management led)	Develop waste inventory	Survey of all areas and processes to identify types and sources of on-site waste generation.	6.1, 6.2
	Monitoring and reporting	Continuously monitor and periodically report waste generation and collection by fraction.	
	Back of house operations	Provide separate bins and train staff to separate waste arising from public areas, maintenance of outdoor and indoor facilities, and other back-of-house areas into appropriate fractions for recycling and correct disposal.	6.2
Procurement (on-site restaurant, shop and cleaning)	Efficient ordering and storage	Order perishable products frequently in quantities required. Store perishable products in appropriate conditions (e.g. correctly adjusted refrigeration units). Order non-perishable products in bulk.	6.1, 8.1, 8.4
	Local sourcing and packaging return	Source food locally where appropriate, and return packaging for reuse.	8.1
	Select low-packaging products	Select products with less or recyclable packaging where possible and consistent with other green procurement criteria – e.g. purchase chemicals in concentrate form.	2.2, 5.3, 6.2
On-site restaurant	Tap water on table	Provide guests with tap water in restaurant.	6.1
	Efficient breakfast provision	Avoid single-portion servings as much as possible within hygiene constraints, and cook to order.	6.1, 8.1
	Organic waste management	Separate waste fractions in the kitchen. Where possible, send oil for biofuel production and send organic waste for anaerobic digestion or composting.	8.2
Reception	Efficient document management	Print documents only when absolutely necessary, double-sided in small font. Use electronic billing.	6.1

This section focuses on the description of an additional measure that is of particular and unique importance to campsites: provision of a conveniently located and user-friendly waste sorting station where campers can place their waste into relevant collection bins for recycling.

Achieved environmental benefit

<u>Mass of waste avoided</u>

According to data from Ecocamping campsites in 2009, best practice in waste management represented by the lowest ten-percentile unsorted waste generation per guest-night equates to 0.34 kg waste per guest-night lower than median performance. For a very large campsite with an average of 500 guests over a six month season, this would equate to a saving of over 31 tonnes of waste per year. For a smaller campsite with an average of 50 guests over six months, this would still equate to over 3 tonnes of avoided waste (landfill or incineration) per year.

Environmetal benefits

Waste prevention through measures such as careful purchasing results in environmental benefits through two major pathways: avoided production and avoided disposal. Recycling avoids waste disposal impacts, but incurs (re)processing impacts that may somewhat offset avoided production impacts (section 6.2). Environmental benefits of waste prevention and recycling include:

- avoided/reduced resource depletion
- avoided/reduced land occupation
- avoided/reduced soil contamination
- avoided/reduced water pollution
- avoided/reduced air pollution
- avoided/reduced GHG emissions.

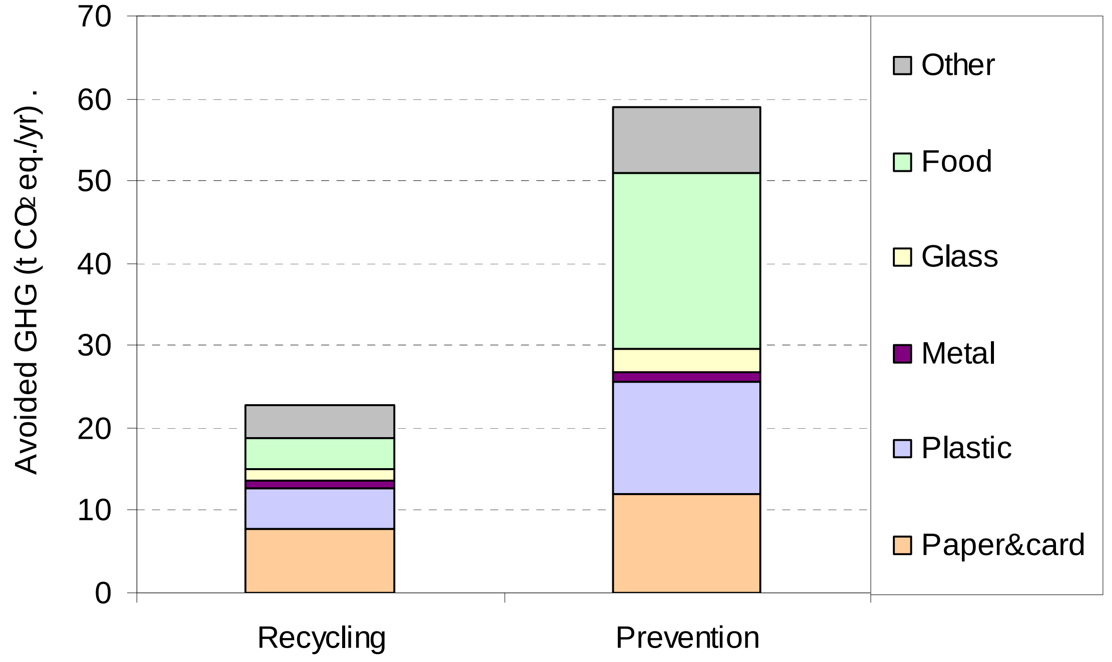
Table 9.22 quantifies the reductions in GHG emissions attributable to the prevention and recycling, respectively, of various waste fractions. In addition, each kg of organic waste sent to anaerobic digestion with energy recovery avoids 0.35 kg CO_2 eq. from waste management and displaced energy generation. Avoided upstream emissions depend strongly on the type of organic waste (section 8.1): one kg of beef, for example, may be associated with over 20 kg CO_2 eq. upstream emissions.

Table 9.22: GHG emissions avoided through the prevention and recycling of different waste fractions

Material	Glass	Board	Wrapping paper	Dense plastic	Plastic film
	kg CO_2				
Prevention	0.92	1.60	1.51	3.32	2.63
Recycling	0.39	1.08	0.99	1.20	1.08
Source: WRAP (2011).					

Best practice GHG avoidance

Figure 9.26 indicates the magnitude of annual GHG avoidance achievable through best practice in waste management at a medium-sized campsite with an average of 100 guests over 6 months of the year. These savings are based on reducing unsorted waste generation from 0.54 to 0.2 kg per guest-night, and equate to 23 to CO_2 eq. per year if the reduction is achieved soley through recycling to 59 t CO_2 eq. if the reduction is achieved soley through waste prevention. On campsites, most waste originates from guests, and waste management programmes should focus on increasing the rate of recycling by guests. However, significant waste prevention is also possible through good management of on-site restaurant, shop, cleaning and reception services.



NB: Based on an average of 100 guests over six months, and a reduction in unsorted waste generation from 0.54 to 0.2 kg per guest-night.
Composition of avoided waste and associated GHG emission savings taken from WRAP (2011) report, based on hotel data, and own elaboration.

Figure 9.26: An example of annual GHG avoidance achievable for a single campsite achieving best, compared with average, waste management performance through <u>either</u> recycling or prevention

Appropriate environmental indicator

<u>Indicators</u>

As for waste in built accommodation, there are three primary indicators of waste management effectiveness, reflecting waste prevention and waste recycling:

- the total waste generated, sorted and unsorted, expressed as kg per guest-night
- the proportion of waste that is sorted and sent for recycling, expressed as a percentage mass of total waste generated
- the quantity of unsorted residual waste sent for disposal, expressed as kg per guest-night.

<u>Benchmark of excellence</u>

Based on the top teni-percentile performance level for Ecocamping camp sites, the following benchmark of excellence is proposed:

BM: total residual waste sent for disposal of ≤0.2 kg per guest-night.

Cross-media effects

Waste prevention is not associated with any cross-media effects, though care must be taken when selecting products with reduced packaging to ensure that the overall lifecycle environmental burden of these products is lower than alternatives with more packaging, especially for food products.

Recycling is associated with energy consumption and other environmental impacts that arise during collection, transport and recovery operations. However, these impacts are usually considerably smaller than impacts arising from the production from raw materials.

A detailed lifecycle assessment for PET recycling demonstrated that PET recycling is significantly more environmentally-friendly than the incineration of the PET bottles in municipal waste incineration plants with waste heat recovery (Dinkel, 2008).

Operational data

Waste prevention and monitoring

Implementation of a waste management plan requires campsite managers to generate an inventory of all the waste arising on different parts of the campsite, and possible measures to prevent or reduce this waste. The main areas of waste generation over which campsite managers have some influence (i.e. excluding private tents and motor-homes) are: on-site restaurants or take-away facilities, on-site shops, and housekeeping stores. A once-off survey may be performed to generate such an inventory, also identifying sources (e.g. packaging of specific products). Costs associated with excess purchasing resulting in waste should be recorded.

On campsites, the majority of waste originates from guests. It is important to regularly monitor and record the total quantity of waste generated (in communal bins) and the proportion that is separated and sent for recycling. Where separated, the quantity of individual waste fractions generated and sent for recycling or disposal should be monitored, at least: organic, glass, paper and cardboard, plastics, metals, electrical items, hazardous wastes. The cost associated with disposal and recycling of these factions, based on local rates, can be calculated in order to indicate the achievable cost savings.

Green procurement decisions should include consideration of recyclability, for example to avoid difficult-to-recycle plastics such as polyvinyl chloride (PVC), low-density polyethylene and polystyrene where possible (see Table 6.11 in section 6.2). Packaging minimisation and reuse (without affecting product quality and longevity) is the most straightforward measure to reduce waste from a lifecycle perspective. Campsite managers may request suppliers of preferred products to improve the environmental performance, including recyclability, of their packaging.

Lifecycle impacts of packaging depend on factors such as whether or not recycled material is used in production, different packaging weights associated with alternative materials, manufacturing location and methods, transport distance, energy sources, fate of used products, etc. A study by the Öko-Institut (2008) into different types of cup that could be used at events highlighted the environmental superiority of light-weight reusable plastic cups over disposable cups, and cardboard over polystyrene cups.

Appropriate food storage is an important way to reduce food waste, as described in section 8.4 and the SRD for the retail trade sector (EC, 2011).

Useful guidance on waste prevention has been compiled on a European Commission website dedicated to the subject: http://ec.europa.eu/environment/waste/prevention/index.htm.

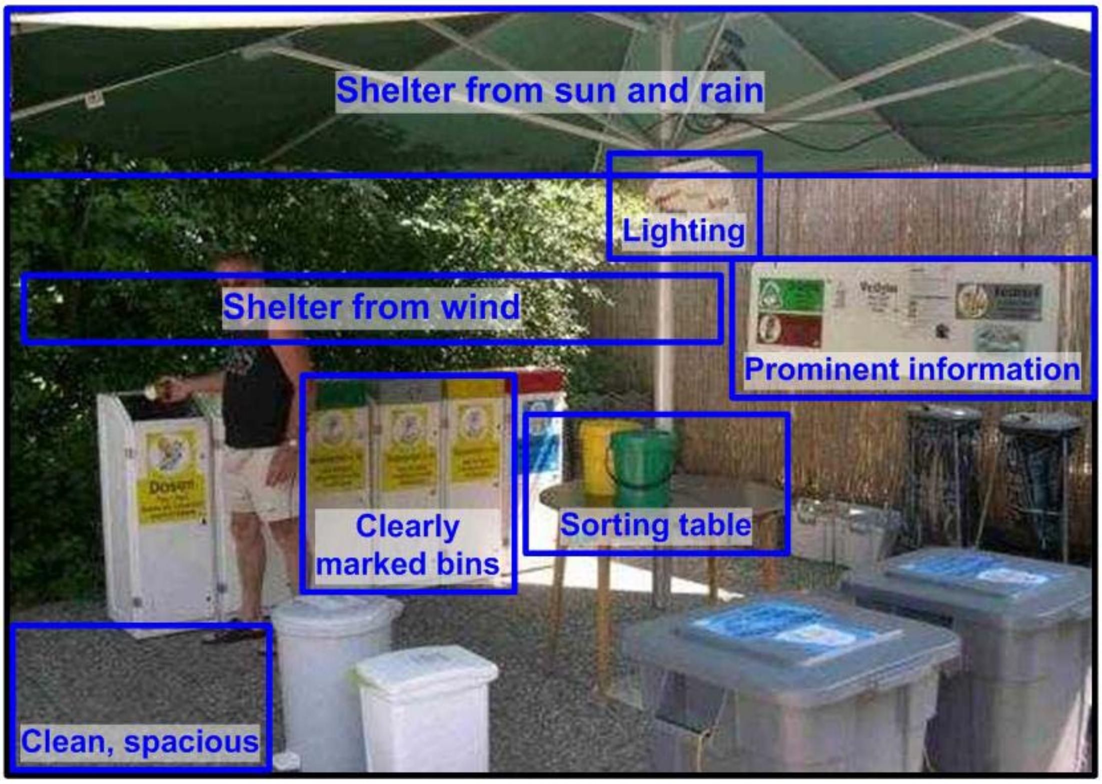
Separating plastic waste fractions

Plastics represent a significant fraction of municipal waste that create environmental problems when sent to landfill owing to their slow decomposition. Many types of plastic are available across a wide range of products, some of which are easier and more likely to be recycled than others (see Table 6.11 in section 6.2). These may be identified by commonly used symbols referred to in the ISO 11469 standard relating to the generic identification and marking of plastics products (see Table 6.11 in section 6.2). Depending on the area and service provider, mixed plastics may be collected for subsequent separation of recyclable fractions, or it may be necessary to separate specific recyclable fractions on site (i.e. in the recycling station).

