EMAS

Community Eco-Management and Audit Scheme

Background Report for a Sectoral Reference Document for Tourism in Europe

Final Draft

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JRC Institute for Prospective Technological Studies, Seville

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EXECUTIVE SUMMARY

To be completed by IPTS in final version.

PREFACE

1. Status of this document

This document is a working draft of the Sustainable Production and Consumption Unit. It is not an official document and does not necessarily reflect the position of the European Commission.

2. Relevant legal background

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

Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001 (EC, 2001);

- Regulation (EC) No 1221/2009 of the European Parliament and Council on 25 November 2009.

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

- ensure that EMAS is a high-quality environmental management scheme that guarantees to external stakeholders and national enforcement authorities that EMAS organisations comply with all relevant environmental legislation and continuously improve their environmental performances;

raise the attractiveness of the scheme for participating organisations[1], particularly for small organisations (SMEs and small public authorities), by reducing the administrative burden for participating organisations and by increasing the visibility of participation in EMAS;

have EMAS recognised as a benchmark for environmental management systems;

allow organisations applying other environmental management systems to upgrade their system to EMAS;

creating an impact beyond the EMAS registered organisations by requiring these organisations to take into account environmental considerations when selecting their suppliers and service providers.

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

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

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

Reinforced environmental reporting. Reporting on environmental performance using the core performance indicators is mandatory for the EMAS registered organisation. These indicators are defined for the following environmental areas: energy efficiency, material and resource efficiency, waste, emissions, and biodiversity/land use;

Guidance on best practice in environmental management. In order to support a more harmonised implementation of best practice in environmental management, the Commission initiates the process of development of reference documents. These documents cover specific sectors and focus on direct environmental aspects of production operations as well as indirect aspects, e.g. product design, the environmental impact of downstream and upstream activities.

Following a number of amendments arising from compromises negotiated with the Council, the European Parliament adopted the proposed revision of EMAS in regulation (EC) No 1221/2009
of the European Parliament and Council on 25 November 2009 (EC, 2009). The revised EMAS came into force on 11th January, 2010. Article 46 within (EC) No 1221/2009 (EC, 2009) introduces sectoral reference documents of which this document is an example (Box 1-1).

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

Box 1-1. Article 46 of (EC) No 1221/2009, pertaining to sectoral reference Documents

Article 46
Development of reference documents and guides

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

(a) best environmental management practice;

(b) environmental performance indicators for specific sectors;

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

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

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

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

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

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

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

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

6. Documents developed in accordance with paragraphs 1and 4 shall be submitted for adoption. Those measures, designed to amend non-essential elements of this Regulation, by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 49(3).

3. Objective of this document

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

4. Information sources

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

5. How to understand and use this document

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

6. Environmental indicators and benchmarks of excellence

With respect to the development of EMAS reference documents for best environmental management practice, environmental indicators will be used. They are defined as follows:

An environmental indicator is '…a parameter, or a value derived from parameters, which points to, provides information about, describes the state of the environmental performance of a technique or measure'.

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

(a) give an accurate appraisal of the organisations performance;

(b) be understandable and unambiguous;

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

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

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

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

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

The indicators can be designed as:

