9 CAMPSITES

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 grey water or waste water 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 grey water 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
Waste water management	– Send waste water to a municipal waste water treatment plant providing at least secondary treatment (section 3.3) – Install an on-site waste water 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 particularly 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.

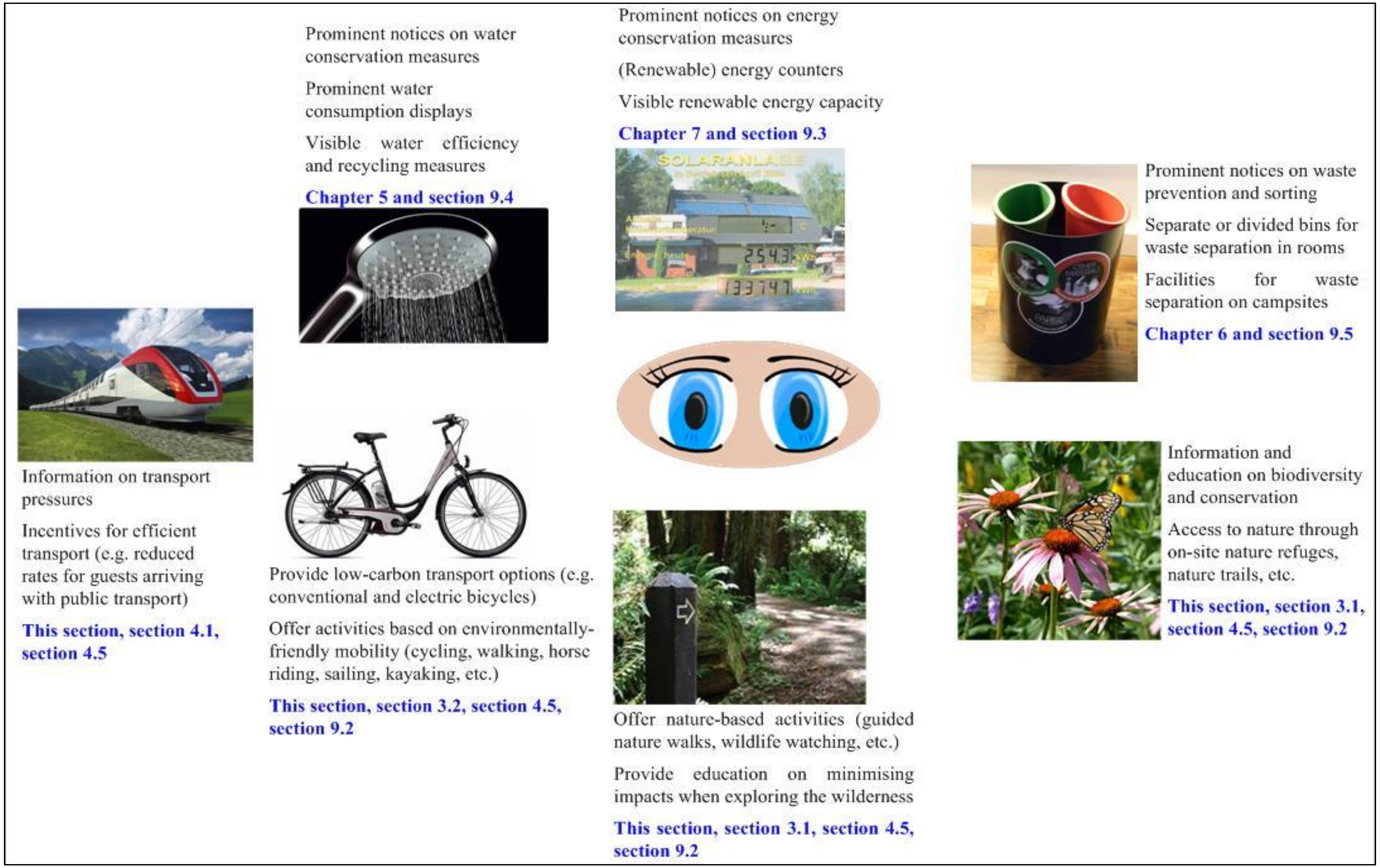


Figure 9.1: Aspects of environmental education for guests in campsites and other accommodation types, and sections of this document addressing them

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 Ecolabel 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 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 waste water 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

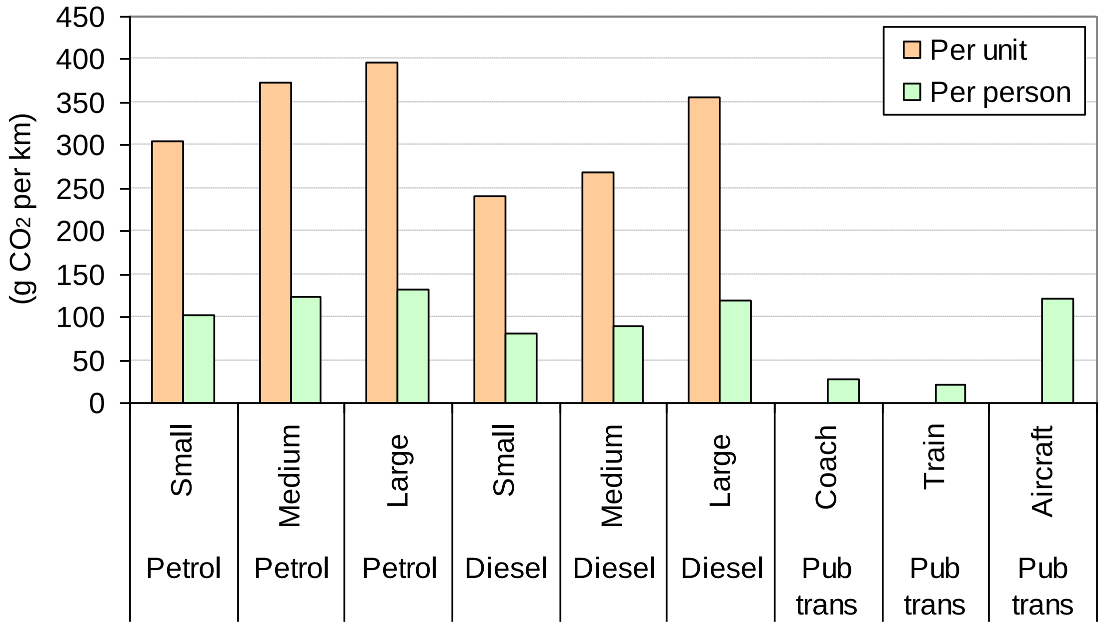
In addition to this, the provision of clear information to guests regarding the efficiency of different forms of transport (e.g. Figure 9.3 and Figure 4.4 in section 4.1) may be useful in influencing behaviour. The most effective locations for such information are brochures and booking websites, to advise 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 journeys are on average considerably shorter than flight journeys. 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).	

Local transport and mobility

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

Minimising impacts when exploring the wilderness

Tourists may cause significant damage to wilderness areas when exploring (e.g. camping expeditions). 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 artefacts. – 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 behaviours, 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 hectare 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 hectare grounds.

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).

References

- 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 principles 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, centred 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 (grey water 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 refuges – 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 / grey water 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 grey water 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 substrates 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 – Grey water 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 ground 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

Indicators

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 efficiency (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 efficiency (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 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 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 grey water 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.