Waste-sorting facilities

Figure 9.27 depicts a good campsite waste collection and recycling station, highlighting various features of best practice. The most important aspects of best practice are to provide:

- shelter from wind, rain, and sun
- adequate lighting
- a raised surface (e.g. table) for convenient waste sorting
- clearly labelled separate bins for the main waste fractions (at least hazardous materials, electrical and electronic materials, glass, paper and card, plastics, metals, organic)
- bins that are adequately sized (also apertures) for each waste fraction
- prominent information on use of the facility
- a clean, spacious and orderly area.



Source: Elaborated from Ecocamping (2011).

Figure 9.27: Important features of a user-friendly campsite recycling station

In relation to the above points, Ecocamping guidelines recommend use of standardised stickers and signange for bins and recycling stations across campsites in the network, to facilitate guest recognition and recycling efforts (Table 9.23). Collection and recycling centres should be tidied every morning – this may involve checking and (re)sorting bins to ensure correct content and encourage correct usage by guests (Table 9.23), as performed on the Uhlenköper Campsite in Germany. Other facilities and features may be integrated to encourage use of the recycling centre – e.g. music, magazine and book exchange, etc. Where organic waste is collected separately, collection bins need to be emptied frequently in warm conditions.

Table 9.23: Signage and performance in a campsite recycling station

	
A correctly filled paper and card bin	A standard Ecocamping recycling station sign
Source: Uhlenköper Campsite (2011).	

Applicability
All types and sizes of campsite can implement a waste management programme involving prevention and recycling. However, local waste recycling options may be restricted in some, especially rural, locations. In areas where the municipality or private companies do not collect separated materials for recycling, accommodation managers can request the municipality to prioritise the provision of such services and seek alternative solutions, as required in such situations by ecolabel criteria for the EU Flower. For example, campsite managers can cooperate with other local stakeholders to arrange shared waste collection, or to send organic waste to local farmers for composting or biogas production. On campsites, there is usually sufficient space and on-site demand for soil improver to justify on-site composting of the important organic waste fraction (section 8.2).

Economics
Waste prevention is closely related to resource efficiency and cost reductions. Avoiding excess products and packaging can reduce purchasing costs and disposal costs. The cost of waste disposal has increased sharply in most European countries over the past decade, and is likely to continue increasing owing to escalating landfill and incineration taxes.

The economy involved in sorting and recycling of waste fractions is dependent on the relevant collection charges applied to different fractions. These vary considerably across and within countries. Collection of residual, organic and hazardous waste usually incurs a cost, whilst collection of separated paper, plastic and metal for recycling is often free of charge (though this varies across municipalities). For example, as referred to in section 6.2, The Savoy pays approximately EUR 110 per tonne for mixed waste collection, compared with free collection for separated recyclable materials, and receives payment of EUR 0.30 per litre for waste cooking oil collected every month by a private company to produce biodiesel.

Driving force for implementation
Legislation is an important driver for preventing and managing waste. Relevant legislation is listed in section 6, and on the European Commission's waste prevention website: http://ec.europa.eu/environment/waste/prevention/index.htm. In particular, the Waste Framework Directive (2008/98/EC) is an important driving force. The main driving forces to minimise waste are:

- environmental responsibility

- legislation
- waste disposal costs
- waste handling costs
- unused product costs (partially used products and unnecessary packaging)
- voluntary EMS or ecolabel criteria
- environmental marketing – waste management is a visible demonstration of environmental commitment.

Reference companies
The Uhlenköper Campsite in Germany and other members of the Ecocamping network provide examples of best practice.

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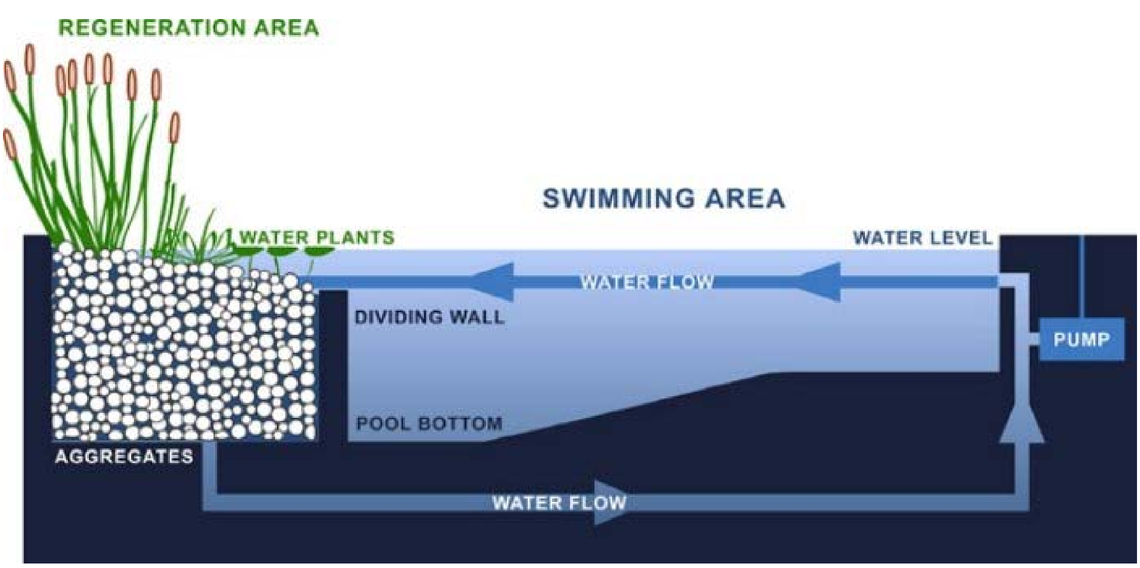
9.6 Natural pools

Description

Swimming pools can consume considerable amounts of energy, water and chemicals, and result in the discharge of chemicals into the environment. Optimisation of conventional swimming pools is described in section 5.6. However, it is possible to further reduce the environmental impact of maintaining and operating a swimming pool by choosing to install, or to retrofit an existing pool with a natural pool.

Natural pools are designed to be hygienically operated without the need for continuous chemical disinfection, and with minimum energy and water requirements. Inspired by natural lake systems, natural pools incorporate a natural filtration system in the form of a regeneration zone, in which specially selected plants and an aggregate substrate filter nutrients, algae and micro-organisms out of the water (Figure 9.28). A dividing wall reaching to approximately 100 mm below the water surface separates the regeneration zone from the swimming zone to prevent contamination of swimming water with soil and aggregate material. Water may also be passed through a mesh screen and phosphate sink, and additional aquatic plants added to the swimming area, to provide further water purification if required. One company claims to have built 3 500 natural pools across Europe in the past 25 years (Biotop Landschaftsgestaltung Gmbh, 2012).



Source: Inspiration Green (2012).

Figure 9.28: Basic schematic water circulation and filtration in a natural pool system

Natural pools can be designed to look conventional, with clear separation of the main swimming area from the planted regeneration area, or to look like a natural pond or lake. They may even be heated and located indoors, as demonstrated on the Artehof Aparthotel and Campsite in Germany. However, natural pools are most easily constructed to look somewhat natural, and without heating. This, combined with the traditional expectation of a sterile pool appearance, means that natural pools have so far not been widely taken up by hotels. Typically, campers spend their holidays closer to nature than hotel guests, and are more receptive to the concept of natural pools. It is for this reason that natural pools are described here, in the campsite chapter of the tourism SRD. However, natural pools are applicable across the tourism industry, as demonstrated by application in a number of hotels.

Achieved environmental benefit

Natural pools avoid the use chlorine and other disinfection agents or treatment systems such as ozonation, thereby almost eliminating resource depletion and ecotoxicity impacts of swimming pools, and significantly reducing energy consumption.

Appropriate environmental indicator

The most appropriate environmental indicator for this technique is simply whether or not the on-site swimming pool is a natural pool that avoids the use of chemical or electrical (via ozonation) disinfection. Thus, the benchmark of excellence for this technique is:

BM: the on-site swimming pool(s) incorporate(s) natural plant-based filtration systems to achieve water purification to the required hygiene standard.

Cross-media effects

Natural pools require more space than conventional pools of the same swimming area. Any consequent effect on biodiversity would depend on the pre-existing biodiversity and the counterfactural land use (including the alternative conventional pool specification). However, natural pools can be integrated into the surrounding landscape, and can support local biodiversity by providing a habitat for aquatic species. So, in addition to reduced ecotoxicity effects, natural pools are likely to result in a significant positive effect on biodiversity compared with conventional pools.

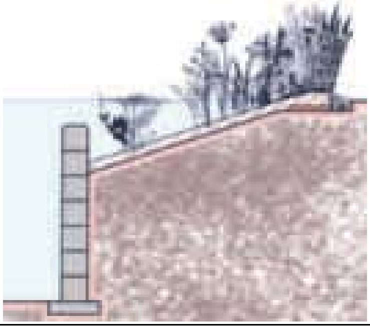
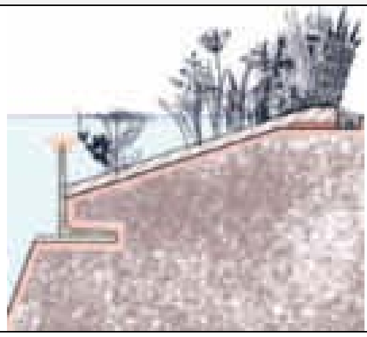
Operational data

Construction design

As with conventional pools, it is important that the pool and filter system (regeneration area) are sized to cope with expected peak demand. Natural pools are not able to hygienically cope with high peak usage rates.

The edge of the pool should be raised, and/or a drainage ditch constructed completely around the pool to ensure that no run-off water enters the pool. Construction of the main body of the pool is as per conventional pools. A rubber membrane or similar flexible impermeable barrier may be used depending on the desired finish. The main distinguishing feature of a natural pool is the regeneration zone separated from the main body of the pool by a submerged diving wall. Table 9.24 provides some examples of different construction methods for the diving wall.

Table 9.24: Main construction techniques for dividing walls in a natural pool

Concrete or cinderblock walls	Corner element construction	Earthwall construction
		
– Precise geometric shapes – Vertical walls from top to bottom in the swimming area – Higher input in materials and costs – Self-construction is possible	– Pre-fabricated components – Quick and easy construction – Attractive design – Swimming area can be shaped as desired – Wooden slats provide seating	– Gently sloping shape of the swimming area – Economically priced – Larger surface area needed due to greater width of earth wall
Source: Biotop Landschaftsgestaltung Gmbh (2012).		

<u>Regeneration zones</u>

Regeneration zones are comprised of an inert coarse substrate such as gravel or loamy sand. Topsoil is avoided, as the idea is to provide a substrate for the plant roots to absorb nutrients from the percolating water, and not to introduce additional nutrient sources. Additional components of the regeneration zone may include lime and elements to bind nutrients and fine particles.

A range of aquatic plants can be used, both in the regeneration zone and the main pool body. These can include include submerged oxygenators, floating plants, shallow marginals, deep marginals, bog/marsh and waterside species. Wherever possible, indigenous plants should be used as they should be adapted to the local environment and will maximise the biodiversity benefits arising from a natural pool. In order to provider effective water treatment, the mix must contain marsh plants that are able to decompose compounds to their constituent elements within the root zone.

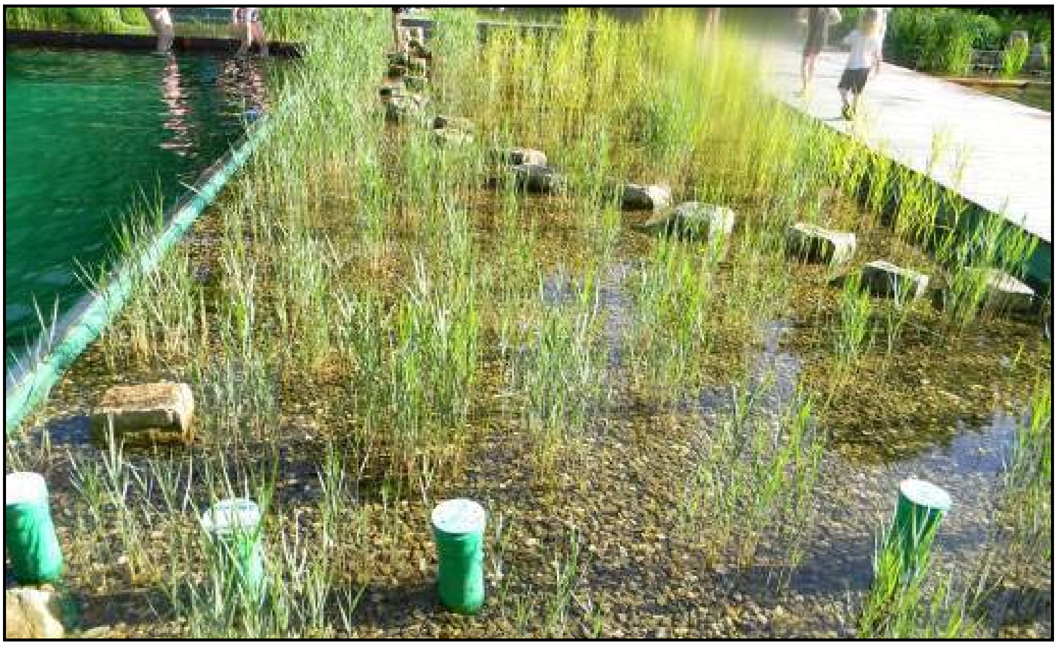


Figure 9.29: A natural pool regeneration zone in the Uhlenköper campsite, Germany

Additional filtration systems

Following filtration in the regeneration zone, water may be pumped through a self-cleaning mesh screen of e.g. 0.3 mm to remove any remaining algae and micro-particles. Although usually not necessary when the regeneration zone is operating correctly, a phosphorus filter may be installed to prevent algae growth (phosphorus is a limiting nutrient in freshwater). Closed pressure filters are available that can be installed separately within the pool and cycle water through a filter substrate containing elements that bind phosphate.