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

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

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

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

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

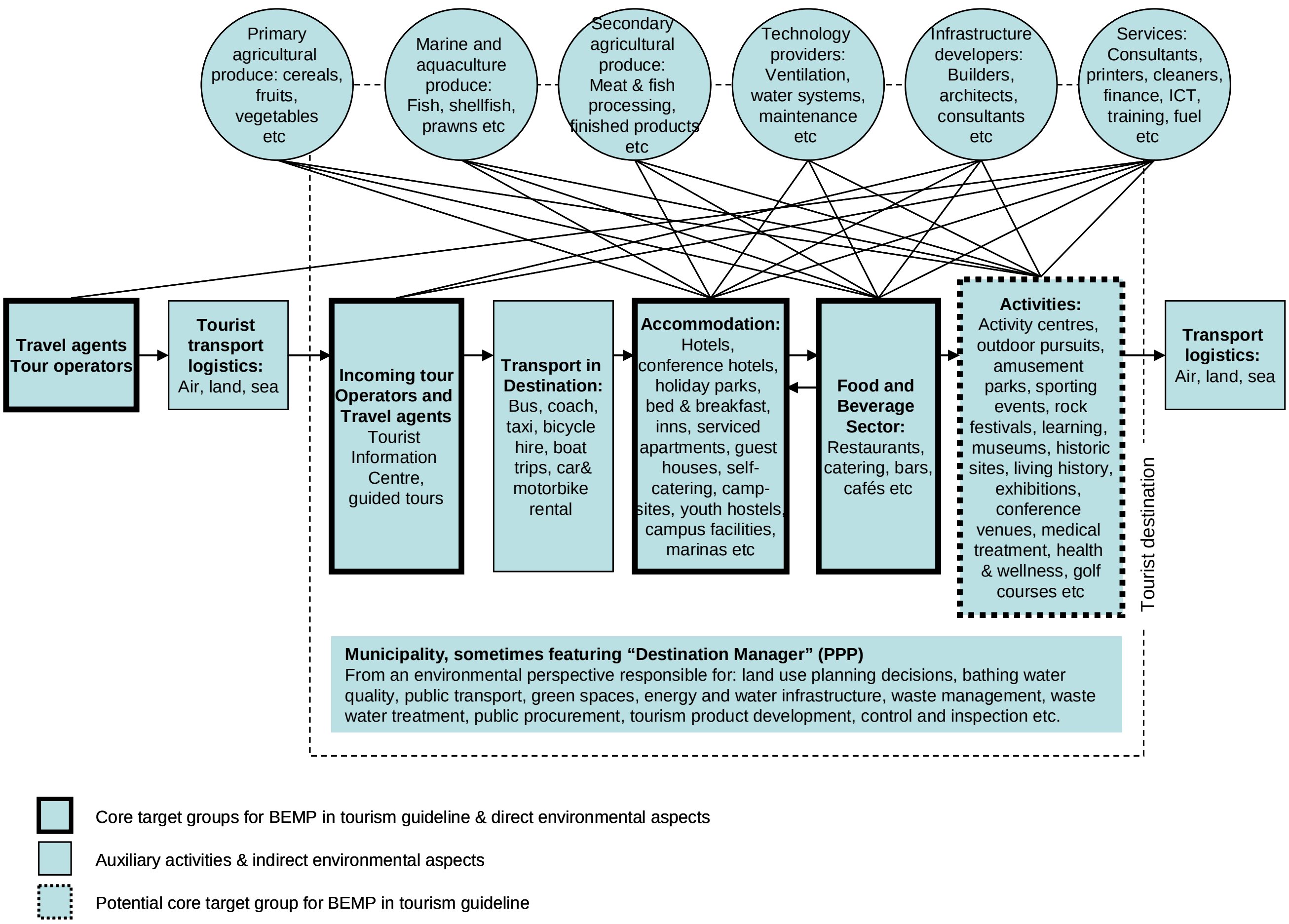
An environmental indicator may concern a whole site or only a certain process or aspect of site. For instance, with regard to energy efficiency, it may not be appropriate to compare the overall specific energy consumption of different whole sites but certain processes of energy-consuming units which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

SCOPE

This document addresses certain of the activities specified in section I 55 of Annex I of Regulation 1893/2006/EC (NACE Rev.2)2, namely: ‘Accommodation and Food Service Activities’ and section N 79 ‘Travel agency, tour operator reservation service and related activities’. Event catering and other food service activities are excluded, as are other reservation services and related activities.

The scope of this Sectoral Reference Document primarily covers best environmental management practise within an organisation of accommodation, food and beverage facilities at tourism destinations and travel agents and tour operators. These sectors are inter-linked with a variety of other sectors as portrayed in the tourism supply chain diagram below. In terms of the tourism product, the activities that a tourist participates in whilst on holiday are also an important part of the tourism value chain, and of potential interest for the EMAS programme. However, it has not been possible to integrate activities within the resources at the disposal of this project.

Figure 1: Scope of document



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

1. Accommodation Services

Three basic types of accommodation are focussed on:

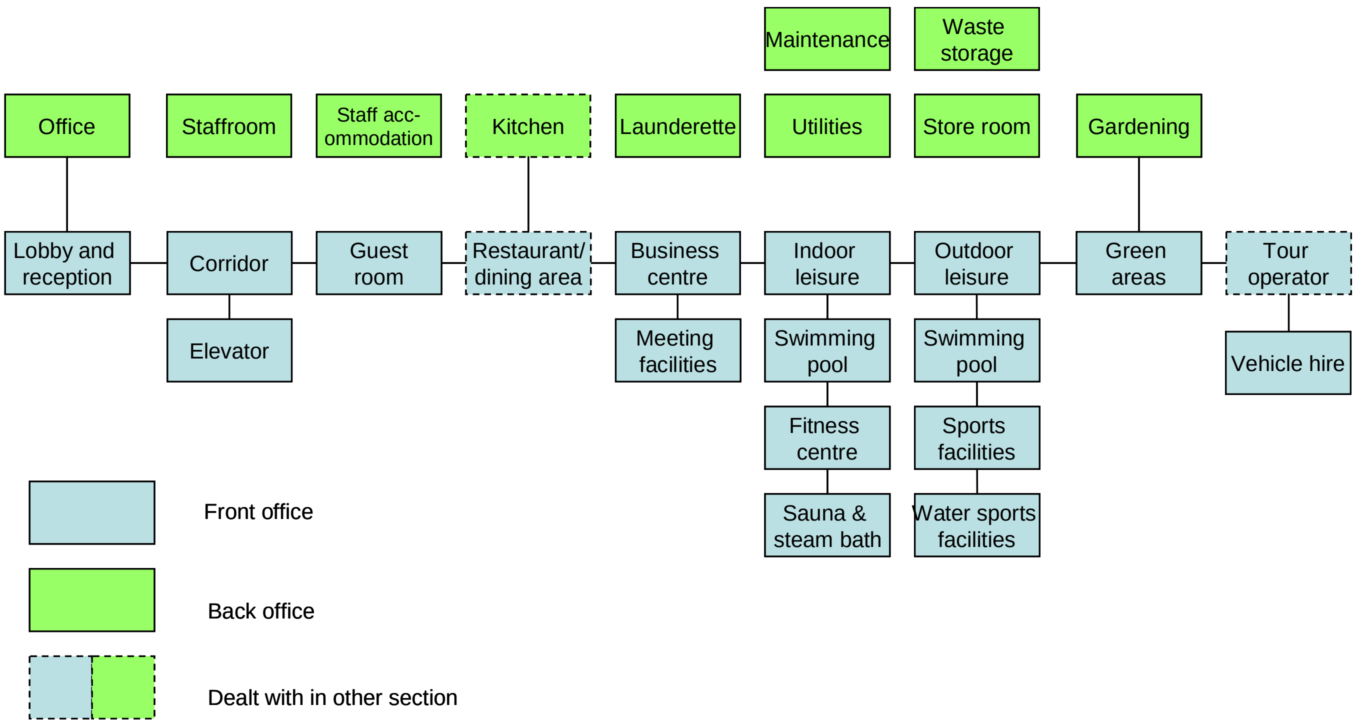
- Serviced accommodation, including hotels, guest houses;
- Non-serviced accommodation, including campsites, youth hostels, self-catering accommodation; and
- Marinas

The systems related to these are described below.

Serviced accommodation

Serviced accommodation typically consists of a combination of the following functions:

Figure 2: Serviced accommodation system



The serviced accommodation system is highly dependent on the level of quality being offered to guests, with star rating systems making specific requirements on the level of equipment and infrastructure offered, as well as the price of the rooms.

The variation between different types of serviced accommodation is immense, reflecting price and quality parameters. The above diagram and the following description are thus indicative only.

Front Office

Lobby and reception
On entry into service accommodation, the guest usually enters a lobby area which may be heated, cooled or ventilated. The lobby area has lighting, and may be carpeted or have natural flooring (wood or stone). The guest is channelled towards the reception area where they are welcomed by staff and allocated their room. The reception features computers, printers and other standard office equipment.

Corridor and elevator
Guests reach their room via corridor and/or elevator. The corridors are lighted and heated, cooled or ventilated. The corridor may be carpeted or feature natural flooring.

Guest accommodation
The guest accommodation may be either a room or an apartment. The rooms are lighted and heated, cooled or ventilated. The floor may be carpet or feature natural materials. The rooms normally feature glass windows.

A room may/usually consist of the following:

- Bed
- Bathroom including toilet, wash basin, shower and bath
- Minibar/fridge
- Multimedia including television, internet connection etc
- Furniture including table and chairs

An apartment usually has more than one room and includes a kitchenette, which features a larger fridge/freezer, kitchen utensils, plates and cutlery.

Restaurant and dining area
Please refer to section on Food and Beverage.

Business Centre and meeting facilities
Larger service accommodation, especially in urban locations, often offer office services to their guests. This may be provided in a specialised room with computers, internet access and printers. Additional functionality includes lighting, heating/cooling, desks and chairs.

In addition, some accommodation facilities may offer varying levels of meeting capacity, ranging from basic boardrooms to full scale meeting rooms with break out rooms attached. These areas are furnished with tables and chairs, audiovisual aids, heating/cooling, lighting, toilet facilities.

Indoor leisure
Service accommodation may offer indoor leisure facilities to guests such as gym/fitness, wellness and swimming pool.