Grey water (and treated black water 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:

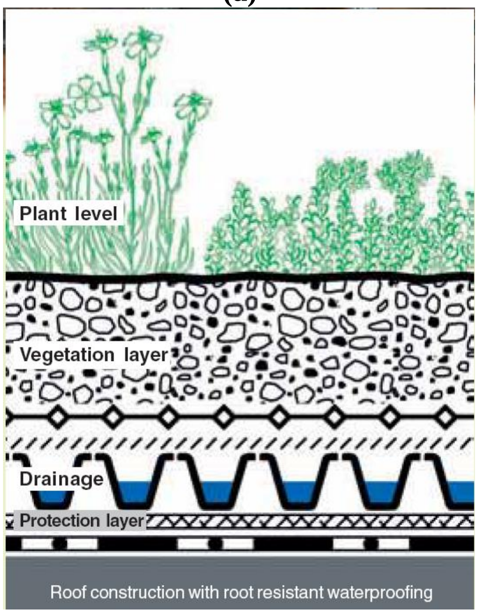
- all non-native aquatic plants, especially water hyacinth (*Eichhornia crassipies*), giant salvinia (*Salvinia molesta*) and water cabbage (*Limnocharis flava*);

- 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>

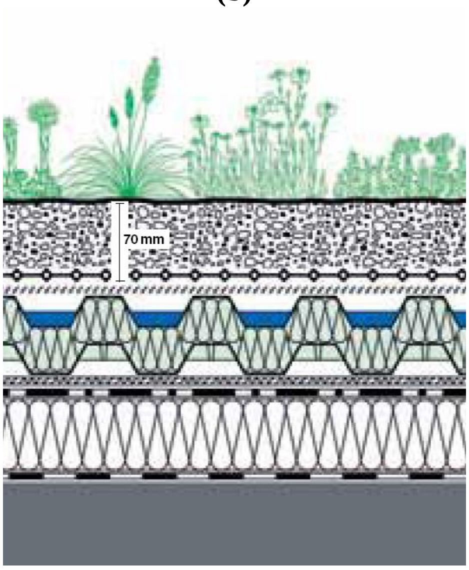
A green roof comprises a waterproofing layer laid onto the underlying roof structure. Then a perforated drainage layer with reservoir capability is constructed, followed by a filter layer including soil loading and plantings (Figure 9.8).

(a)



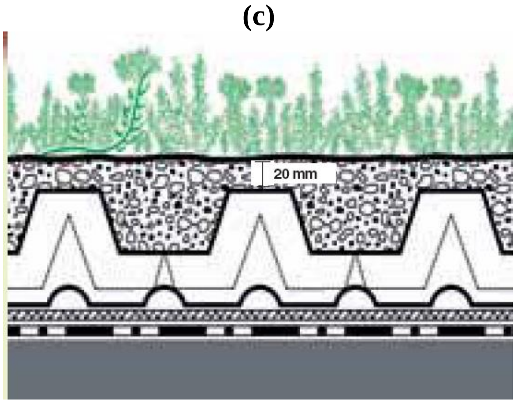
Total build-up height: 100 mm
Weight (saturated): 108 kg/m^2
Water storage capacity: 36 L/m^2
Run-off coefficient C: 0.34

(b)



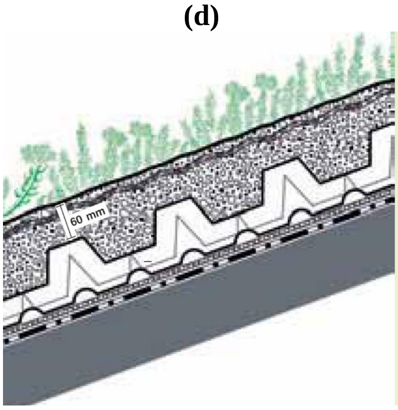
Total build-up height: 130 – 180 mm
Weight (saturated): 108 kg/m^2
Water storage capacity: 36 L/m^2
Run-off coefficient C: 0.34

(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.

<u>Natural areas and barriers</u>

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 examples 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

Irrigation

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 typical 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 grey water 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

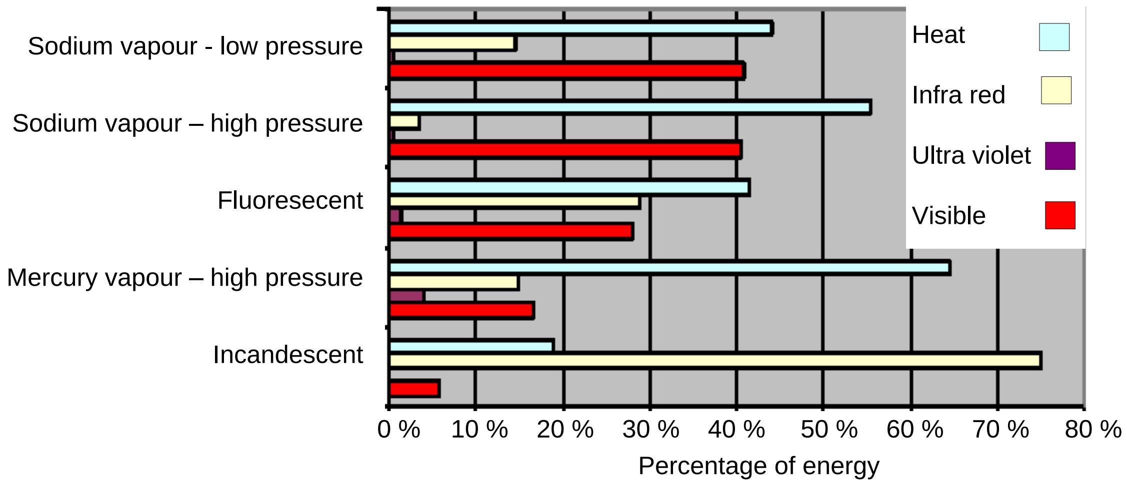
NB: Based on 0.4 L/s flow from a 20 mm valve and 0.9 L/s flow from a 25 mm valve.
Source: Irrigation Tutorials (2012).

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 grey water 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).

<u>Lighting</u>
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.
- Grey water irrigation systems require a separate grey water 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 difficult 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 grey water 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 described 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 propagated and nurtured 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.

References

- Accor, Accor hotels environment charter: practical guide, Accor, 2007, France.
- ASHRAE, Advanced energy design guide for highway lodging, ASHRAE, 2009, Atlanta. ISBN 978-1-933742-61-8.
- Ballynahinch Castle hotel, Playing our part, webpage accessed March 2012: http://www.ballynahinch-castle.com/playing-our-part
- Bauder, Green and biodiversity roofs, webpage accessed March 2012: http://www.bauder.co.uk/green-roofs/biodiversity-roofs
- Bohdanowicz, P., Martinac, I., Determinants and benchmarking of resource consumption in hotels – Case study of Hilton International and Scandic in Europe, Energy and Buildings, Vol. 39 (2007), pp. 82 – 95.
- Brown Roofs, Creating Brown Roof Habitats, accessed January 2011 from: http://www.brownroofs.co.uk
- 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.
- EC, technical report on best environmental management practice in the building and construction sector, EC IPTS, 2012, Seville. Available at: http://susproc.jrc.ec.europa.eu/activities/emas/construction.html
- Ecocamping, Ecology and Economy in Harmony: How to establish sustainability on campsites, Ecocamping, 2011, presentation made in Zadar.
- Europarc Federation, personal communication January 2012.
- Gustems, L., Tots els éssers vius necessiten la nit, presentation September 2009, Club EMAS
- Hub pages, Light pollution webpage, accessed March 2012: http://kerryg.hubpages.com/hub/Light-Pollution
- Irrigation Tutorials, website accessed April 2012: http://www.irrigationtutorials.com/dripguide.htm
- IUCN, Biodiversity: My hotel in action. A guide to sustainable use of biological resources, IUCN, 2008, Gland. ISBN: 978-2-8317-1071-6.
- Nagase, A., Dunnet, N., The relationship between percentage of organic matter in substrate and plant growth in extensive green roofs, Landscape and Urban Planning, Vol. 103 (2011), pp. 230 – 236.
- Kellagher, R., Lauchlan, C., Use of SUDS in high density developments: Guidance Manua, HR Wallingford Report SR666, 2005.
- Safeguard Europe, Biodiverse Roofs, webpage accessed October 2011: www.safeguardeurope.com
- Safeguard Europe, Green roofs and turf roofs, webpage accessed October 2011: www.safeguardeurope.com
- Smith, M., Hargroves, K., Desha, C., & Stasinopoulos, P., Water transformed – Australia: Sustainable water solutions for climate change adaptation. Australia: The Natural Edge Project, TNEP, 2009. Available at: http://www.naturaledgeproject.net/Sustainable_Water_Solutions_Portfolio.aspx
- Zinco, Planning guide: Extensive Green Roofs with System, commercial brochure downloaded December 2011 from: www.zinco.de
- WBCSD, Guide to Corporate Ecosystem Valuation: A framework for improving corporate decision-making, WBCSD, 2011, Geneva. ISBN: 978-3-940388-71-1.

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.