Maintenance

Aquatic plants grow quickly and may require periodic thinning and pruning. Removing the plant mass each autumn acts as a sink for impurities and nutrients from the system. A surface leaf skimmer should be used to remove floating debris from the water, whilst silt (a combination of decaying vegetation, dust and other detritus) can be removed by either a vacuum or bottom purge system (Littlewood, 2004). Where present, phosphorus filter systems need to be periodically rinsed, and the filter substrate changed every few years.

Applicability

Natural pools require an outdoor area of at least 200 m^2, and are not appropriate for pool facilities subject to high peak usage rates.

Economics

The construction costs for a natural pool are similar to a conventional pool (ITP, 2008). Littlewood (2004) quote construction costs of approximately 400 to 470 EUR per m^2 for a natural pool of at least 50 m^2, though costs may have increased since.

However, maintenance costs are significantly lower, as chemical purchasing is avoided and electricity consumption is typically lower than for conventional pools.

Driving forces for implementation

The following features of natural pools provide drving forces for installation (in place of conventional pools):

- water contains no harmful chlorine or chemicals and is therefore healthier and more environmentally friendly

- natural pools may form an attractive and natural-looking landscape feature
- water warms up more quickly in the sun owing to shallow depth in the regeneration zone
- maintenance is less time- and money-intensive than for conventional pools
- natural pools can support local biodiversity.

In summary, a combination of marketing, economic and environmental responsibility motives support the installation of natural pools.

Reference companies

Campsites and hotels that have installed natural pools include:

- Artehof Aparthotel and Campsite in Germany (outdoor plus indoor heated natural pool)
- Dietglut Hotel in Austria
- Uhlenköper Campsite in Northern Germany.

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10 MICRO, SMALL AND MEDIUM SIZED ENTERPRISES

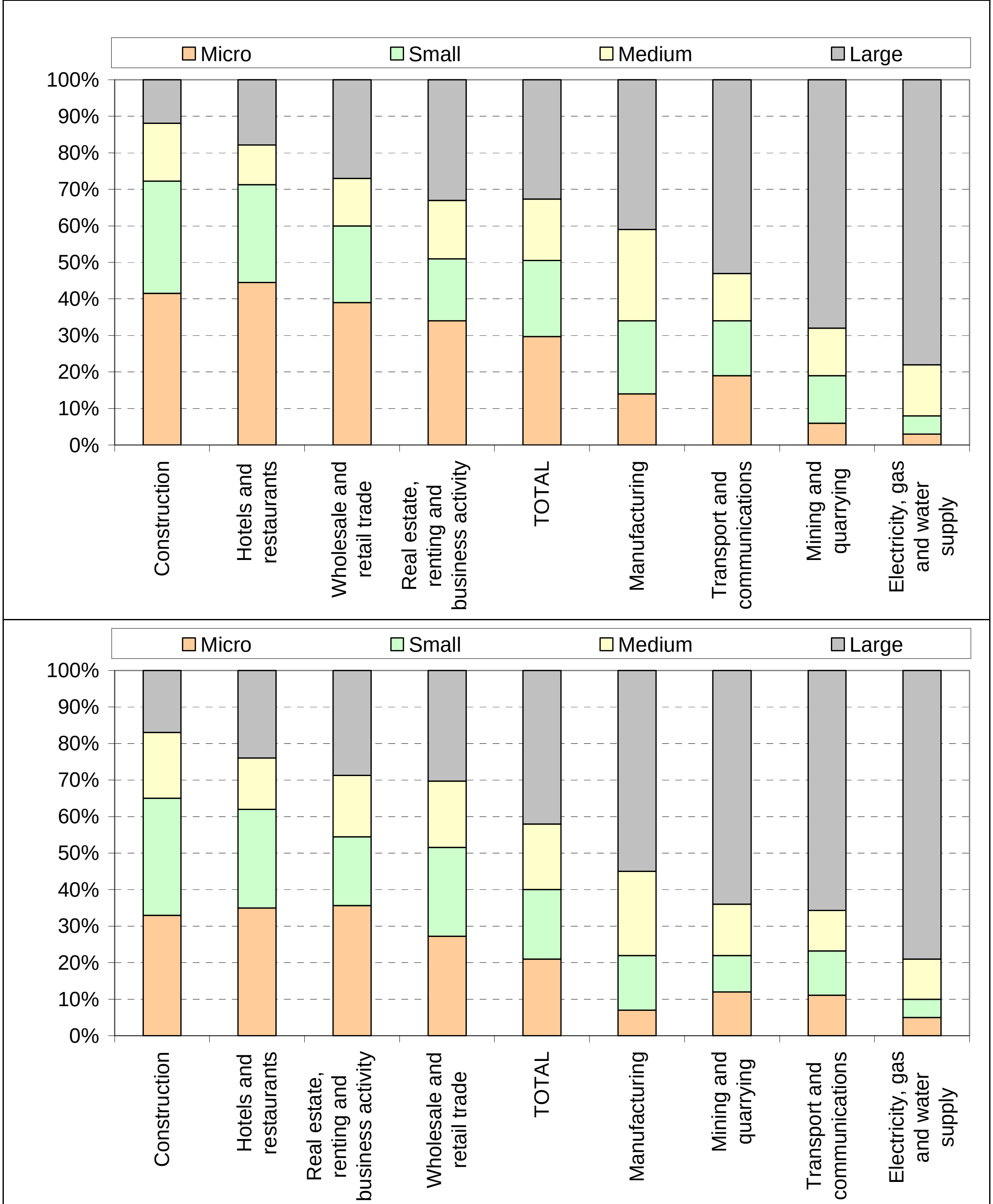
10.1 Micro- and small- and medium- sized enterprises in the tourism sector

Definitions of micro-, small- and medium-sized enterprises are given in Table 10.1. For brevity in this chapter, the term 'SME' includes micro-enterprises. One of the most widely used proxies to rapidly identify an SME is the number of employees. On this basis, Figure 1.1 and Figure 1.2 in section 1.1.2 show that SMEs dominate the hospitality (accommodation and food and beverage services), and especially the accommodation, sectors in terms of numbers of enterprises. In terms of gross value added, SMEs are less dominant but still account for the majority of the sector in most Member States.

Table 10.1: European Commission definitions of 'micro', 'small', 'medium' and 'large' enterprises

Enterprise size class	Definition
Micro	An enterprise that employs fewer than 10 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 2 million.
Small	An enterpise that employs fewer than 50 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 10 million.
Medium	An enterprise that employs fewer than 250 persons and whose annual turnover does not exceed EUR 50 million or whose annual balance-sheet total does not exceed EUR 43 million.
Large	An enterprise that employs 250 or more persons and/or has an annual turnover greater than EUR 50 million or an annual balance-sheet total greater than EUR 43million.
Source: EC (2003).	

Over the EU-27 as a whole, SMEs represent 76 % of gross value added in the hospitality sector (Figure 10.1). This is a higher share than most other sectors in the EU-27.



Source: (EC, 2010).

Figure 10.1: The size-class distribution of enterprises across different sectors within the EU-27, according to the number of persons employed (top figure) and gross-value-added (bottom figure)

In summary, SMEs are especially important within the tourism sector. Rural accommodation in particular is highly likely to be managed as a small business. Consequently, it is very important that best environmental management practice techniques for the tourism sector are applicable to SMEs. This issue is addressed in section 10.3, below.

10.2 Sustainability of SMEs

The study 'SMEs and the environment in the European Union' (Danish Technological Institute, 2010) estimated that 64 % of environmental impact arising in the EU-27 originates from SMEs that, in some sectors, may be less eco-efficient than larger enterprises owing to scale effects and lower investment in new technologies. That study also revealed that 60 % of SMEs in the hospitality sector did not employ any environmental management practices, with 36 % employing basic environmental management practices, and 4 % employing more complex environmental management systems.

It was concluded that environmental legislation poses more of a burden on SMEs than large enterprises because the former have fewer resources to interpret and comply with new legislation. Therefore, financial support from government may be necessary to alleviate the costs of complying with environmental legislation for SMEs. With regard to the application of BEMPs, the simplicity, cost and level of staff training required are key factors affecting uptake by SMEs.

In 2010, the European Commission published a report titled 'Opportunity and Responsibility: how to help more small businesses to integrate social and environmental issues on what they do' (EC, 2010). The aim of this report was to encourage the uptake of Corporate Social Responsibility by SMEs, and follows from a similar earlier report entitled 'Fostering CSR among SMEs' (EC, 2004). A brief summary of key points contained in these two reports is presented below.

The main drivers of environmental responsibility among SMEs are:

- management of internal aspects;
- some environmental measures pay off in the medium/longer term;
- environment, health and cost-efficiency can be improved;
- branding: SMEs identified as good or best performer at local level;
- external aspects: as better response to existing or new legislation..

The main barriers to improving environmental performance across SMEs are:

- the diversity of SMEs makes it difficult to identify generic solutions;
- the difficulty of disseminating information to SMEs;
- the limited management resources typical of SMEs;
- high perceived costs and relatively high actual investment costs (though the latter are usually significantly lower than the former);
- generally, there is lack of awareness, motivation, know-how and know-who;
- reluctance to seek external help.

The main conclusions on mechanisms required to facilitate SMEs with environmental performance improvement include:

- solutions for SMEs should be practical and result oriented;
- education of staff and managers is essential;
- building SMEs clusters to address common problems could reduce costs;
- intermediary organizations with a high level of awareness can facilitate uptake (trade unions, consultants, commerce chambers, etc.);

- advice and financial support from national, regional or local level government is often required.

10.3 Applicability of BEMPs for SMEs

As referred to above, SMEs represent a large portion of the tourism sub-sectors targeted by this SRD. Consequently, most of the BEMP techniques described in this document are applicable to SMEs, and many of the case studies refer directly to SMEs. Table 10.2 provides a summary of the applicability of each BEMP contained in this SRD for SMEs, with some additional notes.

In summary, most BEMPs are highly relevant for BEMPs. A few BEMP measures specifically for large-scale processes, such as optimisation of tunnel washers in large-scale laundries (section 5.5) or that require high investment costs (building envelope retrofitting (section 5.2) are less applicable to SMEs than large enterprises. Conversely, BEMPs that require different value-added marketing (e.g. eco-tours), or that are particularly relevant for rural areas, may be better suited to SMEs than large enterprises owing to the greater flexibility and market repositioning opportunities for SMEs.