<u>Outdoor leisure</u>
Depending on size, location and market, the service accommodation may offer outdoor leisure activities to guests including heated/unheated swimming pool(s), tennis courts, and playgrounds for children, outdoor dining/barbequing area, (access to) golf court. The whole area may be equipped with lamps.

<u>Green areas</u>
A green area/park may surround the buildings and would normally be highly maintained. The whole area may be equipped with lamps and could feature automatic irrigation systems.

<u>Tour operations</u>
Please refer to section on Travel Agents and Tour Operators.

<u>Vehicle hire</u>
Hotels may offer vehicle hire and/or have agreements with taxi and shuttle companies.

Back Office

<u>Office</u>
The management office has similar facilities to the front office/reception area. Management keeps records of transactions, which can be an important source of environmental data, on for example electricity consumption and water usage.

<u>Staff room / accommodation</u>
Depending on the size of the serviced accommodation and the number of employees, staff facilities may be offered including dining and accommodation.

<u>Kitchen</u>
Please refer to section on Food and Beverage

<u>Laundries</u>
Serviced accommodation generates a range of washing requirements related to use of textiles used in the guest rooms, restaurant, kitchen etc. In addition, hotels may offer washing/dry cleaning services for the guests' own garments. Serviced accommodation may outsource its laundry needs or may operate in-house laundries, which are usually equipped with a variety of energy consuming devices including steamers (for spot-cleaning), washing machines (wet and dry) and tumble dryers/drying closets. Apart from these devices, resources are consumed (detergents and water) to deal with the textiles. Dry cleaning is not really "dry" in the sense that textiles are actually washed in fluent solvents. For the drying of the dry-clean process, warm air is used.

<u>Cleaning</u>
The organisation may employ its own cleaning staff or use a cleaning company. Cleaning involves detergents, electrical apparatus and water – some of these might be stored in locked closets in the corridors, and some could be stored separately in a room designated for dangerous materials/chemicals.

Utilities
The main utilities used by a hotel are electricity, natural gas, piped drinking water and sewerage. In urban areas, hotels may be connected to district heating distribution systems. The utility companies typically bill the accommodation on a quarterly basis, providing useful consumption data. The utility companies may also provide advice to their consumers on resource efficiency.

Some hotels use alternatives to the utilities, either in a drive to become more self-sufficient or because of unavailability of utilities. Examples being operation of their own waste water treatment plants, and generation of their own electricity and hot water.

Maintenance
Involves fixing/repairing the mechanical or electrical devices of the hotel but also the performance of routine actions which keep the device in working order. Air-conditioning, heating, gas and electricity are controlled from here.

Gardening
Serviced accommodation may maintain its surrounding green areas or outsource this. For winter sports/skiing hotels, this also includes clearing of snow and ice. Much of the equipment requires power for operations, e.g. lawn mowers (petrol or electric), rotivators (petrol) and hedge trimmers (electric). In addition the gardening area may also feature storage of hazardous materials for use in gardening, e.g. pesticides to combat vermin and herbicides to remove unwanted plants.

Store room and garbage storage
Serviced accommodation may have a store room for storage of materials used in the process. There are also requirements for storage of waste materials produced from the serviced accommodation and potentially from the restaurant/kitchen. The handling and sorting of waste is depending on local arrangements.

Non-serviced accommodation

Non-serviced accommodation includes campsites, self-catering (apartment/house), youth hostels.