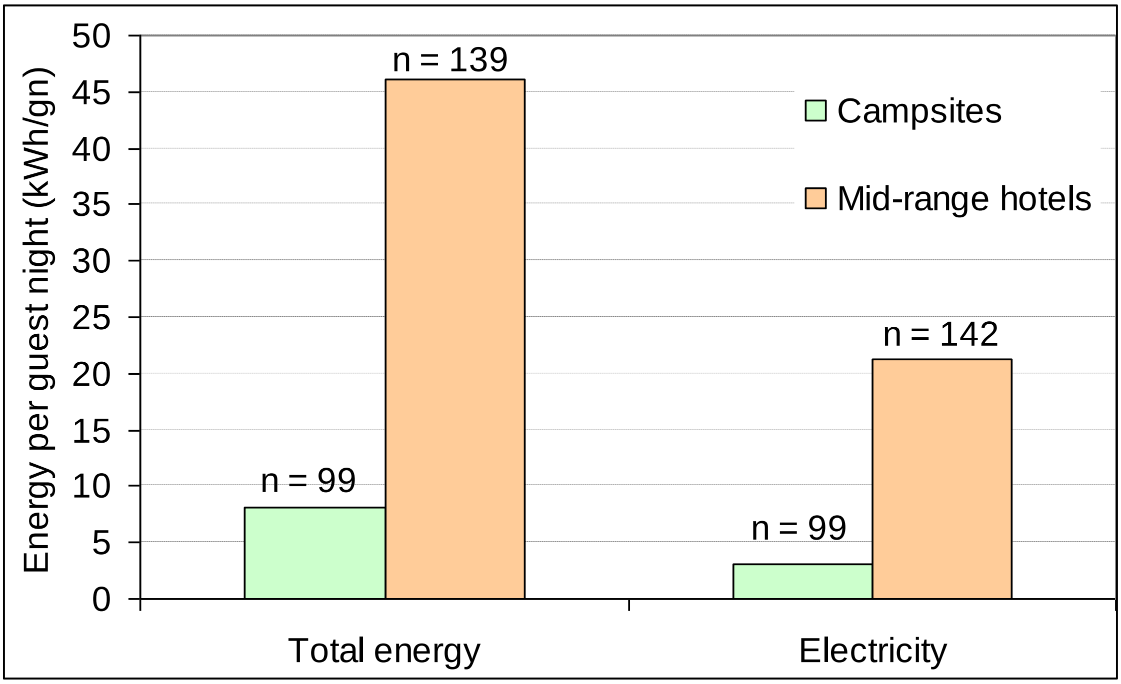


Figure 9.12: Mean total energy consumption and electricity consumption for a mid-range hotel chain and German campsites in the Ecocamping network

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 grey water heat energy recovery, which is also well suited to campsites owing to the concentration of grey water 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
	– Grey water heat recovery	Grey water 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).

Grey water heat recovery

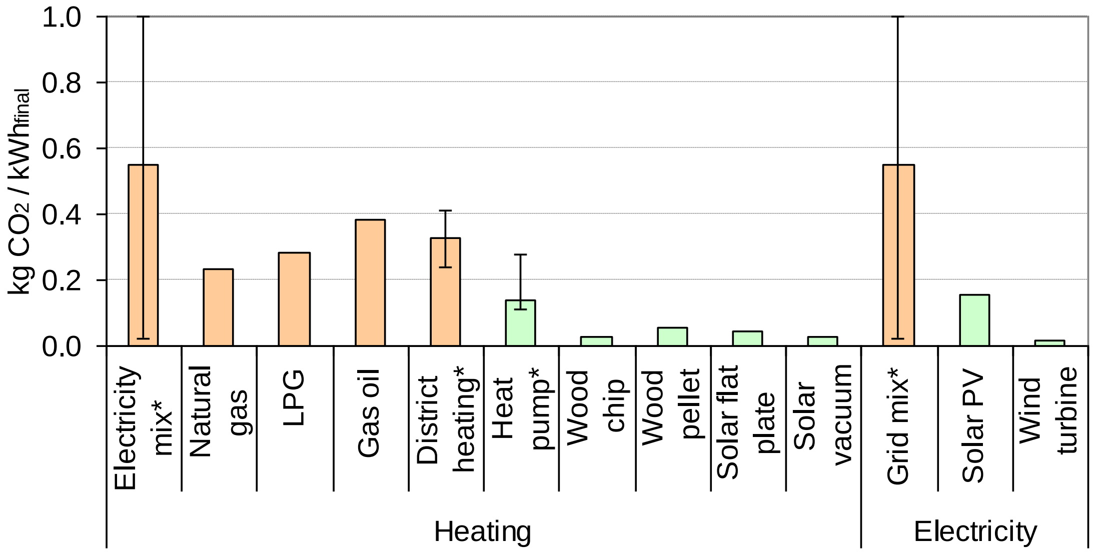
The grey water heat recovery system at the Kühlungsborn Camp, utilising an efficient heat pump, reduces gas consumption for water heating and associated GHG emissions by 40 %.

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:

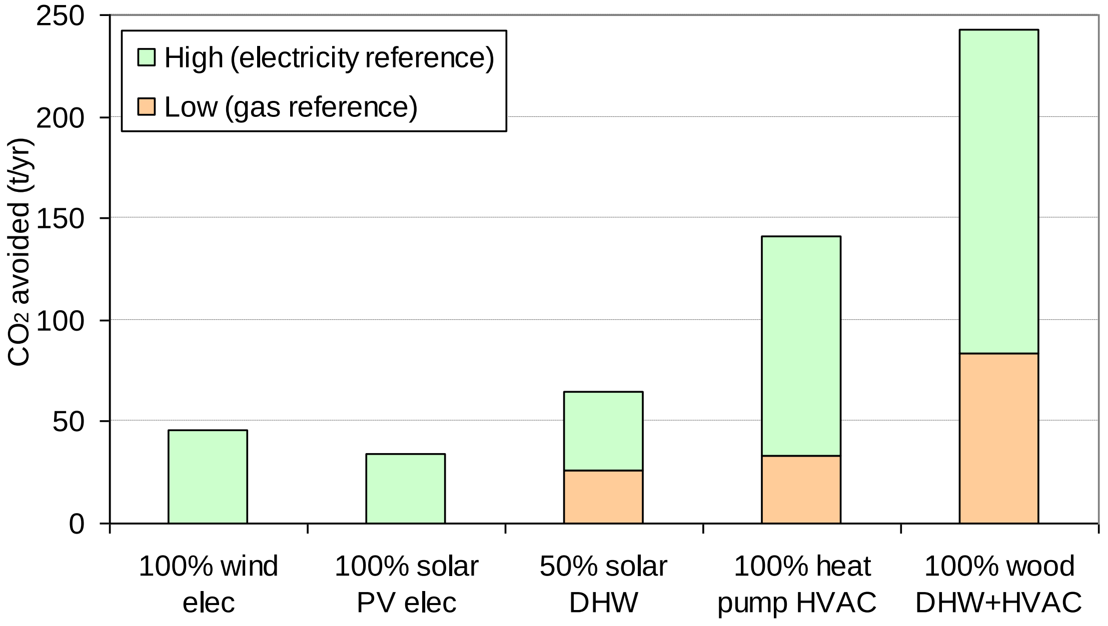
- heat pump heating 40 %
- wood chip heating 86 %
- wood pellet heating 72 %
- solar heating 77 % (flat plate) to 87 % (vacuum tube).



(*)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 calorific 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).

<u>Genuine renewable electricity</u>
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).

<u>Accounting for RE use by heat pumps</u>
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.

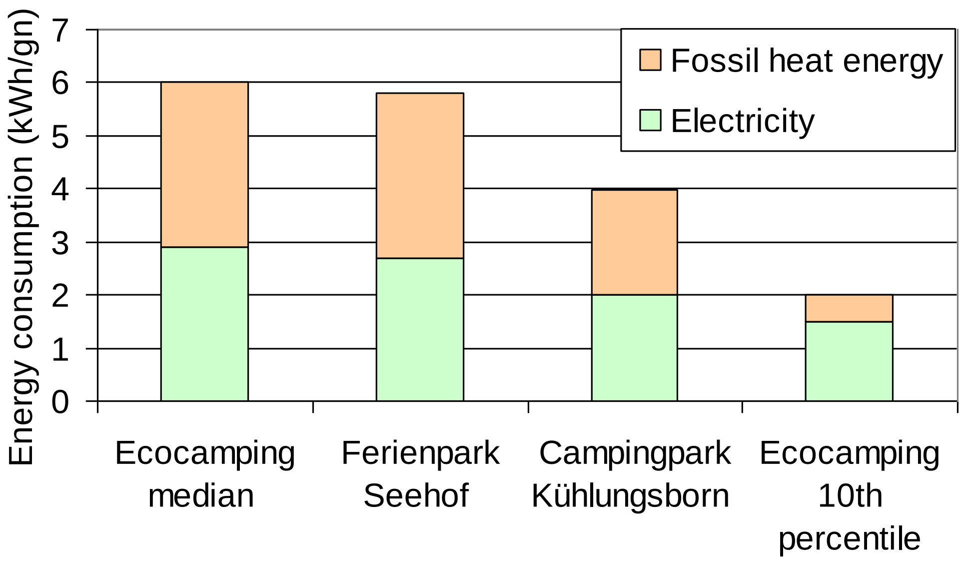
Performance indicators

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

Benchmarks of excellence

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

Energy demand reduction

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).