Table 10.2: Applicability of BEMP sections within this document to SMEs

Actor	Section	BEMP	SME Applic-ability	Notes for SMEs
All	2.1	Environmental management system	High	The effort required for this BEMP is somewhat proportional to size.
	2.2	Supply chain management	High	SMEs well suited to green procurement and associated market positioning, but possibly less direct influence over suppliers.
Destination managers	3.1	Development of strategic destination plans	Medium	If destination management performaed by a destination management organisation, this BEMP is highly relevant for SMEs. But government departments also key actors.
	3.2	Biodiversity and conservation management	Medium	As above.
	3.3	Infrastructure and service provision	Medium	As above, except that implementation (e.g. wastewater treatment) may also be performed by SMEs in some cases.
	3.4	Environmental management of events	High	Event management may be performed by SMEs.
Tour operators	4.1	Reduce and mitigate the environmental impacts of transport operations	Medium	SME tour operators are unlikely to have their own airlines, but may have ground transport and can implement green procurement of transport.
	4.2	Drive environmental improvement of accommodation providers	Medium	Establishing supplier criteria is less applicable to SMEs than large enterprises, but SMEs may use environmental certification to select suppliers.
	4.3	Drive destination improvement	Medium/ Low	SME tour operators can do little on their own to drive destination improvement, but may have an impact through consortia.
	4.4	Develop and promote sustainable tours	High	This BEMP is well suited to SMEs who can target a market niche.
	4.5	Encourage more sustainable tourist behaviour	High	As above

Actor	Section	BEMP	SME Applic-ability	Notes for SMEs
	4.6	Efficient retail and office operations	**High**	Use of online marketing and minimisation of office and retail operations is well-suited to SMEs.
Accommodations (water)	5.1	Water system monitoring, maintenance and optimisation	**High**	Extensive sub-metering may not be applicable for micro-enterprises, but undertaking a water audit and consumption benchmarking is applicable to all enterprises.
	5.2	Efficient water fittings in guest areas	**High**	The payback time for installing efficient water fittings is short.
	5.3	Efficient housekeeping	**High**	Investment costs are low and savings significant.
	5.4	Optimised small-scale laundry	**High**	Small-scale laundry operations particularly relevant for SMEs.
	5.5	Optimised large-scale laundry	**Low**	Only relevant for SMEs in as far as they select efficient outsourced laundry providers.
	5.6	Optimised pool management	**Medium**	Applicable where SMEs have a swimming pool.
	5.7	Rainwater and greywater harvesting	**Medium**	Investment costs high but applicable to new-build SME accommodation and campsites.
Accommodations (waste)	6.1	Waste prevention	**High**	This BEMP can realise significant savings without much investment.
	6.2	Waste sorting and recycling	**High**	As above.
	6.3	Wastewater treatment	**High**	This BEMP especially for rural accommodations that are likely to be SMEs.
Accommodations (energy)	7.1	Energy monitoring and management systems	**High**	Electricity sub-metering easy to install during construction and renovation. Energy audit and basic benchmarking universally applicable and can significantly reduce costs.
	7.2	Improved building envelope	**Medium**	PassiveHouse and Minergie P energy performance economically achievable for SME new-builds. Retrofit options may be expensive with long payback.
	7.3	Optimised HVAC systems	**High**	Full system optimisation may require high investment, but many basic measures can be implemented at low cost.
	7.4	Efficient application of heat pumps and geothermal heating/cooling	**Medium**	A cost-effective option when applied during construction or renovation.
	7.5	Efficient lighting and electrical equipment	**High**	Efficient lighting associated with a short payback. Investment may be higher where luminaries need replacing.
	7.6	Renewable energy sources	**Medium**	Longer payback periods but especially applicable in rural settings.
Kitchens	8.1	Green sourcing of food and drink products	**High**	Green procurement and associated value-added marketing well suited to SMEs.
	8.2	Organic waste management	**High**	This BEMP can realise significant cost savings. Composting most relevant in a rural context where SMEs prevail.

Actor	Section	BEMP	SME Applic-ability	Notes for SMEs
	8.3	Optimised dish washing and food preparation	High	Procurement of efficient dishwashers and water-fittings associated with short payback.
	8.4	Optimised cooking, ventilation and refrigeration	High	SMEs may select efficient equipment, but more importantly have more direct control over operational efficiency measures.
Campsites	9.1	Environmental education of guests	Medium	SMEs are well positioned to offer value-adding guest education options and to provide bicycles, etc, for guest use. Resource constraints may be an issue.
	9.2	Environmental management of outdoor areas	High	This BEMP is universally relevant. Payback may be quantified through improved attractiveness to potential guests.
	9.3	Campsite energy efficiency and renewable energy installation	High	Energy efficiency measures associated with short payback, renewable installation with longer payback times.
	9.4	Campsite water efficiency	High	Water efficiency requires relatively low investment for significant savings. Greywater recovery applicable to wash-houses operated by SME campsites.
	9.5	Campsite waste minimisation	High	This BEMP can significantly reduce waste disposal costs.
	9.6	Natural pools	Medium	Applicable where outdoor pools installed or planned. Well-suited to green marketing.

10.4 Alternative financing of energy efficiency measures for SMEs

As documented throughout the BEMP techniques contained in this SRD, under the 'Economics' sub-headings, various government assistance is provided by Member States to encourage installation of specific water- and energy-saving equipment. For example, the Enhanced Capital Allowance scheme in the UK allows businesses to offset the costs of new efficient equipment against tax. However, despite often short payback periods for many BEMP measures, including those referred to in the case study below, it can be difficult for SMEs to raise the capital required, especially under current conditions of restricted bank lending. The case study below provides one example of how this problem can be circumvented, by contracting the services of an Energy Service Company (ESCO). ESCOs do not necessarily represent the best option for all SMEs, especially where SMEs can raise the capital required to implement eco-efficiency measures themselves and where on-site energy management is good. ESCOs can facilitate SMEs to implement energy efficiency measures with a payback period of less than 10 years.

Hotel Palacio Ca Sa Galesa case study

Hotel Palacio Ca Sa Galesa is a small luxury (five-star) hotel with 12 bedrooms, located in Palma de Mallorca. Despite being renovated recently (in 2010) hotel energy consumption is high, at over 296 MWh per year (49 kWh per guest-night), and there is considerable potential to improve energy efficiency through modest investment in relevant measures. Consequently, to avoid the upfront invest costs necessary to realise this energy efficiency potential, the hotel enlisted the services of Energy Service Company (ESCO).

Following an audit of the hotel, the ESCO devised an energy management plan for the hotel, comprising measures summarised in Table 10.3. Installation of an efficient lighting system (low-energy lamps and intelligent control), replacement of one old gas boiler and an electric heat pump with a more efficient condensing boiler, and installation of a pool cover, could reduce hotel energy consumption by over 64 MWh per year (22 %).

Table 10.3: Proposed energy saving measures and associated economics for the Hotel Palacio

Proposed measure	Details	Annual energy saving	Invest-ment cost	Annual economic saving
		kWh	EUR	EUR
Replace halogen lamps with LEDs	7 x 4 W, 105 x 7 W, 119 x 10 W	19 713	7278.50	2468.60
Replace incandescent lamps with LEDs	545 x 5 W, 65 x 8 W, 53 x 15 W, 1 x 20 W	13 301	2479.91	2538.27
Install lighting control	40 x presence sensors, 7 presence/natural-light sensors	8 898	5378.54	1143.73
Replace old boiler and electric heat pump with new condensing boiler	Install a 29.9 kW natural-gas boiler for hot water, swimming pool and space heating	21368	9285,12	1045,82
Install a pool cover	Insulated pool cover for small 6 m^2 indoor pool	875	449.90	112.47
Installation of capacitors	Enables instantaneous peaks in electricity demand to be met without increasing connection capacity.	0	1 033.00	379.19
Optimise electricity contract	The electricity contract can be optimised in relation to the specified peak demand.	0	367.05	422.61
Tele measurement equipments	For measurement and verification of consumes and detection of new saving opportunities	0	1 425.00	0
Total		**64 155**	**29 917**	**8 111**
Source: Balantia (2012).				

The business case for the ESCO management plan is summarised in Table 10.4. The formula for calculating what the hotel pays to the ESCO annually is:

$P = R + S + E + (0.5 \times E_s)$		
P	Annual payment to ESCO	
R	Repayment for investment	EUR 7 337 fixed (provides 15 % return on investment)
S	Service fee	EUR 2 450 in first year, inflation indexed
E	Energy cost	EUR 24 141(*) in yr 1, multiplied by estimated energy-price inflation (5.9 % for first year, then 3 % annually for the remaining years)
E_s	Additional energy saved	EUR 2 590 in first year (minimum future benefit is this value multiplied by energy price inflation)
(*)This is after the EUR 8 111 of savings identified in Table 10.3 have been realised.		

The ESCO guarantees that P is equal to or lower than the base energy cost (i.e. the energy cost without measures, assuming 3 % annual energy-price inflation). Therefore, in the worst case scenario, the hotel has a guaranteed maximum expenditure on energy services for the next ten years that is lower than the likely cost without taking any energy efficiency measures, and will benefit from energy efficiency measures fully after the ten-year contract without needing to make any upfront investment in those measures.

Table 10.4 summarises the estimated net benefit for the ESCO and for the hotel over the ten year contract. This benefit translates into EUR 40 525 for the ESCO (minus any interest paid on the initial investment), and EUR 61 568 for the hotel. In addition, the hotel benefits from all energy savings after the ten year contract, for the remaining lifetime of the equipment (estimated at three years beyond contract for the lighting, and up to ten years beyond contract for the boiler).

Table 10.4: Summary of the total investments and savings over the ten-year energy-service contract

Period	ESCO investment	ESCO income from hotel	Hotel savings
Start	– EUR 29 917 – Repositioning lighting: EUR 2 928		– Investment in measures: EUR 29 917 – Repositioning lighting: EUR 2 928
Years 1-10	– (E) Energy consumed: EUR 276 755 (*) – Monitoring & verification costs: EUR 12 100 – Maintenance costs: EUR 12 400	– (R) Repayment: EUR 73 370 – (S) Service fee: EUR 24 500 service – (E) Energy consumed: EUR 276 755 (*) – (E_s) Additional energy savings (@ 50 %): EUR -15 227	– Energy savings from initial measures: EUR 98 466 – Maintenance: EUR 12 400 – (E_s) Additional energy savings (@ 50 %): EUR 15 227
Total	EUR 318 873	EUR 359 398	EUR 158 938
Net benefit over 10 years		**EUR 40 525**	**EUR 61 568**
Years 11-14 (lighting) Years 11-21 (boiler)		None (contract over)	100 % of energy savings for remaining equipment lifetime

(*)On the basis of realising only the initial energy saving measures (Table 10.3).

Source: Balantia (2012).

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11 CONCLUSIONS

11.1 General aspects

Timing of the work process

The kick-off meeting for the elaboration of the pilot reference document on best environmental management practice for the tourism sector was held in March 2011. The overall structure of the document and the one for presenting the techniques was agreed. After the period for collecting information and data, carrying out important site visits and developing the draft document, the second working group meeting was held in November 2011 in order to verify and to agree on information and data to be used for the document. The working group concluded by expert judgment on the most appropriate environmental performance indicators and benchmarks of excellence.

Sources of information, development of the document

A pre-study was undertaken by Gontmij-Carlbro consultants. Much information required for the elaboration of this document was obtained from tour operator representative organizations and hotel chains in addition to TWG members. In some cases, limited process-level data from tourism actors meant that literature or technology manufacturer values had to be used. Ecolabel criteria were also relevant for some BEMPs. Site visits were used to gain insight into specific processes and BEMP measures.

Level of consensus

The conclusions on the environmental performance indicators and benchmarks of excellence were drawn at the second meeting of the working group in November 2011. There was consensus and no split views were recorded.

11.2 Specific conclusions

This document is the reference document for the tourism sector and has been developed according to Article 46(1) of the EMAS Regulation 1221/2009/EC. The most important environmental aspects, direct and indirect, relevant to the organisations or companies belonging to the tourism sector were identified. This document summarises the best environmental management practices dealing with these identified aspects, including sector specific environmental indicators and derived benchmarks of excellence for the environmental performance of organisations and processes/techniques carried out by these organisations respectively.

The conclusions, gathered on this chapter, have been derived by expert judgement, performed by the European Commission through the JRC-IPTS, and by the Technical Working Group (TWG). This group was composed of companies' representatives, umbrella associations, verification bodies, accreditation bodies, researchers, and the European Commission, who organised and chaired the meetings of the TWG.

This document was developed based on information exchange with tourism organisations, consultation with experts, literature review and site visits. Some of the companies providing information were big players at a European and also at global level. EMAS is a voluntary scheme and the document should be regarded as a support for the efforts of all the actors in the sector who intend to improve the environmental performance therein, with or without a certified environmental management system. The document may be helpful both for all those organisations who have implemented EMAS, or who want to implement it, and also for all those who have implemented any other environmental management system or who intend to improve their environmental performance and to move towards greater sustainability.

In the EMAS registration process, with respect to preparing the environmental statement and to assessing their environmental performance, organisations shall take the reference documents into account. Consequently, the environmental performance should be reported using the specific indicators as described below. Best practice techniques and benchmarks of excellence provide reference points against which an organisation can compare its environmental performance in order to identify improvement potentials. The document may be used in the same manner by verifiers when checking the requirements according to Article 18 of the EMAS regulation.

The specific conclusions of the reference document are structured according to the bullet points of Article 46(1). First, identified best environmental management practices (BEMP) are listed. Then, the common specific indicators of the tourism sector are described. Finally, derived benchmarks of excellence for each aspect, where appropriate, are shown.

11.3 Best environmental management practices

A best environmental management practice (BEMP) is defined in the EMAS regulation as 'the most effective way to implement the environmental management system by organisations in a relevant sector and that can result in best environmental performance under given economic and technical conditions'. In this document, identified best practices are described from Chapter 2 to Chapter 9. Their environmental performance has been evaluated in technical detail along with economic considerations. The described practices address the most important environmental aspects of the tourism sector, both direct and indirect. Following the preamble of the EMAS regulation, the aim of the reference document is to help organisations to better focus on the most important environmental aspects of the sector. For this purpose, detailed technical information and data were collected and collated, often based on case studies. The structure of the technical descriptions of the different practices is similar to the Best Available Techniques Reference Documents (BREFs) according to Article 13 of the Industrial Emissions Directive (formerly the IPPC Directive): description, achieved environmental benefits, appropriate environmental indicator, cross-media effects, operational data, applicability, economics, driving force for implementation, reference companies and reference literature.