Campsites

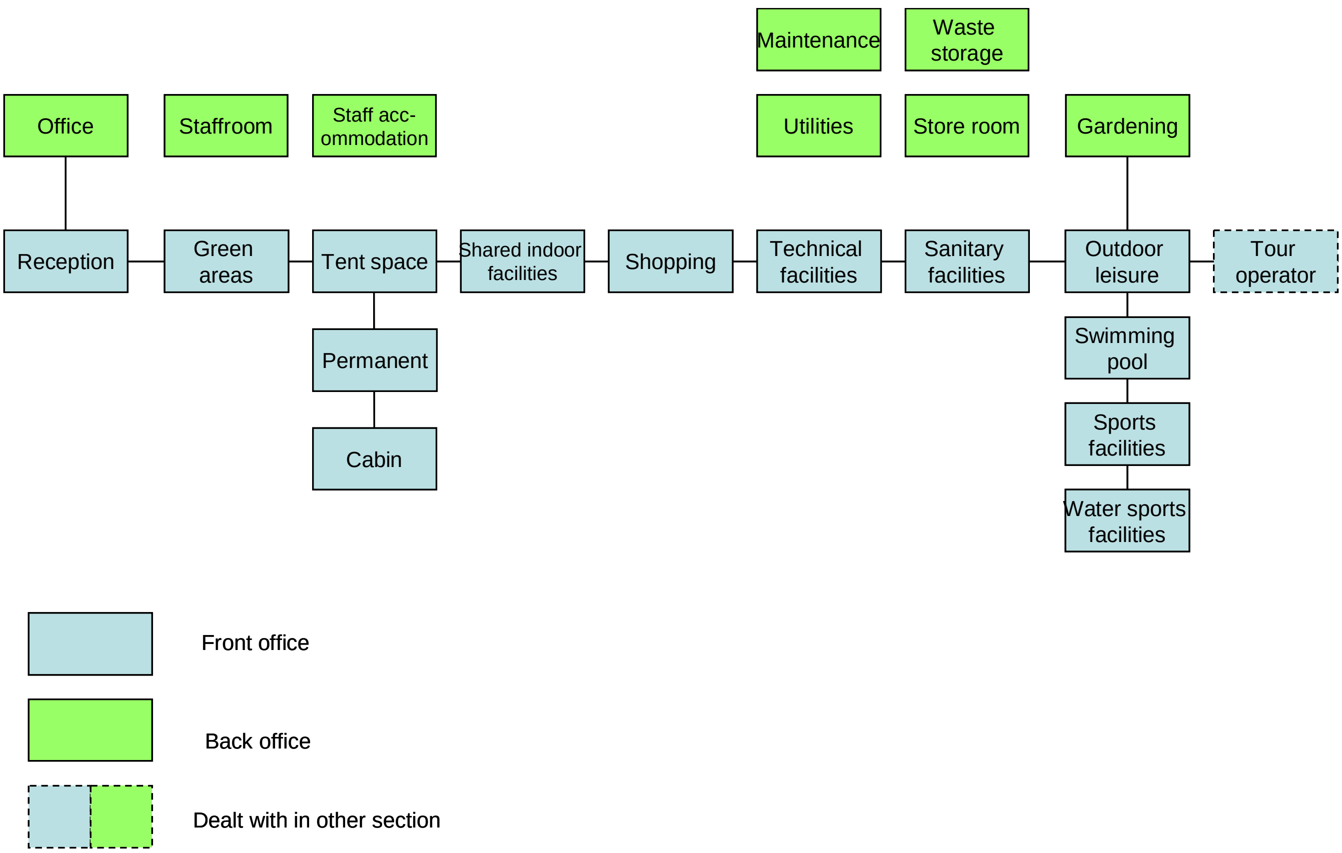
Reception and/or administrative building
Normally, a camp-site has some sort of closed area where guests need to register at arrival. The reception features computers, printers and other standard office equipment. It which may be heated, cooled or ventilated; it has lighting and may be carpeted or have natural flooring (wood or stone). The reception/administrative building could easily be adjacent to the private residence of the camp-site owner. Somewhere in the area, a storeroom and maintenance room may be located.

Tent and caravan space
Appointed areas for tents, caravans and auto campers are made available. These units are self-contained areas for a pre-determined number of tents, caravans and auto campers. They are typically equipped with toilet and wash facilities as well as electricity.

Lodgers
Most camp-sites feature areas for year-round guests that are able to locate their shelter, such as a trailer, on-site on a permanent basis.

Cabins/holiday cottages
Some camp-sites feature cabins and holiday cottages of varying standard and price. The simplest cabins only consist of one room and some bunk beds and facilities are all in the common area. Holiday cottages can be fully equipped with rooms, kitchen, bathroom and modern facilities such as TV, internet etc. In that case it is similar to apartments described in the self-catering section below.

Figure 3: Camping accommodation system



Technical facilities
A camp-site offers various technical facilities to its guests reflecting price and market parameters. Some of the following facilities may be provided:

- Electrical connections
- Lighting (area)
- Car-wash area
- TV and cable-TV connection/satellite signal
- Telephony
- Wireless hotspots

- Bike-workshop

Sanitary facilities
When it comes to sanitary facilities, the variation is considerable depending on market parameters. However, at least some of the below facilities would normally be at hand:

- Toilets (common area)
- Wash basins
- Showers
- Washing cabins
- Nursing room(s)
- Facility/ies for emptying chemical toilets
- Washing facilities with the provision of hot and cold water
- Washing machine(s) and tumble dryer(s)

Shopping/retail
Campsites may provide retail shopping opportunities and restaurants/bars, ranging from a simple over-the-counter shop to sophisticated shopping centres. Restaurants and bars are dealt with in other sections of this document. Retail and shopping will not be elaborated on in this document – please refer to the Sectoral Reference Document for Retail.