Alternative energy technologies

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 offsetting GHG emission savings attributable to reduced energy consumption. Air-source heat pumps also generate some noise.	Use of low GWP refrigerants. The EU Ecolabel 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

<u>Lighting</u>

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.

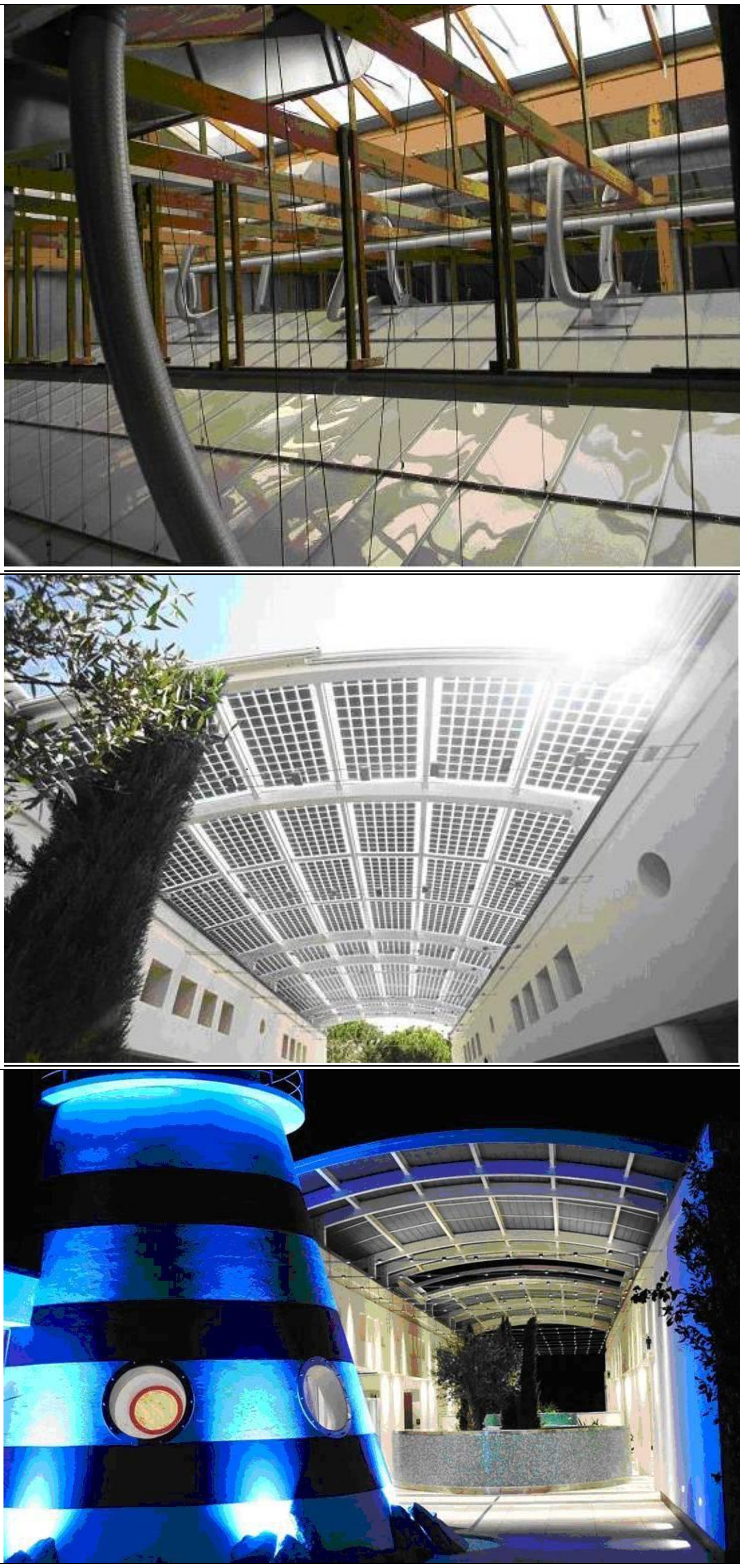


Figure 9.16: Window panels in the roof and suspended translucent ceiling allow natural light into the wash area of Kühlungsborn Campsite (above) and transluscent retractable roof of the wash area in the Jesolo International Campiste (below)

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 capacities 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).

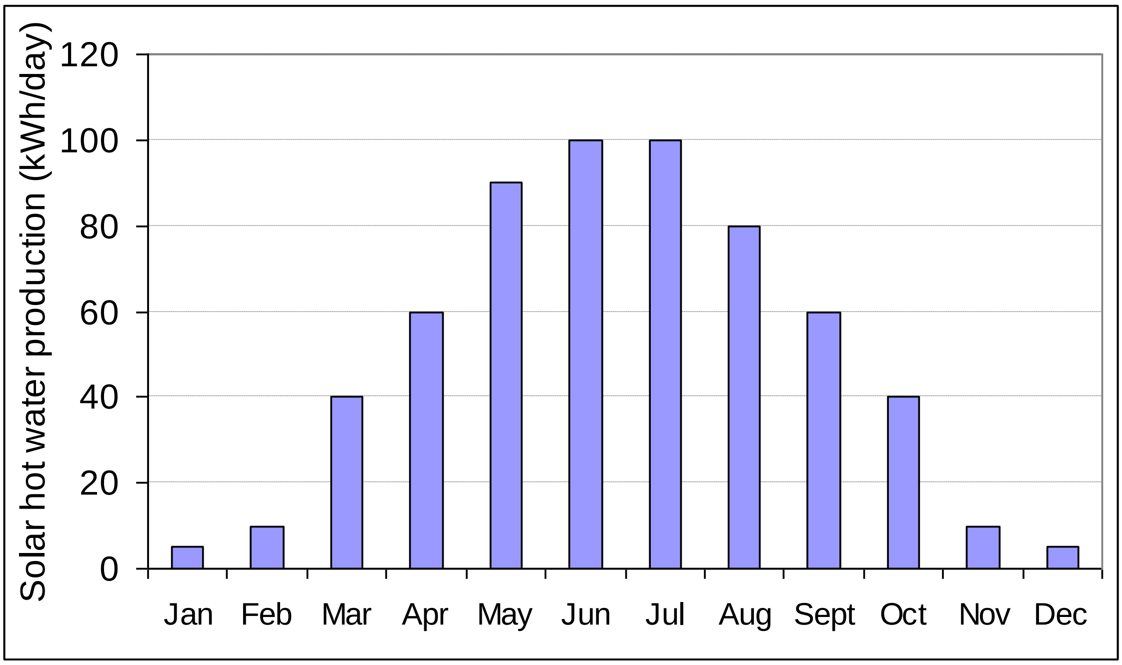


Figure 9.17: Maximum daily solar hot water production throughout the year for 41 m^2 of flat-plate solar panels installed on the east facing roof of a washroom in Seehof Campsite

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

Grey water generation in campsites is concentrated in washroom areas, facilitating the separate collection and storage of grey water for heat recovery. Heat from grey water may be recovered by passing grey water 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 grey water 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, grey water 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, grey water is filtered and pumped out to irrigate the green area.
3. Following heat transfer from grey water, 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 grey water 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.