In the following sections, best practices for the different actors and environmental aspects are submitted. The most important actors and environmental aspects identified for the tourism sector were:

- cross-cutting, environmental management and supply chain management
- destination managers
- tour operators (transport, accommodation, destination management, tourist behaviour, retail operations)
- accommodation water consumption
- accommodation waste generation
- accommodation energy consumption
- kitchens (sourcing, organic waste generation, water and energy consumption)
- campsites (guest education, outdoor area management and energy and water consumption).

11.3.1 Cross-cutting

1. BEMP is to undertake an assessment of the most important direct and indirect environmental aspects associated with the enterprise, and to apply relevant performance indicators and

compare with relevant benchmarks of excellence as described in this document. . See section 2.1.

2. BEMP is to identify supply chain environmental hotspots, considering the entire value chain, and to identify relevant control points (e.g. product selection, avoidance, green procurement, supplier criteria) that can be used to minimise the environmental impact over the value chain. See section 2.2.

11.3.2 Destination managers

1. BEMP is to establish a unit or organisation responsible for the strategic sustainable development of the destination, that coordinates relevant departments to implement specific actions within the framework of a Destination Plan. See section 3.1.

2. BEMP is to monitor the state of biodiversity within the destination, and to implement a biodiversity conservation and management plan that protects and enhances total biodiversity within the destination through, for example, development restrictions and compensation measures. See section 3.2.

3. BEMP is to ensure that environment-related services within the destination, especially water supply, wastewater treatment, waste management (especially recycling measures) and public transport/traffic management, are sufficient to cope with peak demand during tourism high season in a sustainable manner. See section 3.3.

4. BEMP is to monitor the environmental impact of large events, and I environmental management plans for such events that avoid and mitigate impacts, such as the provision of additional public transport to the event, the provision of good waste management facilities, and the offsetting of carbon and biodiversity impacts. See section 3.4.

11.3.3 Tour operators

1. BEMP involves choice editing of packages offered to avoid unnecessary flights (e.g. Forum Anders Reisen criteria), and to implement energy efficiency measures for transport fleets (owned or supplied), including green procurement of the most efficient vehicles, retrofitting aircraft and coaches/buses with energy saving options such as winglets, and optimisation of operations (e.g. maximise load factors). See section 4.1.

2. BEMP is to require or encourage environmental certification of accommodation providers, or to require compliance with specific environmental criteria, or to require environmental performance reporting that can be used to implement benchmarking. See section 4.2.

3. BEMP is to work on discreet projects, ideally coordinated through tour operator consortia and involving destination managers, that address environmental hotspots associated with tourism within destinations. See section 4.3.

4. BEMP is to develop and promote tourism packages that exclude the most environmentally damaging options, and include environmental front-runner transport, accommodation and activity options. See section 4.4.

5. BEMP is to provide information to customers on the environmental impacts of tourism packages, and targeted, positive and engaging messages on actions that can be taken by customers during selection, and guests during holidays, to minimise their environmental impact. See section 4.5.

6. BEMP is to minimise the use of resources, especially paper and ink, for advertising and office operations, to select environmentally certified materials and services (e.g. printing services), and to ensure energy and water efficiency across all office and retail operations. See section 4.6.

11.3.4 Accommodation water consumption

1. BEMP is to undertake a water consumption audit and monitor water consumption across key water-consuming processes and areas (i.e. sub-metering) in order to identify efficiency improvement options, and to ensure that all equipment is maintained through appropriate periodic inspection, including during housekeeping. See section 5.1.

2. BEMP is to install efficient water-fittings, including low-flow spray taps and low-flow thermostatic-controlled showers, low- and dual-flush WCs, and waterless urinals. In the interim, aerators may be retro-fitted to existing fittings. See section 5.2.

3. BEMP is to minimise laundry requirements through green procurement of bedclothes and towels (in terms of size, density, colour, material), and by requesting or encouraging guests to reuse bedclothes and towels. Best practice is also to train staff on the implementation of water- and chemical-efficient cleaning methods, and to procure environmentally certified consumables for bedrooms and bathrooms. See section 5.3.

4. BEMP is to procure the most water- (and thus energy-) efficient washing extractors and the most energy efficient driers (e.g. heat-pump driers) and ironers, to reuse rinse water and, in high-water-stress areas, main wash water following micro-filtration. Best practice is also to recover heat from waste water and exhaust ventilation air. See section 5.4.

5. BEMP is to select an efficient laundry service provider that is certified by an ISO Type-1 ecolabel or that complies with criteria in such labels (e.g. Nordic Ecolabelling, 2009), or to ensure that on-site large-scale laundry operations comply with such criteria. See section 5.5.

6. BEMP is to optimise the frequency and timing of backwashing based on pressure drop rather than fixed schedules, to use ozonation or UV treatment and careful dosing control to minimise chlorination, and to recover heat from exhaust ventilation air.

7. BEMP is to install a greywater recovery system that recovers greywater for use in indoor processes (e.g. toilet flushing) following treatment or exterior processes (e.g. irrigation), or a rainwater collection system that uses rainwater for indoor purposes. See section 5.7.

11.3.5 Waste management

1. BEMP is to prevent waste generation through green procurement of products, considering product lifecycle impacts – for example by avoiding single-use items (food, soaps, shampoos) and by buying cleaning agents in concentrated and bulk form – and by careful management of procurement volumes. See section 6.1.

2. BEMP is to provide separated waste collection facilities throughout the establishment, to ensure that there is a clear procedure for staff waste separation, and to contract relevant recycling services at least for glass, paper and cardboard, plastics, metals and organic waste. See section 6.2.

3. BEMP where wastewater is not sent to a centralised wastewater treatment plant is to install an on-site wastewater treatment system that treats wastewater at least to secondary, and preferably to tertiary, level. See section 6.3.

11.3.6 Accommodation energy

1. BEMP is to undertake an energy audit and monitor energy consumption across key energy-consuming processes and areas (i.e. sub-metering) in order to identify efficiency improvement options, and to ensure that all equipment is maintained through appropriate periodic inspection. See section 7.1.

2. BEMP is to ensure that new buildings are compliant with the highest achievable energy ratings, as indicated by conformance with PassiveHouse and Minergie P standards, and that

existing buildings are retrofitted to minimise heating and cooling energy requirements. See section 7.2.

3. BEMP is to minimise energy consumption from HVAC systems by installing zoned temperature control and controlled ventilation with heat recovery (ideally controlled by CO_2 sensors), energy-efficient components (e.g. variable-speed fans), and to optimise HVAC in relation to building-envelope and energy source characteristics. See section 7.3.

4. BEMP is to install efficient (e.g. eoclabelled) heat pumps for heating and cooling, or where possible ground water cooling. See section 7.4.

5. BEMP is to install zoned and appropriately sized compact fluorescent and LED lighting with intelligent control based on motion, natural-light and time. See section 7.5.

6. BEMP is to install on-site geothermal, solar or wind energy generation where appropriate, and to procure electricity from a genuine (verifiable additional) renewable electricity supplier. See section 7.6.

11.3.7 Kitchens

1. BEMP is assess food and drink supply chains to identify environmental hotspots and key control points, including choice editing of menus to avoid particularly damaging ingredients (e.g. some out-of-season fruit), and selection of environmentally-certified products. See section 8.1.

2. BEMP is to minimise avoidable food waste by careful menu development and portion sizing, and to ensure that all organic waste is separated and sent for anaerobic digestion where available, or alternatively incineration with energy recovery or local/on-site composting. See section 8.2.

3. BEMP is to select efficient washing equipment, including trigger-operated low-flow pre-rinse spray valves, efficient dishwashers and connectionless steamers, and to monitor and benchmark water consumption in kitchen/restaurant areas. See section 8.3.

4. BEMP is to select efficient cooking equipment, including induction-hob or pot-sensor-controlled gas ovens, efficient refrigeration equipment that uses a natural refrigerant such as ammonia or carbon dioxide, and to control ventilation according to demand. See section 8.4.

11.3.8 Campsites

1. BEMP is to provide guests with interactive on-site education of environmental issues, including courses, nature-trails, or equipment such as low-carbon transport (bicycles, electric bicycles). See section 9.1.

2. BEMP is to maximise on-site biodiversity through planting of native species, installation of green or brown roofs and walls, and to minimise water consumption for irrigation and light pollution arising from outdoor lighting (e.g. through use of correctly-angled low-pressure sodium lamps). See section 9.2.

3. BEMP is to minimise energy consumption for water-heating, HVAC and lighting through installation of low-flow fittings, good building insulation, and fluorescent or LED lighting, and also to install on-site renewable energy generating capacity (e.g. solar water heating). See section 9.3.

4. BEMP is to minimise water consumption through the installation of low-flow taps and showers, shower-timer controls, and low- and dual-flush WCs. See section 9.4.

5. BEMP is to minimise residual waste generation by implementing waste prevention, by providing convenient on-site waste sorting facilities, and by contracting wate recycling services. See section 9.5.

6. BEMP is the installation of, or conversion of an existing pool to, a natural pool. See section 9.6.

11.4 Common specific key performance indicators of the tourism sector

Indicator	Common Units	Short description	Recommended minimum level of monitoring	Related core indicator (Annex IV of EC 1221/2009)	Other or alternative indicators
CROSS CUTTING					
Supply chain improvement / green sourcing	% of products or services complying with specific environmental criteria	A lifecycle approach is required to assess the major environmental impacts arising in main product and service value chains (including upstream and downstream impacts). Appropriate criteria and certification should be sought to reduce lifecycle environmental impacts. Also applies to green sourcing of food for kitchens.	Per site (may be aggregated to organisation level)	All	Lifecycle assessment indicators for supply chains
DESTINATION MANAGEMENT					
Destination planning	Implementation of Destination Plan Tourism Sustainability Group destination indicator set Global Tourism Sustainability Council indicator set	Destination management best practice is represented by implementation of a comprehensive Destination Plan. Reporting according to international indicator sets such as the EC Tourism Sustainability Group and Global Sustainable Tourism Council indicators is useful and may help to standardise assessment of destination management performance.	Destination	All	% key tourism service providers environmentally certified
Biodiversity	Implementation of destination biodiversity management plan Species abundance Protected area (hectares, % of destination)	Biodiversity monitoring can be based on many sub-indicators, such as the abundance of particular species, protected areas, stakeholder perceptions, ecosystem services, keystone species. Carrying capacity and limits of acceptable change are important concepts that may be quantified and used to define limits for tourism development.	Destination	Biodiversity	Keystone species Limits of acceptable change Land use zoning TSG indicators GTSC indicators
Services	Sustainable water	Service provision covers a range of aspects,	Destination	All	Peak tourist demand

Indicator	Common Units	Short description	Recommended minimum level of monitoring	Related core indicator (Annex IV of EC 1221/2009)	Other or alternative indicators
	provision % wastewater tertiary treatment % waste recycled % public transport % renewable energy	especially water provision, wastewater treatment, waste recycling, public transport provision. Carrying capacity may also be used to define thresholds for the human-nature system, reflecting the quality and sustainability of services provided within destinations.			relative to carrying capacity Specific wastewater parameters TSG indicators GTSC indicators
TOUR OPERATORS					
Transport	Forum Anders Reisen flight criteria kg CO_2/passenger-km % CO_2 offset with certified carbon credits	Tour operators comply with Forum Anders Reisen flight criteria for packages offered, to avoid unnecessary flights. Tour operators monitor fuel/energy consumption of aircraft, buses, coaches and trains under their control, and request data for sub-contracted transport providers. Direct CO_2 emissions enable comparison across different modes (e.g. high-speed electric train vs flights). For aviation emission offsetting, appropriate radiative forcing index factor should be applied, and certified carbon credits should be used.	Organisation Aircraft / vehicle fleets	Energy efficiency Material efficiency Emissions	L/100 passenger-km g NOx, SOx, PM, VOCs per 100 passenger-km
Accommodation supplier improvement	% of bed nights or value sold complying with specific environmental criteria	Tour operators assess the environmental performance of all accommodation suppliers and implement appropriate improvement options, favouring third-party certified environmental standards, but including informal environmental management systems.	Organisation	All	Certified environment-related standards (e.g. EU Flower, Nordic Swan) Certified EMS (ISO 14001, EMAS)
Destination improvement	% services environmentally improved within	Qualitative indicator, elaborated in benchmark (below). However, a multitude of indicators relevant to measure effectiveness, including TSG indicators, wastewater treatment level, water	Destination and organisation	All	Tourism Sustainability Group destination indicator set