Green areas – outdoor leisure
Campsites may include activities for all ages and the outdoor area is the main scene for many of these. The following might be present in the camp-site area:

- Sports:
    - Badminton, table tennis, tennis
    - Basketball, golf, mini-golf, petanque, volleyball, billiard/pool
    - Playing field
    - Water complex (pools (heated or not), slides, spa, sauna etc)
- Play-land:
    - Playground which may feature moon cars/go-carts, bouncing castles, trampolines etc
    - Area with animals

Shared indoor facilities
Shared indoor facilities at campsites may include TV-room, cooking area, game hall, internet area and sauna/pool facilities.

Tour operations
Please refer to section on Travel Agents and Tour Operators.

Youth hostels and self-catering

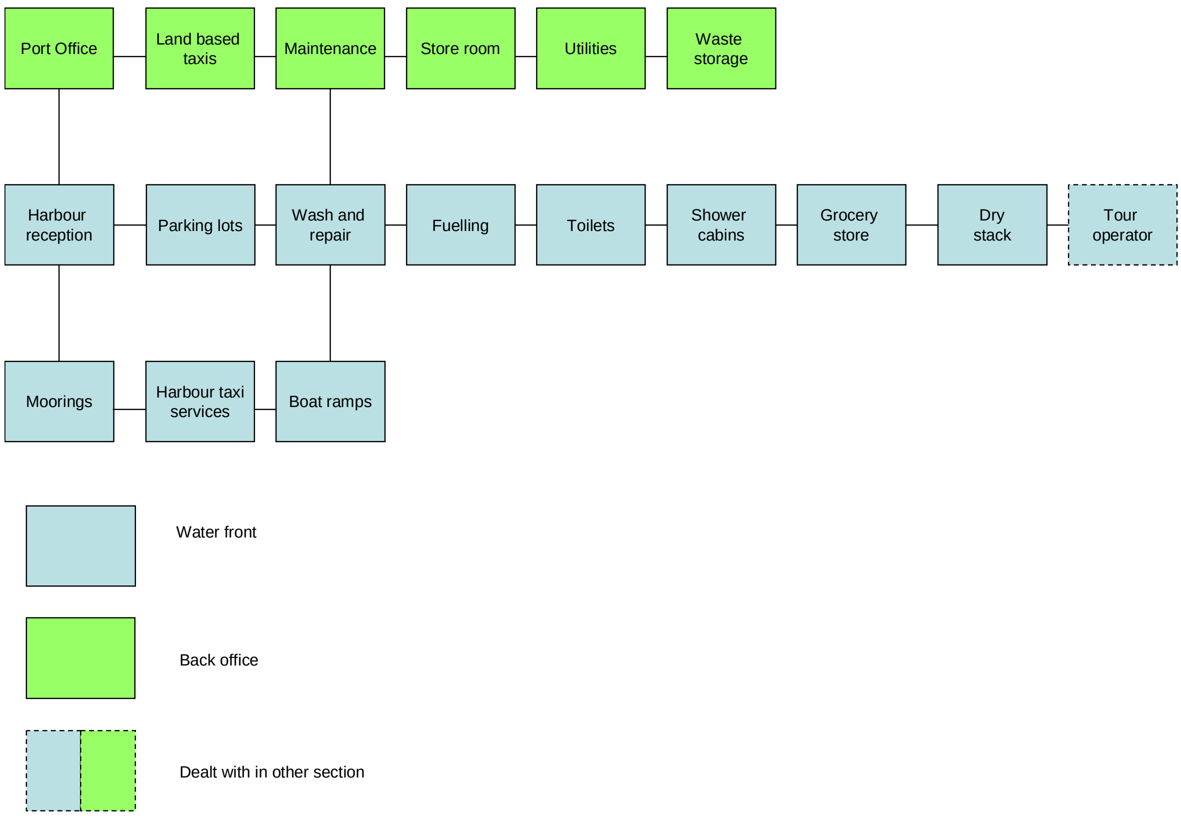
Youth hostels provide budget-oriented, sociable accommodation where guests can rent a bed in a dormitory, or pay extra and get their own room. They share a bathroom, lounge and sometimes a kitchen. Normally, the hostel is staffed by at least some kind of a concierge and hence contains a reception. For some hostels, you bring your own sheet and bed covers; others offer rental of these.

The self-catering apartment or house usually has more than one room and includes a kitchenette and bathroom and potentially access to outdoor areas (private or common). Access to recreation might also be an option (pool indoor/outdoor, gym/sports, wellness). Self-catering and youth hostels generally share some of the core functions as serviced accommodation, e.g.: reception, corridors, rooms, kitchen and maintenance. The reader is thus referred to the relevant sections in description of serviced accommodation.