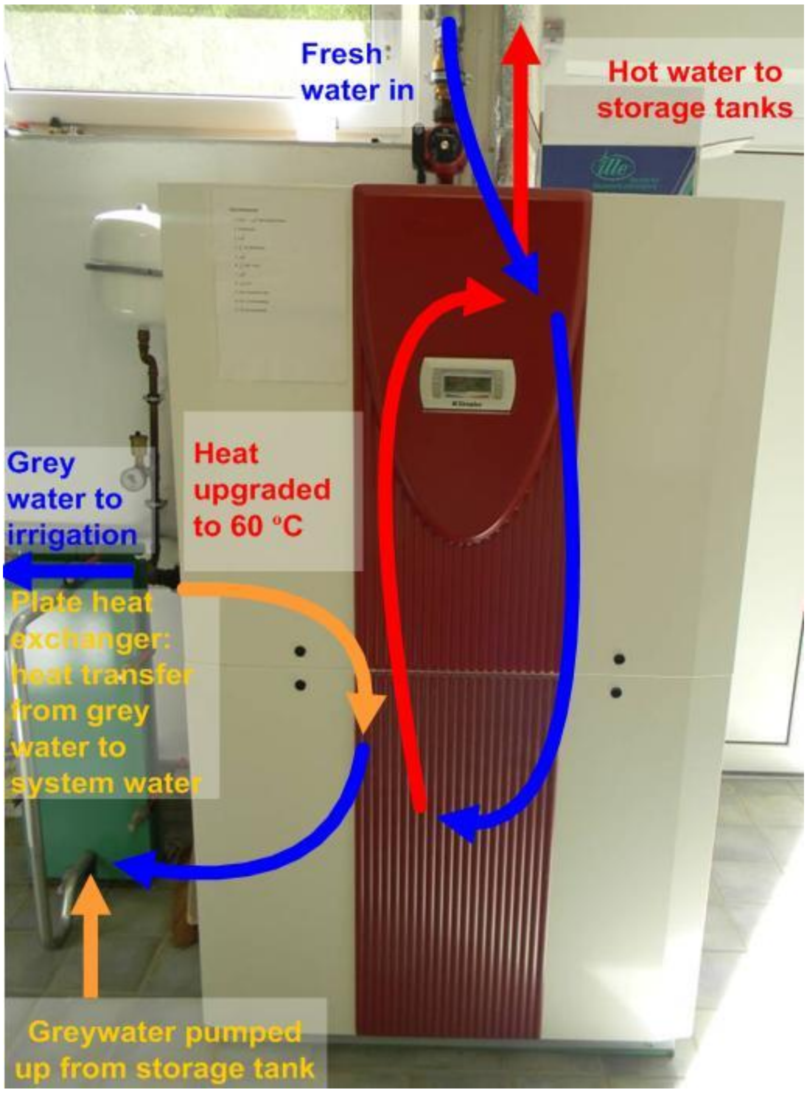


Figure 9.18: Plate heat exchanger (left) and heat pump (centre) used to extract and upgrade heat from washroom and laundry grey water to heat washroom water at Kühlungsborn Camp

<u>Renewable electricity</u>
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

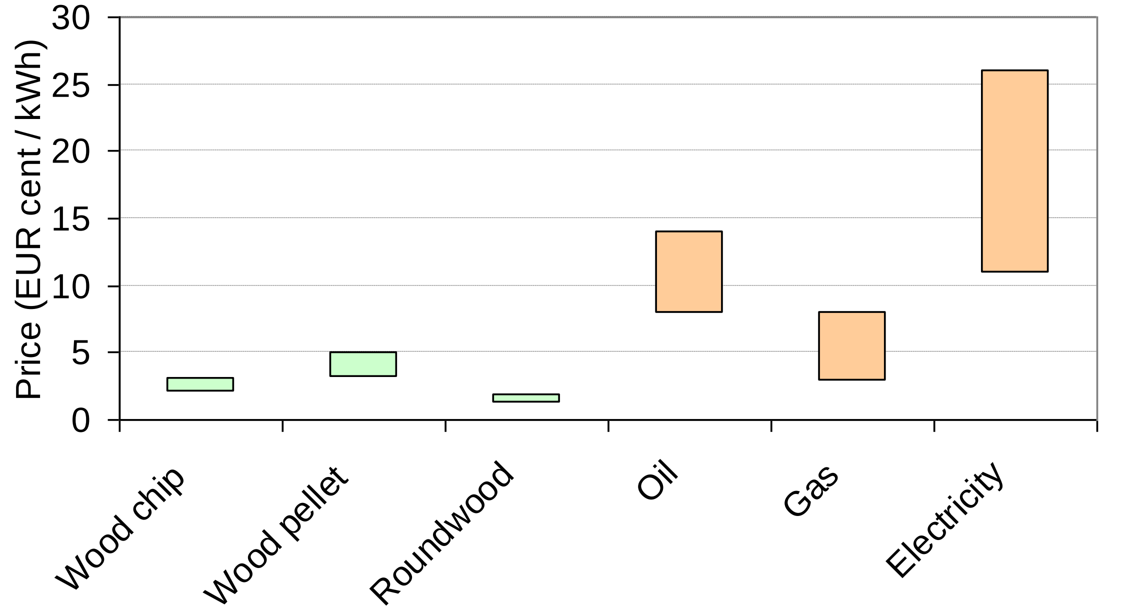
Installation of water efficient fittings is associated with short payback times (see section 9.3).

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).

References

- Ardente, F., beccali, G., Cellura, M., Lo Brano, V., Life cycle assessment of a solar thermal collector: sensitivity analysis, energy and environmental balances, Renewable Energy, Vol. 30 (2005), pp. 109-130.
- BSI, Specification for the assessment of the life cycle greenhouse gas emissions of goods and services, BSI, 2011, London. ISBN 978-0-580-71382-8.
- Carbon Trust, Making sense of renewable energy technologies: Opportunities for businesses in Northern Ireland CTG011, Carbon Trust, 2008, London.
- Carbon Trust, Biomass heating: A practical guide for potential users, Publication CTG012, Carbon Trust, 2009, London.
- DEFRA, 2011 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting,DEFRA, 2011, UK
- EC, Directive 2009/28/EC of the European Parliament and of the council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, OJEU, L 140/16.
- Ecocamping, Der klimafreundliche Campingplatz Leitfaden zum betrieblichen Klimaschutz im Campingunternehmen, Ecocamping, 2010, Konstanz.
- Ecocamping, personal communication June 2011.
- Ecocamping, Ecology and Economy in Harmony: How to establish sustainability on campsites, Ecocamping, 2011, presentation made in Zadar.
- Ecotrans, Environmental initiatives by European tourism businesses: Instruments, indicators and practical examples. A contribution to the development of sustainable tourism in Europe, Ecotrans, 2006, Stuttgart.
- Energy.eu, Europe's Energy Portal fuel price website, accessed October 2011: www.energy.eu/
- EPED, European Platform for Electricity Disclosure calculation methodology, webpage accessed February 2012: http://www.eped.eu/portal/page/portal/EPED_HOME/Methodology
- ESTIF, CEN Keymark Scheme for Solar Thermal Products, European Solar Therma Industry Federation webpage accessed May 2012: http://www.estif.org/solarkeymarknew/index.php
- GEMIS, Global Emission Model for Integrated Systems, Version 4.5 (2005).
- ITP, Environmental Management for Hotels. The industry guide for sustainable operation (3rd edition), ITP, 2008, UK.