Indicator	Common Units	Short description	Recommended minimum level of monitoring	Related core indicator (Annex IV of EC 1221/2009)	Other or alternative indicators
	destinaiton Influence over destination managers Participation in improvement projects	quality, etc. (see indicators for destination managers, above).			ABTA Destination Sustainability Indicators
Sustainable tours	% front-runner sustainable tours sold (by value) Tour ecolabels	Sales share of front-runner sustainable tours within total tour sales. Front-runner tours identified by ecolabels (e.g. Austrian ecolabel for travel packages), and avoid high impacts from transport, water-stress (avoid over-burdened destinations), etc.	Organisation	All	
Efficient retail and office operations	Grams paper per customer Environmental certification of paper and printing kg CO_2/customer	The quantity of paper consumed per customer, and whether that paper is environmentally certified (e.g. FSC or recycled), and has been printed using environmentally-certified equipment and ink, or printing services, are the primary indicators that capture the main direct impacts of tour operator retail and office operations. Lifecycle GHG emissions associated with these operations may be expressed per customer. Energy and water consumption, and waste generation, from office operations are also useful indicators.	Organisation	Material efficiency Waste Emissions	kWh/m^2yr office energy consumption m^3/employee office water consumption
ACCOMMODATIONS					
Water consumption	L/guest-night	Total water consumption on the accommodation premises over one year, normalised per number of guest nights. Many process-specific indicators of water efficiency may also be used (see below). Water consumption for large swimming pools or restaurants serving a high proportion of non-residents may be excluded from the indicator for accommodation benchmarking.	Per hotel or equivalent (may be aggregated to organisation level) Sub-metering of accommodation areas	Water	L/kg laundry L/dining-guest L/m^2 pool Water recycling (% water use)

Indicator	Common Units	Short description	Recommended minimum level of monitoring	Related core indicator (Annex IV of EC 1221/2009)	Other or alternative indicators
Water fitting efficiency (flow rates)	L/minute % of low-flow fittings	Expressed per type of fitting, and as a percentage fro all fittings within a premises. For example, 90 % of basin taps have a maximum flow rate <6 L/minute.	Per fitting type (e.g. shower taps) at hotel level or equivalent	Water (Energy efficiency)	L/guest-night
Efficient housekeeping	kg laundry/guest-night % reduction in laundry through reuse	Total laundry mass generated per guest-night, depending on reuse rate, textile quantity, size and density. The % reductions specifically achieved through guest reuse may be estimated. The quantity and type of chemicals used for cleaning are also important.	Per premises	Water Energy efficiency Waste	Grams/guest-night active chemical ingredients % ISO type-1 ecolabelled chemicals
Laundry efficiency	L/kg laundry	May be onsite or offsite. Differentiate between accommodation room laundry (sheets and towels) and kitchen/restaurant laundry (tablecloths, etc.) that require more intensive washing. Requires sub-metering in laundry areas.	Per laundry used by accommodation	Water Energy efficiency	L/guest-night
Swimming pool management	Implementation of a pool management plan Application of ozonation or UV treatment	Reflecting the current low level of monitoring of pool water, energy and chemical consumption, best practice is currently reflected by the implementation of a pool efficiency plan that includes water, energy and chemical monitoring, and the use of alternative disinfection techniques (may be supplementary to chlorination, to reduce the quantity of chlorine required).	Per premises	Water Energy efficiency Material efficiency	L per m^2 pool area per year L per guest-night Also for energy (kWh) and chemicals (g)
Greywater and rainwater recycling	Implementation of greywater or rainwater recycling	The installation and use of a system that uses greywater for internal or external (e.g. irrigation) purposes, or that uses rainwater for interior purposes (e.g. flushing toilets), represents best practice.	Per premises (at organisation level: % of premises)	Water	Rate of water recycling (m^3 per year or L per guest-night)
Waste prevention	kg/guest-night total waste generation	This indicator includes recycled waste fractions. The purpose is to assess the effectiveness of waste prevention measures (e.g. reuse).	At least per hotel or equivalent (may be	Waste Material efficiency	L/guest-night total waste generation Implementation of a waste management plan

Indicator	Common Units	Short description	Recommended minimum level of monitoring	Related core indicator (Annex IV of EC 1221/2009)	Other or alternative indicators
			aggregated to organisation level) Per source area (e.g. kitchen, housekeeping)		
Waste recycling	% waste reused or recycled kg unsorted waste per guest night	Expressed as a percentage of total waste generated (above).	Per hotel or equivalent (may be aggregated to organisation level)	Waste Material efficiency	L unsorted waste per guest night Implementation of a waste management plan
Wastewater treatment	BOD_5, COD, total nitrogen, total phosphorus removal efficiency (%) BOD_5, COD, total nitrogen, total phosphorus concentration in final effluent (mg/L)	Refers to performance of on-site wastewater treatment systems.	Per hotel or equivalent	Waste Water	Implementation of effective biological treatment
Heating, cooling and ventilation energy	kWh/m^2yr PassiveHouse or Minergie P standard conformance	Final energy consumption for heating, cooling and ventilation monitored and expressed per heated/cooled area. For new buildings, conformance with low-energy standards such as PassiveHouse and Minergie P is a useful indicator of best practice. In cases where heating and cooling energy cannot be separated from other process energy, total final energy consumption may be used.	Per hotel or equivalent and at the organisational level (aggregated value)	Energy efficiency	Specific primary energy consumption kWh/guest-night U-values for building fabric kg CO_2/m^2yr Use of integrative

Indicator	Common Units	Short description	Recommended minimum level of monitoring	Related core indicator (Annex IV of EC 1221/2009)	Other or alternative indicators
					standards
Lighting efficiency	W/m^2 kWh/m^{2}yr	Lighting power installed to meet illumination needs per unit of area. If data are available on energy consumption specifically for lighting (kWh/m^{2}yr), based on sub-metering, these can be used to also reflect control efficiency. Total electricity consumption may also reflect lighting efficiency for accommodation that does not use a significant amount of electricity for space cooling.	Per hotel or equivalent	Energy efficiency	Specific energy consumption for lighting kWh/m^{2}yr electricity consumption Intelligent control system (y/n) % low energy lighting in place W/lumen (lighting equipment)
Renewable energy	% final energy from renewable sources certified renewable energy credits	This indicator is calculated as the percentage of final energy consumption supplied by onsite renewable energy generation, and/or offsite renewable energy contracted by the enterprise, including renewable electricity where this can be demonstrated to be additional to renewable energy accounted for in national grid average electricity generation.	Per hotel or equivalent and at the organisational level (aggregated value)	Energy efficiency Material efficiency	kWh/m^{2}yr renewable energy generation onsite kg CO_2/m^{2}yr
KITCHENS					
Green sourcing	% key ingredients certified with relevant environmental standards (e.g. MSC)	See 'Supply chain improvement / green sourcing', above.	Per key ingredient purchased, (may be aggregated to organisation level)	All	% key ingredients locally sourced Lifecycle assessment indicators (e.g. kg CO_2 eq./kg ingredient)
Organic waste management	kg/dining-guest % organic waste recycled	Total organic waste divided by the number of covers (dining guests) served. Percentage recycled refers to waste going to energy recovery or composting depending on services available.	Per kitchen or hotel (may be aggregated to	Waste Material efficiency	Implementation of a waste management plan

Indicator	Common Units	Short description	Recommended minimum level of monitoring	Related core indicator (Annex IV of EC 1221/2009)	Other or alternative indicators
			organisation level)		
Water consumption	L/cover	Divide total water consumption by number of covers (dining guests) served. Numerous processes contribute to water consumption, and ideally monitoring should be at process level (dish-washing, taps, steam cookers, etc.).	At least per kitchen or hotel (may be aggregated to organisation level) Per process	Water (Energy efficiency)	L/rack dishwasher consumption L/min pre-rinse spray valve and tap flow rates Trigger/sensor operated water fittings Implementation of a water management plan
Energy consumption	kWh/dining-guest	Divide total energy consumption for kitchen by number of cover meals. Include all energy sources (e.g. electricity, natural gas, LPG). Many processes contribute to energy consumption, and ideally monitoring should be at process level (dish-washing, taps, steam cookers, etc.).	At least per kitchen or hotel (may be aggregated to organisation level) Per process	Energy efficiency	Hob heat transfer efficiency (%) Energy star labels Induction hobs or pot sensor hob-control Implementation of an energy management plan
CAMPSITES					
Guest education	Effective environmental education is provided for guests on site	Guest education can take many forms, from provision of low-impact mobility (e.g. bikes, electric vehicles) on site, to the provision of courses addressing environmental issues and nature walks.	Per campsite	All	A multitude of indicators may be relevant
Biodiversity	Onsite biodiversity management plan	There are many aspects of biodiversity management on campsites. As for destination managers, species abundance and presence of key indicator species may be useful indicators, but the most important indicator is the management of biodiversity through a plan that measures relevant sub-indicators and leads to implementation of relevant measures (e.g. green barriers, native planting).	Per campsite	Biodiversity	% native species Green barriers (y/n) Green roofs/walls (y/n) Contribution to conservation schemes

Indicator	Common Units	Short description	Recommended minimum level of monitoring	Related core indicator (Annex IV of EC 1221/2009)	Other or alternative indicators
Energy consumption	kWh/guest-night	Total final energy consumption on the campsite, expressed as kWh per person. Energy consumption within buildings and kitchens may also be expressed as per indicators above for accommodation and kitchens (kWh/m^{2}yr and kWh per cover)	Per campsite (may be aggregated to organisation level) Per process	Energy efficiency	kWh/m^{2}yr final energy consumption
Water consumption	L/guest-night % low-flow fittings L/m^2 non-recycled water for irrigation	As per accommodation, above, but also management of outdoor areas (planting native species and irrigation control) to minimise water consumption for irrigation.	Per campsite (may be aggregated to organisation level) Per fitting	Water	Implementation of a water management plan
Renewable energy	% energy from renewable sources kWh/guest-night non-renewable final energy consumption	As per accommodation, above.	Per campsite (may be aggregated to organisation level)	Energy efficiency Material efficiency	kW renewable energy installed kWh renewable energy consumed per year or per guest-night
Natural pool	Installation of a natural pool (y/n)	Installation of a pool that uses natural filters (sand, gravel, plants) in place of chemical disinfection.	Per campsite	Material efficiency Water Waste	

11.5 Benchmarks of excellence

The following table lists benchmarks of excellence according to the main target actors and environmental aspects, as per the sequence of best environmental management practice descriptions in subsequent sections of this document.

Cross-cutting (Chapter 2)
• appropriate indicators are used to continuously monitor all relevant aspects of environmental performance, including less easily measured and indirect aspects such as biodiversity impacts • all staff are provided with information on environmental objectives and training on relevant environmental management actions • best environmental management practice measures are implemented where applicable • the organisation has applied lifecycle thinking to identify improvement options for all major supply chains that address environmental hotspots • ≥97 % of chemicals, measured by weight of active ingredient, used in accommodation and restaurant premises are ecolabelled (or can be demonstrated to be the most environmentally friendly available option) • ≥97 % of all wood, paper and cardboard purchased by accommodation and restaurant enterprises are recycled or environmentally certified (ecolabelled, FSC, PEFC)
Destination management (Chapter 3)
• implement a Destination Plan that: (i) covers the entire destination area; (ii) involves coordination across all relevant government and private actors; (iii) addresses key environmental challenges within the destination • destination managers report on all applicable indicators developed by the Tourism Sustainability Group and/or the Global Sustainable Tourism Council, at least every two years • minimise and compensate for any biodiversity displaced by tourism development so that destination-level biodiversity is at least maintained in high nature value areas, and increased in degraded areas • environment-related services, including public transport, water provision, wastewater treatment and waste recycling, are designed to cope with peak demand and to ensure the sustainability of tourism within the destination • ≥95 % wastewater generated in the destination receives at least secondary treatment, or tertiary treatment for discharge to sensitive receiving waters, including during peak tourist season • ≥95 % of waste is diverted from landfill and recycled, or at least sent for anaerobic digestion or incineration with energy recovery • average tourist water consumption of ≤200 L per day • public transport, walking and cycling accounts for ≥80 % of journeys within city destinations
Tour operators (Chapter 4)
• tour operators do not offer flights for: (i) destinations less than 700 km; (ii) destinations up to 2 000 km away for a duration of stay less than eight days, or; for destinations more than 2 000 km away with a duration of stay less than 14 days • tour operator airline fleets achieve average specific fuel consumption of ≤2.7 litres per 100 passenger km, falling to ≤2.4 litres per 100 passenger km by 2014