Marinas

Marinas, as well as the two former sub-categories of accommodation, vary in level of quality and price too. It is a harbour with wharfs keeping boats and yachts and with services for recreational boating. Guests are either visitors in vessels arriving from the seaside or permanent users renting a mooring all year round (or during summer time).

Figure 4: Marina accommodation system



A marina may include ground facilities such as parking lots for vehicles and boat trailers. Slipways (or boat ramps) transfer a boat from a trailer into the water. A marina may have refuelling, washing and repair facilities, ship chandlers, stores and restaurants – depending on size and location. Further to this, a well equipped marina could also contain a boat hoist well (a travelling crane) operated by service personnel and have out-of-water-storage (dry stack) — particularly useful out-of-season, and important where water freezes. The following basic facilities are typically at hand:

- Port office and harbour master

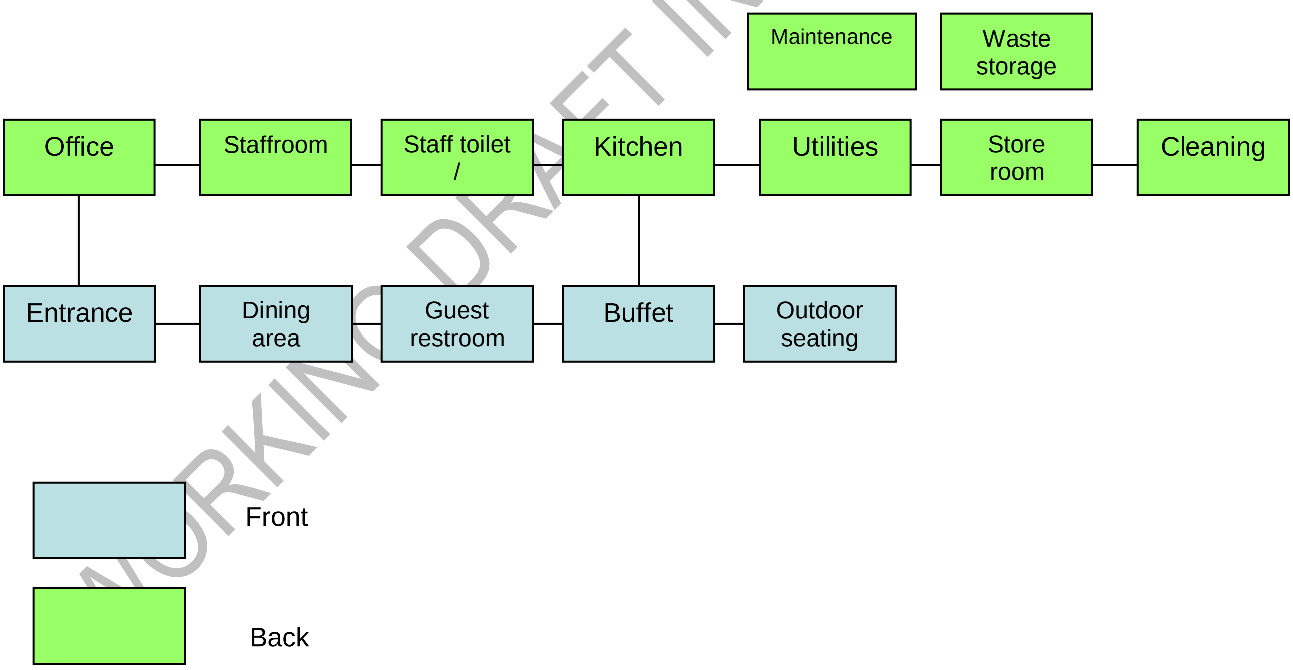
- Harbour taxi services (from boat to shore)
- Land based taxis
- Toilets
- Shower cabins
- Grocery store/service of a kind (from kiosks to restaurants)
- Fuelling facility
- Parking lots
- Moorings
- Wash and repair facilities
- Storage (of chemicals, paints etc)

Food and Beverage Services

The food and beverage sector includes restaurants, mobile food service activities, event catering, and beverage serving activities. Restaurants vary greatly and, depending on location and market, may serve both tourists/one time visitors and residents. A restaurant/bar prepares and serves food and drink to its guests. Meals are generally served and eaten on premises but take-away and food delivery services may also be part of the restaurant/bar offer.

The system related to food and beverage services is described below.