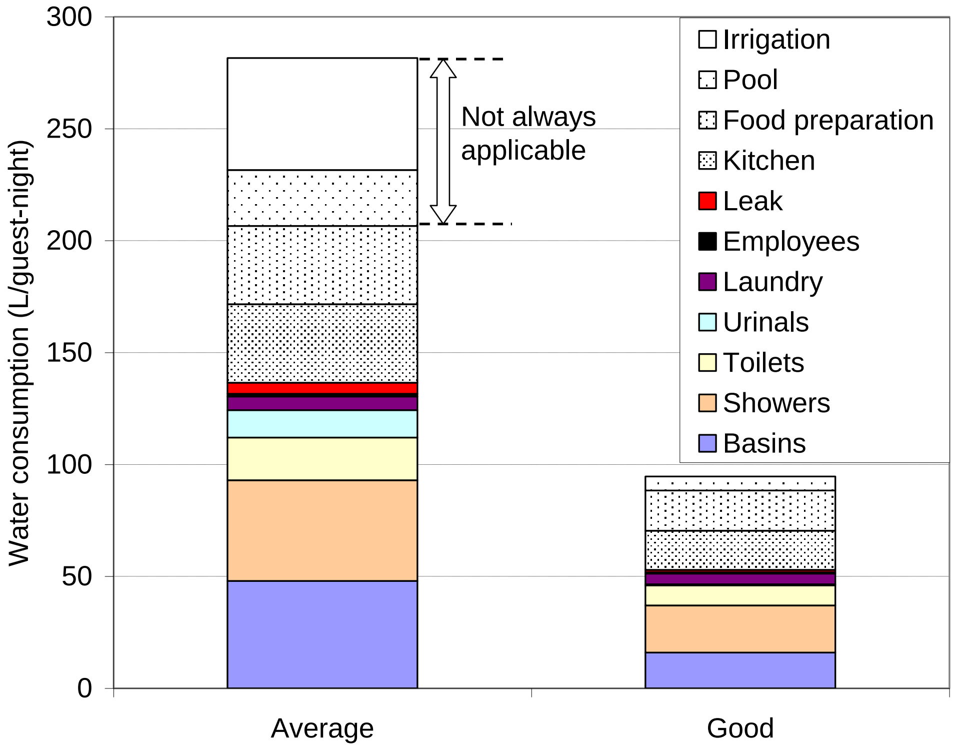
- Kühlungsborn Campsite, personal communication June 2011.
- Passivehaus Institute, 2010, The Passive House Planning Package, available at http://www.passipedia.org
- SEAI, Domestic solar systems for hot water: A Consumer Guide, SEAI, 2010, Ireland. Accessed October 2011: http://www.seai.ie/Renewables/Solar_Energy/Domestic_solar_systems_for_hot_water_Consumer_Guide_2010.pdf
- SEAI, Solar benefit calculator, accessed October 2011: http://www.seai.ie/Renewables/Solar_Energy/Solar_Heating_at_Home/
- Seehof Campsite, personal communication June 2011.
- Uhlenköper Campsite, personal communication June 2011.

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 waste water 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).

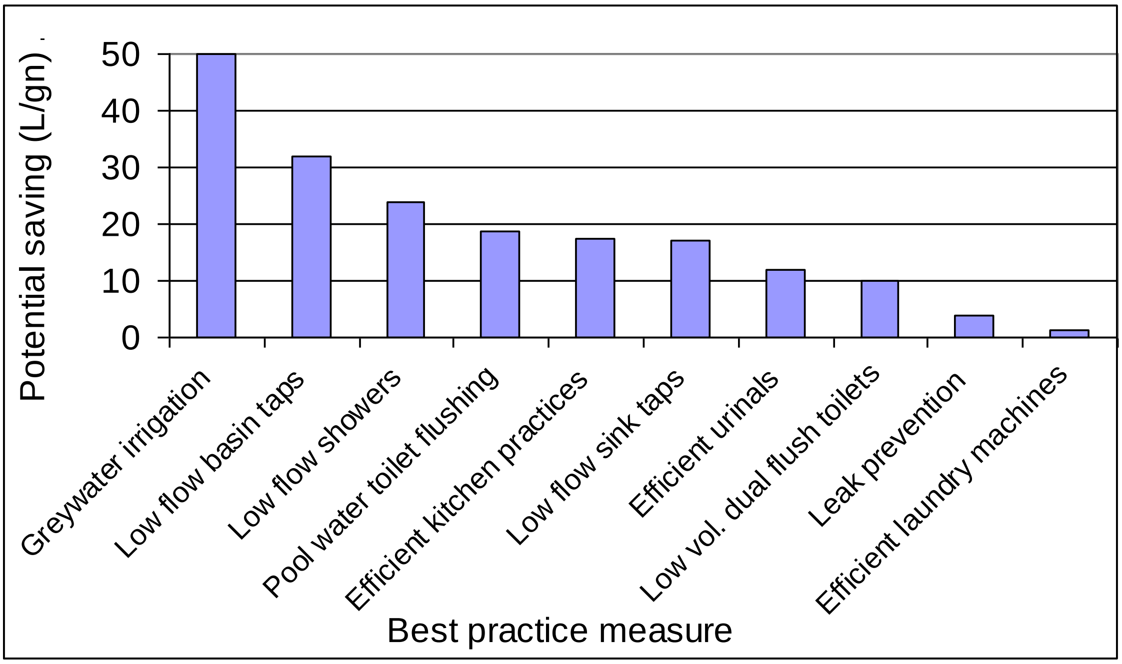
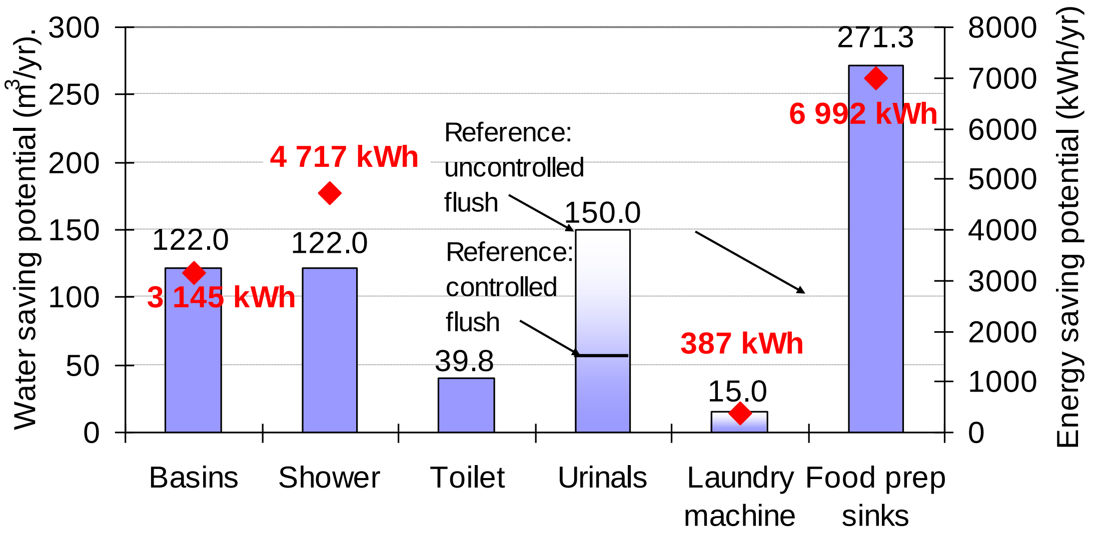


Figure 9.22: Potential water savings expressed per guest-night across best practice measures for a four-star (ADAC classification) campsite

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 campsites 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).

References

- ADAC, Classification of the sanitary equipment [for campsites], ADAC, 2004, Germany.
- Accor, Sustainable development: International Guidelines Construction & Refurbishment, Accor, 2008, Paris.
- Bristan, Technical data sheet: flow limiters, Bristan, 2011 http://www.bristan.com/WebRoot/BristanDB/Shops/Bristan/Products/WEB_DATA-1057911-1-D3-1.PDF
- Business Link, Water resource webpage, accessed October 2011: http://www.businesslink.gov.uk/bdotg/action/detail?itemId=1082900820&type=RESOURCES CEIR, CT1 working group summary of existing and proposed standards relevant to the water efficiency of fittings, CEIR, 2011.
- Challis, Water widget universal shower aerator, Callis, 2011 http://www.alchallis.com/products/water/documents/UniversalShoweraerator.pdf
- Culu, Waterless Urinals webpage, accessed November 2011: http://www.culu.eu/wasserlose-urinale/
- DEFRA, Water Technology Guide, accessed October 2011: http://wtl.defra.gov.uk/technology.asp?technology=00030004&sub-technology=000300040003&partner=&section=66&submit_=Search&page=8&tech=000300040003
- EC, Study on water performance of buildings, DG ENV, 2009, Brussels.
- Ecocamping, Ecology and Economy in Harmony: How to establish sustainability on campsites, Ecocamping, 2011, presentation made in Zadar.
- Ecocamping, personal communication June 2011.
- Ecosys, Hospitality H2O: water efficiency guide, Ecosys, 2007, Kent. Available at: http://www.ecosys.org.uk/docs/water_efficiency07.pdf
- Ecotrans, Environmental initiatives by European tourism businesses: Instruments, indicators and practical examples. A contribution to the development of sustainable tourism in Europe, Ecotrans, 2006, Stuttgart.
- Environment Agency, Conserving water in buildings: a practical guide, Environment Agency, 2007, Bristol UK.
- Envirowise, Reducing water use: showers, Envirowise, 2007, Didcot UK.
- Green Building Store, Water-efficient sanitary ware ES4 WC and Airflush waterless urinal, Green Building Store, 2009, UK. Accessed October 2011: http://www.greenspec.co.uk/html/product-pages/ifoceraES4.php
- Grohe, Showerheads home page, Grohe, accessed October 2011: http://www.grohe.com/uk/4768/showers/head-side-showers/
- Plumbing Supply Services, product catalogue webpage accessed October 2011: http://www.plumbingsupplyservices.co.uk/acatalog/Low_Flush_WC_s.html

- Smith, M., Hargroves, K., Desha, C., & Stasinopoulos, P., Water transformed – Australia: Sustainable water solutions for climate change adaptation. Australia: The Natural Edge Project, TNEP, 2009. Available at: http://www.naturaledgeproject.net/Sustainable_Water_Solutions_Portfolio.aspx.
- UK Government, The Water Supply (Water Fittings) Regulations 1999 No. 1148, Her Majesty's Stationary Office, 1999, UK.
- Waterless Urinals, Homepage, accessed October 2011: http://www.waterlessurinals.co.uk/conversion_products/
- Waterwise, Homepage, accessed October 2011: www.waterwise.org

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 campsites (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.