- average coach or bus fleet fuel consumption of ≤0.75 litres per 100 passenger km and at least 90 % of fleet are EURO 5- compliant or run on alternative fuel systems
- transport GHG emissions from all packages sold are automatically compensated by investing directly in GHG avoidance projects or by purchasing certified carbon credits
- ≥90 % accommodation suppliers, based on sales value or overnight stays, are in compliance with at least basic environmental requirements (preferably recognised by third-party certification)
- the tour operator drives destination environmental improvement by: (i) improving supply chain performance; (ii) influencing destination management; (iii) direct improvement schemes
- the tour operator promotes sustainable tourism packages in mainstream advertising material, and front-runner sustainable (e.g. ISO Type-I ecolabelled) tourism packages represent a sales share ≥ 10 %
- the tour operator employs effective marketing and communication methods to encourage more sustainable choices in the selection of tourism packages
- the tour operators informs all it's guests with destination specific information and awareness raising to promote correct behaviour in the destination
- hard copy office and promotional material: (i) is avoided wherever possible; (ii) uses 100 % recycled or environmentally-certified (e.g. ecolabelled, FSC, PEFC) paper; (iii) is printed by environmentally-certified (e.g. EMAS, ISO14001) printing services
- energy and GHG management plans are implemented and energy and GHG emissions arising from retail and office activities are reported and expressed per m^2 retail and office space per year, and per customer
- water consumption ≤2.0 m^3 per employee per year

Accommodation: minimising water consumption (Chapter 5) (includes all aspects of housekeeping and laundry best practice)

- implementation of a site-specific water management plan that includes: (i) sub-metering and benchmarking all major water-consuming processes and areas; (ii) regular inspection and maintenance of water system "leak points" and appliances
- total water consumption ≤140 L per guest-night in fully serviced hotels, and ≤100 L per guest-night in accommodation where the majority of the bathrooms are shared across rooms (e.g. hostels)
- water consumption, and associated energy consumption for water heating, of ≤100 L and 3.0 kWh per guest-night, respectively, for ensuite guest bathrooms
- shower flow rate ≤ 7 L/min, bathroom tap flow rate ≤6 L/min (≤ 4 L/min new taps), average effective toilet flush ≤ 4.5 L, installation of waterless urinals
- at least 80 % of bedclothes are cotton-polyester mix or linen, and at least 80 % of bedroom textiles have been awarded an ISO Type 1 ecolabel or are organic
- consumption of active chemical ingredients within the tourist accommodation of ≤10 grams per guest-night
- reduction in laundry achieved through reuse of towels and bedclothes of at least 30 %
- at least 80 % by active-ingredient weight of all-purpose cleaners, sanitary detergents, soaps and shampoos used by the tourist accommodation shall have been awarded an ISO Type I ecolabel
- laundry is outsourced to efficient commercial laundry service providers complying with benchmarks specified in section 5.5

- all new domestic washing machines have an EU energy label rating of 'A^{+++}', or average annual laundry water consumption ≤7 L per kg laundry washed in laundries with commercial machines
- total laundry process energy consumption ≤2.0 kWh per kg textile, for dried and finished laundry products
- at least 80 % by active-ingredient-weight of laundry detergent shall have been awarded an ISO Type I ecolabel (e.g. Nordic Swan, EU Flower)
- all laundry is outsourced to a provider who has been awarded an ISO type-1 ecolabel (e.g. Nordic Ecolabelling, 2010), and all in-house large-scale laundry operations, or laundry operations outsourced to service providers not certified with an ISO Type-1 ecolabel, shall comply with the specific benchmarks for large-scale laundries described in this document
- total water consumption over the complete wash cycle ≤5 L per kg textile for accommodation laundry and ≤9 L per kg textile for restaurant laundry
- total process energy consumption for dried and finished laundry products ≤0.90 kWh per kg textile for accommodation laundry and ≤1.45 kWh per kg textile for restaurant laundry
- exclusive use of laundry detergents compliant with Nordic Swan ecolabel criteria for professional use (Nordic Ecolabelling, 2009), applied in appropriate doses
- wastewater is treated in a biological wastewater treatment plant having a feed-to-microorganism ratio of <0.15 kg BOD_5 per kg dry matter per day
- implementation of an efficiency plan for swimming pool and spa areas that includes: (i) benchmarking specific water, energy and chemical consumption in swimming pool and spa areas, expressed per m^2 pool surface area and per guest-night; (ii) minimisation of chlorine consumption through optimised dosing and use of supplementary disinfection methods such as ozonation and UV treatment
- installation of a rainwater recycling system that supplies internal water demand, or a greywater recycling system that supplies internal or external water demand

Accommodation: waste minimisation (Chapter 6)

- total waste generation (sorted plus unsorted) of ≤0.6 kg per guest-night
- at least 84 % of waste, expressed on a weight basis, is recycled
- unsorted waste sent for disposal is less than 0.16 kg per guest-night
- where it is not possible to send wastewater for centralised treatment, on-site wastewater treatment includes pre-treatment (sieve/bar-rack, equalisation and sedimentation) followed by biological treatment with >95 % BOD_5 removal, >90 % nitrification, and environmentally-acceptable sludge disposal

Accommodation: minimising energy consumption (Chapter 7)

- implementation of a site-specific energy management plan that includes: (i) sub-metering and benchmarking all major energy-consuming processes; (ii) calculation and reporting of primary energy consumption and energy-related CO_2 emissions
- total final energy consumption ≤180 kWh per m^2 heated and cooled area and per year
- for exiting buildings, final energy consumption for HVAC and water heating ≤75 kWh, or total final energy consumption ≤180 kWh, per m^2 heated and cooled area per year
- the rated energy performance of new buildings conforms with Minergie P or PassiveHouse standards
- water-source heat pumps and/or geothermal heating/cooling is used in preference to conventional heating and cooling systems wherever feasible, and heat pumps comply

with EU Flower criteria • installed lighting capacity <10 W per m^2 or lighting electricity consumption <25 kWh/m^2yr (heated and cooled floor area) • total electricity consumption ≤80 kWh m^2yr (heated and cooled floor area) • the equivalent of 50 % of the accommodation's annual energy consumption is generated by on-site renewable sources, or by verifiably additional off-site RE sources • 100 % of electricity is from traceable renewable electricity sources not already accounted for by another organisation or in the national electricity average generating mix, or that is less than two years old
Kitchens (Chapter 8)
• the enterprise is able to provide documented information, at least including country of origin, for all main ingredients • at least 60 % food and drink products, by procurement value, are certified according to basic or high environmental standards or criteria • at least 40 % food and drink products, by procurement value, are certified according to high environmental standards or criteria • ≥95 % of organic waste separated and diverted from landfill, and, where possible, sent for anaerobic digestion or alternative energy recovery • total organic waste generation ≤0.25 kg per cover, and avoidable waste generation ≤0.18 kg per cover • implementation of a kitchen water management plan that includes monitoring and reporting of total kitchen water consumption normalised per dining guest, and the identification of priority measures to reduce water consumption • installation of efficient equipment and implementation of relevant efficient practices described in this document, as far as possible within demonstrated applicability and economic constraints • at least 70 % of the purchase volume of chemical cleaning products (excluding oven cleaners) for dish washing and cleaning are ecolabelled • implementation of a kitchen energy management plan that includes monitoring and reporting of total kitchen energy consumption normalised per dining guest, and the identification of priority measures to reduce energy consumption • installation of efficient equipment and implementation of efficient practices described in this technique, including: (i) induction hobs or gas flame hobs with pot sensor control; (ii) commercial fridges and freezers with specific energy consumption of ≤1.14 and ≤3.6 kWh per L volume per yr, respectively
Campsites (Chapter 9)
• the accommodation enterprise encourages and facilitates environmentally responsible behaviour and activities, and provides environmental education for guests through on-site activities and courses • maintain or increase on-site biodiversity by planting native species, creating refuges for local animal species, and installing green or brown roofs where possible, and by minimising chemical inputs, light and noise pollution • minimise light pollution and wildlife disturbance by installing timer- or sensor-controlled, efficient, and appropriately angled luminaries producing zero-uplight • minimise water consumption by planting native species and mulching, and by installing controlled irrigation systems fed with greywater where possible

- on-site final fossil-energy and electricity consumption of ≤2.0 kWh per guest-night
- 100 % of electricity is from traceable renewable electricity sources not already accounted for by another organisation or in the national electricity average generating mix, or that is less than two years old
- total water consumption of ≤94 litres per guest-night on fully serviced four- and five-star campsites, and water consumption of ≤58 litres per guest-night on all other campsites
- total residual waste sent for disposal of ≤0.2 kg per guest-night
- the on-site swimming pool(s) incorporate(s) natural plant-based filtration systems to achieve water purification to the required hygiene standard

12 GLOSSARY

Term	Meaning
ABTA	Association of British Travel Agents
AD	Anaerobic Digestion
AONB	Area of Outstanding Natural Beauty (UK)
ASC	Aquaculture Stewardship Council
ASHRAE	American Society of Heating, Refrigeration and Air-conditioning Engineers
BAT	Best Available Technology
BCRSP	Basel Criteria on Responsible Soy Production
BEMP	Best Environmental Management Practice
BMS	Building Management System
BOD	Biological Oxygen Demand
BoE	Benchmark of Excellence
BREEAM	British Research Establishment Environmental Assessment Method
BREF	BAT Reference document
BSI	Better Sugarcane Initiative
4C	Common Code for the Coffee Community
CBD	Convention on Biological Diversity
CBR	Cost Benefit Ratio
CBW	Continuous Batch Washer
CDM	Clean Development Mechanism
CFCs	Chlorofluorocarbons
CFL	Compact Fluorescent Light
COD	Chemical Oxygen Demand
COP	Coefficient of Performance (heating appliances)
CRI	Colour Rendering Index (lighting)
CT	Colour Temperature (lighting)
DEFRA	Department for Environment, Food and Rural Affairs (UK)
DHW	Domestic Hot Water
DIN	Deutsches Institut für Normung (German Standards Institute)
DMO	Destination Management Organisation
DPF	Diesel Particulate Filter
DPSIR	Drivers-Pressures-State-Impact-Response (environmental modelling cycle)
EBBC	European Business and Biodiversity Campaign
EC	European Commission
EEA	European Environment Agency
EER	Energy Efficiency Ratio (cooling appliances)
EHSMS	Environment, Health and Safety Management Scheme
EIA	Environmental Impact Assessment
EMAS	Eco-Management and Audit Scheme

EMS	Environmental Management System
EN	European Norm
EPA	Environmental Protection Agency
FT	Fairtrade
GAP	Global Good Agricultural Practice
GDP	Gross Domestic Product
GHG	Green House Gases
G(P)P	Green (Public) Procurement
GRI	Global Reporting Initiative
GSTC	Global Sustainable Tourism Council
GWP	Global Warming Potential
HCFCs	Hydrochlorofluorocarbons
HES	Hotel Energy Solutions[13]
HSPF	Heating Seasonal Performance Factor
HI	Hostelling International
HNV	High Nature Value
HVAC	Heating Ventilation and Air conditioning
IED	Industrial Emissions Directive
IFC	International Finance Corporation (part of World Bank)
IPPC	Integrated Pollution Prevention and Control
IPTS	Institute for Prospective Technological Studies
ISO	International Standards Organisation
ITP	International Tourism Partnership
JRC	Joint Research Centre
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LED	Light Emitting Diode
LEZ	Low Emission Zone
MEA	Millenium Ecosystem Assessment
MSC	Marine Stewardship Council
NGO	Non-governmental organisation
NMVOC	Non-Methane Volatile Organic Compounds
NPC	National (or regional) Product Certification
PCF	Product Carbon Footprint
PEFC	Programme for the Endorsement of Forestry Certification
PE	Polyethylene (plastic)
PER	Primary Energy Ratio
PET	Polyethylene Terephthalate (plastic)

[13] The Hotel Energy Solutions (HES) project has received co-funding from the Intelligent Energy Europe Programme of the European Union. The content and results of the project are the sole responsibility of the HES partners and can under no circumstances be regarded as reflecting the position of the European Union.

pkm	Passenger-kilometre
PP	Polypropylene (plastic)
PS	Polystyrene (plastic)
PV	Photovoltaic
PVC	Polyvinyl Chloride (plastic)
PRSV	Pre Rinse Spray valve
RA	Rainforest Alliance
RE	Renewable Energy
RFI	Radiative Forcing Index
RLF	Red-listed fish
RSPO	Round Table on Sustainable Palm Oil
RTRS	Round Table on Responsible Soy
SAC	Special Areas of Conservation (EC Habitat's Directive)
SCBD	Secretariat for the Convention on Biological Diversity
SEA	Strategic Environmental Assessment (regional plans)
SEER	Seasonal Energy Efficiency Ratio
SME	Small and Medium Enterprise
SPA	Special Protection Areas (EC Bird's Directive)
SRA	Sustainable Restaurant Association
SRD	Sectoral Reference Document
TOI	Tour Operators' Initiative for Sustainable Tourism Development
TSG	EC Tourism Sustainability Group
TWG	Technical Working Group
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNWTO	United Nations World Tourism Organisation
UV	Ultra Violet
WBSCD	World Business Council for Sustainable Development
WW	Wastewater
WWF	World Wildlife Fund
WWTP	Wastewater Treatment Plant