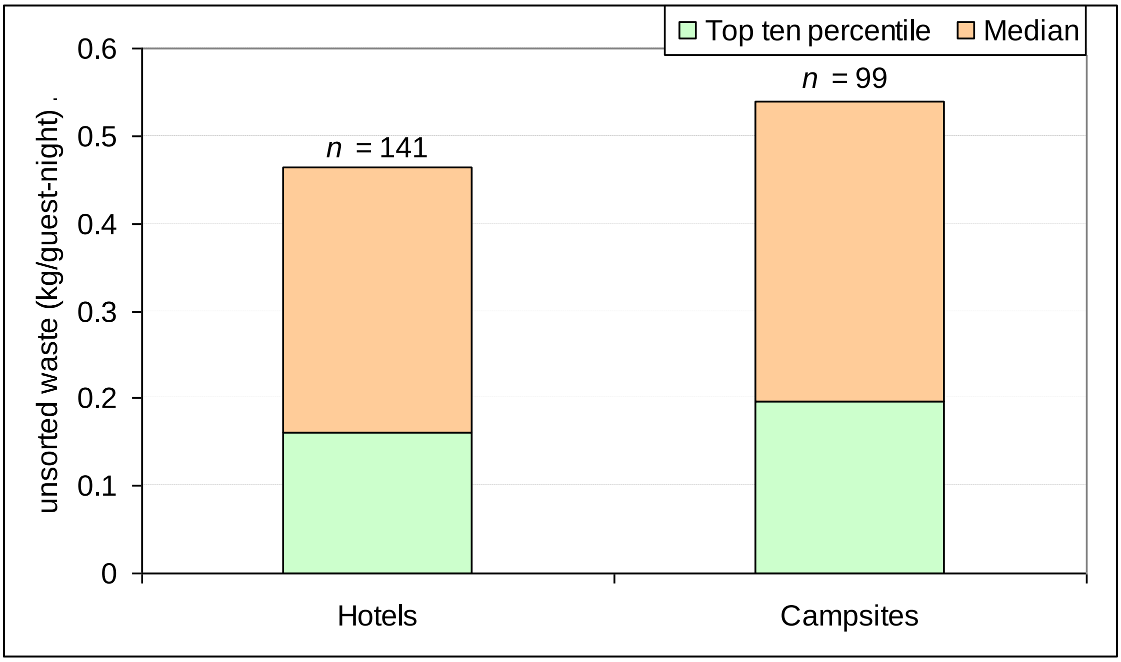


Figure 9.25: Median and top ten-percentile unsorted waste generation for good performing mid-range hotels and Ecocamping campsites

As described in section 6, waste minimisation requires implementation of a comprehensive waste management plan based on priorities defined in the waste management hierarchy (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.

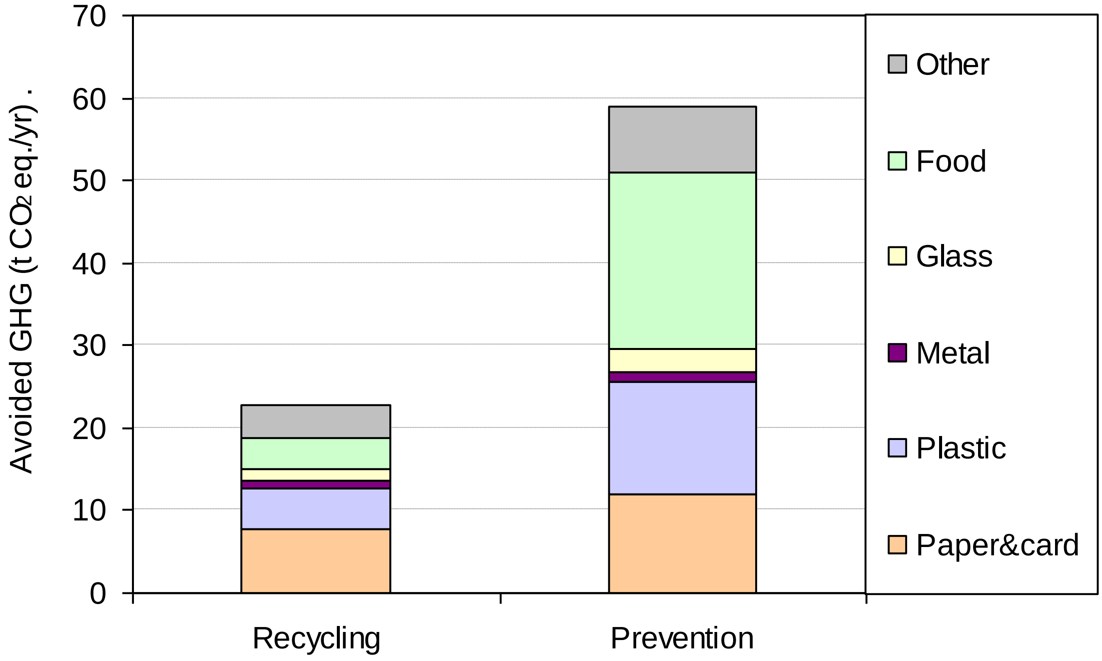
Table 9.22 quantifies the reductions in GHG emissions attributable to the prevention and recycling, respectively, of various waste fractions. In addition, each kg of organic waste sent to anaerobic digestion with energy recovery avoids 0.35 kg CO_2 eq. from waste management and displaced energy generation. 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 technical report 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.

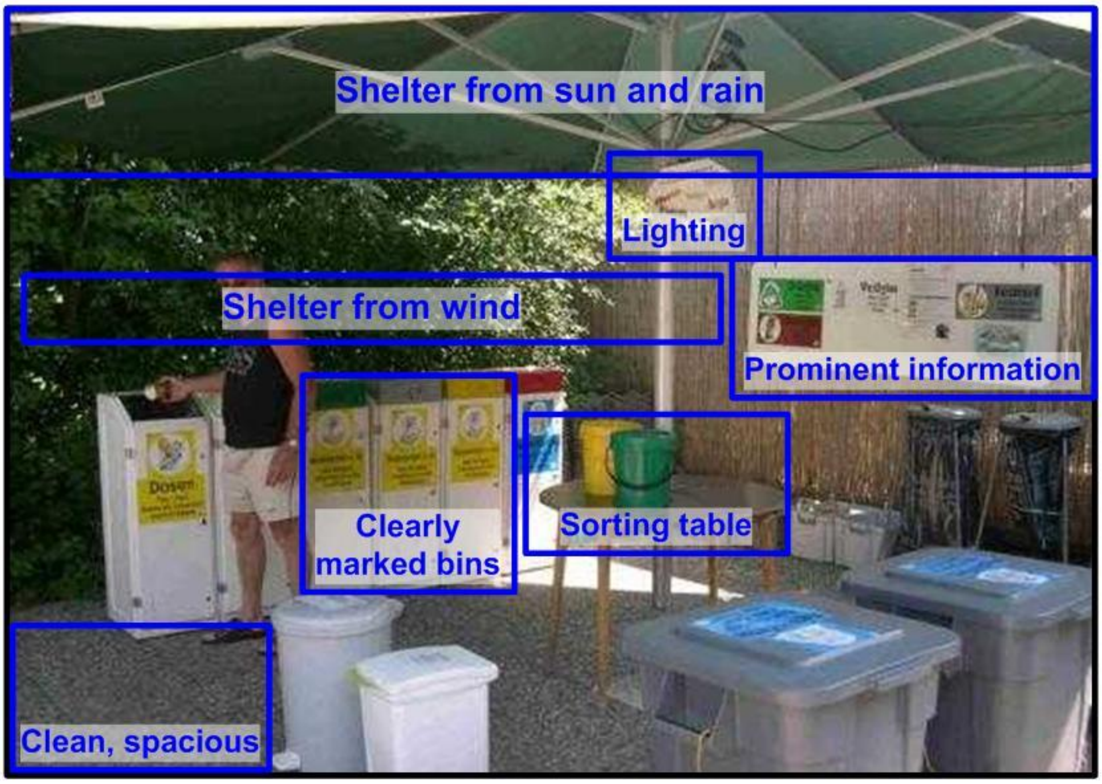
Separating plastic waste fractions

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 signage 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 Ecolabel. 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.