ANNEX 1: EUROPEAN BUSINESS AND BIODIVERSITY CAMPAIGN BIODIVERSITY CHECK CRITERIA FOR TOURISM ORGANISATIONS

	Biodiversity criteria	Questions	Key data /Indicator for Tourism /Tour Operators	Source for key data /indicator
1.	Strategy / Management	Management /Governance	Grey lines = Priority Indicators White lines = Can Indicators	
A	In general	Why is biodiversity a significant environmental and / or business aspect for your company?	Clear committment towards integration of biodiversity into business (e.g. Sustainability/Biodiversity part of the code of conduct)	Sustainability Report /Environmental Policy /Code of Conduct of company
		Are you using an Environmental Management System? Is biodiversity a relevant aspect in this management system?	Environmental Programme /Sustainability Programme includes quantified (if possible) biodiversity targets	EMAS /ISO 14001 Environmental Programme. Sustainability Programme
		What are the targets regarding biodiversity in your current environmental programme?	% of biodiversity related measures of total measures in Environmental Programme /Sustainability Strategy	EMAS /ISO 14001 Environmental Programme. Sustainability Programme
		Do you identify potential adverse impacts on ecosystem services and biodiversity in your activities and do you take measures to eliminate or minimize these impacts?	Environmental Impact Assessments include explicitly biodiversity parameters. Own monitoring system in place to monitor and evaluate potential and real impacts on biodiversity	Index of EIAs conducted. Results of own monitoring
		Where do you see risks in terms of biodiversity ?	Economic Valuation of Ecosystem services; internalization of cost of biodiversity impact caused	Companies own scheme to valuate the economic value of ecosystem services
		Where do you see opportunities in terms of biodiversity management?	Economic Valuation of Ecosystem services	Companies own scheme to valuate /quantify the economic value of ecosystem services
		Do you check your suppliers' biodiversity involvement?	Procedure in place to check environmental quality of suppliers- including involvement regarding biodiversity. Procurement rules in place supporting the procurement of more sustainable products or services	Companies procurement rules /criteria
B	Habitat changes	What is you management approach to avoid the loss of biodiversity, to restore biodiversity? If prevention or restoration are not possible or fully effective, do you compensate losses through actions that will lead to a net gain in biodiversity services over time?	Biodiversity Balance: Comparison of biodiversity losses and biodiversity net gain of compensation measures	Companies own statistics
C	Endangered species	Do you take any measures to preserve any endemic or endangered species or habitat that may be adversely affected?	Compliance with nature protection legislation /environmental legislation. Coorperation with NGOs regarding preservation of biodiversity	Source for key data: Code of conduct / (Group) Strategy / (Group) Biodiversity Strategy
		Do you avoid approaches that threaten the survival or lead to the global, regional or local extinction of species?	Compliance with nature protection legislation /environmental legislation. Coorperation with NGOs regarding preservation of biodiversity	Source for key data: Code of conduct / (Group) Strategy / (Group) Biodiversity Strategy
E	Access and Benefit Sharing	Do you have a strategy / programme to guarantee the fair and equitable sharing of benefits arising from the use of natural resources?	ABS-Strategy or programme in place (yes /no).	Source for key data: Code of conduct / (Group) Strategy / (Group) Biodiversity Strategy
2.	Stakeholder			
	All relevant areas	Do you collaborate with international organizations and / or scientific institutions to address biodiversity aspects on a global level?	Identification of competent international organisations /scientific institutes (yes/no). Number of projects /initiatives with stakeholders	Companies own data (list of stakeholders, agreements, project reports)
		Do you collaborate / communicate with residents, NGOs, investor groups, local or regional administrations or scientific institutions to address biodiversity aspects on a local level?	Identification of competent national/local organisations /scientific institutes (yes/no). Number of projects /initiatives with stakeholders	Companies own data (list of stakeholders, agreements, project reports)
		Do you report on any biodiversity aspect (i. e. to your clients, to local communities, local interest groups)?	Stakeholder identified. Publication of reports with reference to biodiversity yes/no. GRI-Standards fulfilled yes/no	List of stakeholders, GRI - Certification
		Are you member of any initiatives or think tanks that address biodiversity issues? If yes, which one, and what is your role?		Companies own sources
		Do you receive feedback from stakeholders and /or the public regarding your engagement /impact on biodiversity? Do you consider this feedback?	Possibility for feedback has been established. Process in place to respond to feedback from stakholder	Companies own documentation of communication with stakeholders
3.	Headquarters / estate			
A	In general	How is biodiversity related to your headquarters / facility and estate management?	Number of biotopes and % of natural gardening at companies own premises	Inventory of biotopes (if necessary with support of NGOs), companies own data
A			ha /m^2 of sealed /urbanized land in relation to production (economic value, quantity)	Companies own data

B	**Habitat changes**	Does your company have any location and sites of land owned, leased, managed in, or adjacent to that is located in protected areas or areas of high biodiversity value or areas next to protected areas?	ha of sites adjacent to (≤ 5m) or included in protected areas	Companies own data
		Does your company incorporate the protection of natural habitat, wetlands, forest, wildlife corridors, protected areas and agricultural lands into the development of buildings and construction works?	ha /qm of natural land and/or intact biotopes in relation to total companies premises	
C	**Endangered species**	Do you investigate if there are endangered species (IUCN Red List and National Conversation List) in the areas affected by your operations? If yes, which one?	Number of species of the IUCN Red List Index; FFH-Directive (Annex I - IV) at companies own premises	Inventory /Field mapping together with local NGO
D	**Neobiota (Not native species)**	Did the construction of new sites influence the migration of Neobiota (not native species)?	Number of neobiota species, extension (in ha/m^2) of neobiota plants at companies own premises	Inventory /Field mapping together with local NGO
	Exploitation of natural resources / energy and water consumption	Does water consumption of the company lead to any risk of drying out rivers, lakes, wetlands and/or water shortage for local population?	Environmental Impact assessment taking into consideration impacts of climate change. Monitoring system in place	
		Are there any activities of restoration / reforestation to compensate the exploitation of resources?	Ha /qm of restored habitats or reforested area. Comparision to surface of damaged habitat	Companies statistics, ISO /EMAS Environmental Report
		Water consumption and waste water production of buildings	Yearly water consumption /yearly waste water volume; level of treatment of waste water	Companies statistics, ISO /EMAS Environmental Report
		Production of waste /harzours waste in buildings	Yearly waste production / % of recycled waste in comparision to total volume	Companies statistics, ISO /EMAS Environmental Report
4.	**Supply chain (Accomodation, recreational activities)**		**Key data or indicator**	**Source of data**
A	**In general**	How is biodiversity related to your supply chain and/or to your procurement processes?	% of (regional) products (accomodation, recreational activities, food etc.) with certification (ecolabel and/or EMS)	Companies Procurement Policy and criteria. Companies own statistics
A			Special reference to labeled products in catalogues, brochures, website etc.	Companies own data; evaluation of monitoring results, feedback from stakeholders
B	**Habitat changes**	Is there any land use for tourism infrastructure /tourism services which influences biodiversity?	Number of recreational activities with risks for biodiversity offered to tourists (own activities and activities organized by suppliers). Number of accomodations in protected areas or sensitive areas. Monitoring in place (yes/no)	FFH Directive, national, regional legislation. Environmental Impact Assessment. Companies own monitoring system
		If yes, how do you compensate these activities?	Cooperation with local NGOs and/or scientific institutions in order to minimize impact of recreational activities and/or accomodation infrastructure in sensitive areas (yes/no, tpye of involvement)	Environmental Impact Assessment, Assessment of local /national NGO
C	**Endangered species**	Are there tourism infrastructure and /or services that influence the life of endangered species (in a positive and / or negative way)?	Number of recreational activities with risks for biodiversity offered to tourists (own activities and organized by suppliers). Number of accomodations in protected areas or sensitive areas. Monitoring in place (yes/no)	FFH Directive, national, regional legislation.Environmental Impact Assessment. Companies own monitoring system
			Cooperation with local NGOs and/or scientific institutions in order to minimize impact of recreational activities and/or accomodations in sensitive areas (yes/no, tpye of involvement)	Assessment of local /national NGO. Companies own monitoring system
			Information for tourists regarding protected species /illegal souvenirs	Catalogue, website, brochures
D	**Neobiota (Not native species)**		Environmental criteria for hotels and recreational infrastructures include preference to plant and protect native species (yes/no)	Environmental criteria for contracted hotels and own hotels
	Access and Benefit Sharing	Do you have a strategy / programme to guarantee the fair and equitable sharing of benefits arising from the use of natural resources in this process?	Number of agreements with local population /number of persones benefitted. Contribution to BIP per cápita from these cooperations	Companies own statistics, Local NGOs, regional administrations
	Exploitation of natural resources / energy and water consumption	Are there any activities of restoration / reforestation to compensate the exploitation of resources?	Ha of restored habitats / reforestation	Companies own statistics, Local NGOs, regional administrations
		What is the proportion of products from suppliers meeting the requirements of standards and certification schemes in terms of biodiversity? If yes, which standards and certification schemes? Which part of your procurement does it represent?	% of hotels with recognized ecolabel of total number of hotels contracted.% of providers of recreational activities with ecolabel of total number of providers	
		Do you conserve and reuse water in your own operations and stimulate water conservation within its sphere of influence?	water consumption of hotels per guest and night. Percent of hotels connected to public sewage treatment plant or own sewage treatment facility	European, national,regional legislation. Companies own estatistics
		What are your influences and activities to reduce CO_2 emissions?	energy consumption of hotels per guest and night. % of zero-emmission recreational activities in comparison to total recreational activities	European, national,regional legislation. Companies own estatistics
		What are your influences and activities in terms of overfertilization and use of pestizedes in tourism infrastructures	Reduced use of fertilizer and pesticides and/or use of biodegradable pesticides is part of the environmental criteria for contracted hotels /own hotels	Companies environmental criteria for hotels. Companies own monitoring system

6.	**Logistics and transports**			
A	**In general**	How is biodiversity related to your logistics and your transport processes?	Ecological requirements for transport suppliers in place (yes/no)	Companies procurement rules for transport suppliers
B			Information for tourists regarding alternative transport to the destination (bus, train) and public transport at the destination. Incentives to use public transport (e.g. free bus ticket)	Companies own data sources (catalogues, brochures). Companies ecological criteria for contracted hotels. Companies monitoring
		In case of any destruction, have you realized activities to reconstruct protected areas by reforestation / restoration? (Size of these areas)	Influencing /supporting local authorities regarding restoration of habitats (Ha/qm of restored habitats)	
C	**Endangered species**	Do any roads disturb the routes of "migrating species"?	km of roads adjacent to (≤ 5m) or crossing protected areas	Environmental Impact Assessment, Assessment of local /national NGO
F	**Exploitation of natural resources / energy and water consumption**	What are you doing to reduce the transport related energy demand and CO_2 emissions?	Own transport services: CO_2 emissions in comparison to legally requested standards. Other transport companies: Criteria regarding CO2 emissions yes/no	Companies own statistics. European/national/regional legislation. Procurement criteria for transport suppliers
			Number of irregularities/ accidents; level of risk of accidents	Companies own statistics: legal definition of accidents which need to be anounced to the authorities
7.	**End product / services**			
A	**In general**	How is biodiversity related to your end product properties / services?	Life-Cycle-Analysis including biodiversity for main tourism product types	Life-Cycle Analysis
8.	**Distribution / Marketing / Communications**			
	All areas	How is biodiversity related to your marketing or communication activities (e.g. using biodiversity labels as a sales argument, communication on biodiversity, etc.)	Quantity (No of pages in catalogue /brochure etc.) of biodiversity related information for tourists. Number of tourists reached. Quality of information	Companies' own information. Evaluation of NGOs. Feedback from costumers (surveys)
		Are your costumers sensitive to biodiversity issues? Is biodiversity a new driver for marketing and communication?	Regular surveys to costumers including questions related to biodiversity yes/no	Survey on tourists (in general /at the destination /in the hotel)
		Do you integrate biodiversity issues in your sustainability and / or your annual report?	Publication of biodiversity targets, measures and indicators	Sustainability Report; EMAS /ISO Environmental Report
		Other ways of communication about your activities regarding biodiversity towards costumers, stakeholders, suppliers …	Procedure /instruments in place to analize feedback related to biodiversity from costumers, stakeholder, suppliers (quality indicator)	Surveys among costumers, stakeholders, suppliers …Evaluation of feedback on website, others
10.	**HR**			
	All areas	Are there any employee volunteering projects addressing biodiversity?	Number of employees involved in volunteering projects; payed time given by the companies for employee involvement; budget (in %) for employee volunteering projects in relation to total budget	Companies own statistics; Environmental Report;
		Are there any employee programs in terms of transport and business trips that contribute to reduce emissions, energy and other environmental impacts on biodiversity?	Quality Indicator: Feedback from employees on communication on biodiversity /companies initiatives for biodiversity protection. Source: surveys, analysis of comments	Surveys among employees; analysis of comments
		Have you developed employee training programmes including biodiversity issues related to their position or to the activities of your company?	Number of employees of suppliers trained (e.g. suppliers of recreational activities). % of free lance guides with certification	Companies own statistics; Environmental Report;