References

- British Plastics Federation, Homepage, accessed October 2011: http://www.bpf.co.uk/Sustainability/Plastics_Recycling.aspx
- Compost Doctors, Homepage, accessed October 2011: http://www.crn.org.uk/compostdoctors/index.htm
- DEFRA, Guidelines for GHG conversion factors for company reporting, version 2, DEFRA, 2009, UK.
- DEFRA, Disposal of waste food by retail premises under the Animal By-Products Regulation (ABPR), DEFRA, 2011, London UK. Accessed at: https://www.gov.uk/dealing-with-animal-by-products
- Demesne, webpage accessed October 2011: http://www.demesne.info/Sustainable-Living/Plastics-Recycling.htm
- Dinkel, Oekologischer Nutzen des PET-Recycling Schweiz, Dinkel, 2008, Switzerland. Available at: http://ww.petrecycling.ch
- EC, technical report on best environmental management practice for the retail trade sector, EC (IPTS), 2011, Sevilla. Available to download from: http://susproc.jrc.ec.europa.eu/activities/emas/retail.html
- Ecocamping, Ecology and Economy in Harmony: How to establish sustainability on campsites, Ecocamping, 2011, presentation made in Zadar.
- Ecocamping, personal communication June 2011.
- Ecotrans, Environmental initiatives by European tourism businesses: Instruments, indicators and practical examples. A contribution to the development of sustainable tourism in Europe, Ecotrans, 2006, Stuttgart.
- Eggleston, S., Buendia, L., Miwa, K., Ngara, T., Tanabe, K., IPCC Guidelines for National Greenhouse Gas Inventories. Waste. IPCC National Greenhouse Gas Inventories Programme vol. 5, Institute for Global Environmental Strategies, 2006, Kanagawa, Japan.
- ETC/SCP, Europe as a Recycling Society. The European Recycling Map. Working paper 5/2010, ETC/SCP, 2010, Copenhagen Denmark.
- Kühlungsborn Campsite, personal communication June 2011.
- Öko-Institut, Comparative Life Cycle Assessment of various Cup Systems for the Selling of Drinks at Events, Öko-Institut, 2008, Vienna, Basel, Darmstadt.
- Seehof Campsite, personal communication June 2011.
- Uhlenköper Campsite, personal communication June 2011.

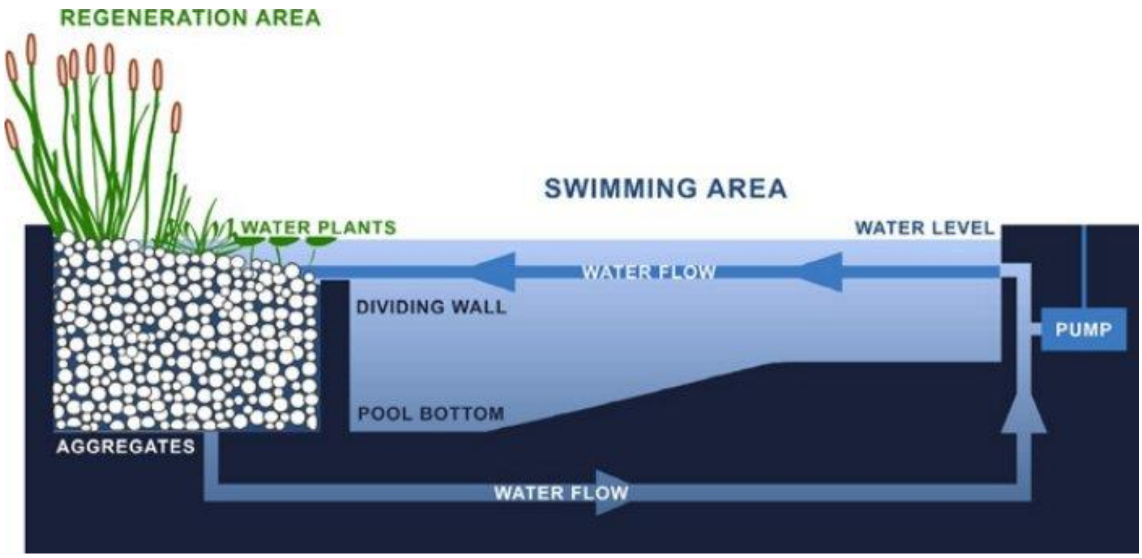
- Waste Care Corporation, Trash compactors, balers, recycling equipment, industrial shredders and grinders, waste equipment and other waste related products and services: http://www.wastecare.com/Articles/Waste_Reduction_Recycling_Tips_Hotels.htm Accessed October, 2011.
- WRAP, The composition of waste disposed of by the UK hospitality industry, WRAP, 2011, UK. ISBN 1-84405-452-7.

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 this document. 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 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.

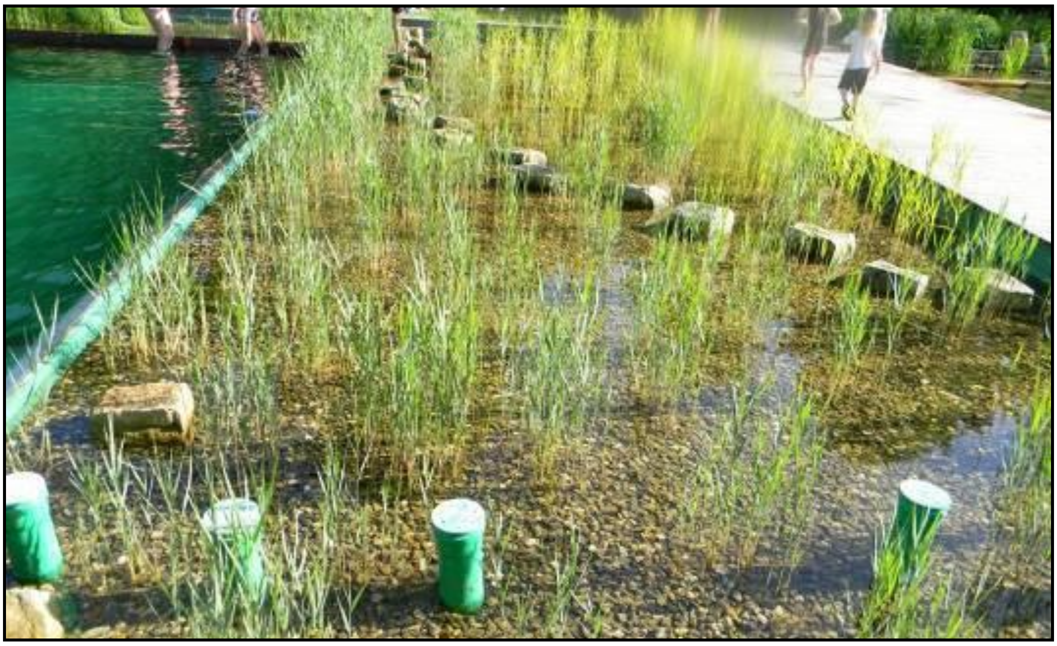


Figure 9.29: A natural pool regeneration zone in the Uhlenköper campsite, Germany

<u>Additional filtration systems</u>

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.

<u>Maintenance</u>

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.

References

- Artehof, Indoor natural swimming pool homepage, accessed April 2012: http://www.arterhof.de/naturhallenbad.html?&L=2
- Biotop Landschaftsgestaltung Gmbh (2012), Natural pools homepage, accessed April 2012: http://www.swimming-teich.com/
- ITP, Sustainable Hotel Siting Design and Construction: The Industry Guide to Good Practice, Prince of Wales Business Leaders Forum, 2008, UK. ISBN-13: 978-1899159161.
- Littlewood, M., Natural swimming pools, BFF, 2004, UK.

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