Figure 5: Food and beverage system



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

Front

<u>Entrance</u>

Guest entry may be either directly into the dining area or, in case of adjacency to a hotel, via the shared areas.

Dining area
The dining area is where the bar/restaurant performs its main function: serving food and drink to the guests. The area may be heated, cooled or ventilated. The dining area has lighting, and may be carpeted or have natural flooring (wood or stone).

Guest toilets
Guests will have access to toilets which are equipped with lighting, heated, cooled or ventilated.

Buffet
The serving area may contain a buffet area where guests serve themselves. This includes heated and cooled equipment to maintain the food and drink at the required temperatures.

Outdoor seating
The dining area may include outdoor seating. This features use of more durable furniture and outdoor patio heaters in colder climates.

Back

Office
Larger restaurants and bars typically have office facilities on the premises – where they are part of a hotel, these might be shared. It would feature computers, printers and other standard office equipment.

Staff room and toilet
Staff often needs to change clothes and must of course have access to a toilet and related hand washing facilities. Depending on the size of the food and beverage service, a proper room can be reserved to changing clothes and/or taking breaks.

Kitchen
The kitchen is the backbone of the restaurant. Basic foodstuffs such as vegetables, meats, fish, herbs and spices, are stored in the kitchen facilities such as (walk-in) freezers and fridges, and store room. Food is processed through cleaning, cutting, slicing, mixing and heating/freezing. Drinks (cold or hot) can be prepared here or in a bar. Kitchen contain a variety of different equipment including:

- Oven (gas or electricity)
- Grill (open grills, gas-fired)
- Steamer
- Griddle (flat plate of heated metal)
- Frier (deep Frier, pressure Frier)
- Kettle
- Coffee machine
- Ice machine
- Industrial scale mixers
- Dishwashers (tunnel type, hood type etc)

Utilities
The main utilities used by a restaurant/bar are electricity, natural gas, drinking water and sewerage. In urban areas, restaurants may be connected to district heating distribution systems. The utility companies typically bill the restaurant/bar on a quarterly basis, providing useful consumption data. The utility companies may also provide advice to their consumers on resource efficiency. Some restaurants/bars might use alternatives to the utilities, either in a drive to become more self-sufficient or because of unavailability of utilities. Examples being operation of their own waste water treatment plants, and generation of their own electricity and hot water.

Maintenance
Involves fixing/repairing the mechanical or electrical devices of the restaurant/bar but also the performance of routine actions which keep the devices in working order. Air-conditioning, heating, gas and electricity are controlled from here. Use of pesticides to control vermin and insects.

Cleaning
The restaurant might have employ its own cleaning staff or use the service of a cleaning company. Cleaning involves detergents, electrical apparatus and water.

Store room
Restaurants need room for storage of a variety of materials including vegetables, spices, herbs and flavourings as well as cleaning materials. The handling and sorting of waste materials depends on local arrangements.

Travel Agents and Tour Operators

Travel agents

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

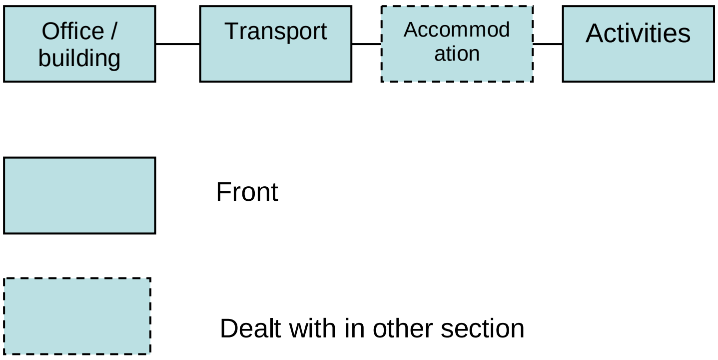
Travel agents also deal with independent travellers, and may help plan their journey using timetables before booking their air, rail or ferry tickets and accommodation. Some agents specialise in business travel, dealing with complicated itineraries. They also offer advice on passport, visa and vaccination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

Travel agency shops ranging from the multiples, with several hundred outlets each, to the individual shop. Some travel agents also undertake tour operating.

Tour Operators

The following systems description is proposed for Tour Operators.

Figure 6: Tour operator system



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

Both travel agents and tour operators reside in some sort of office/building which means that their functioning is related to typical office equipment such as chairs and desks/counters, computers, printers, fax, internet connection, telephones and office supply such as paper. Particularly tour operators produce brochures, catalogues and leaflets which normally are presented on thick, glittered colourful paper. Tour operators also often have offices at destination wherefrom they pick up guests, arrange guided tours or perform tourist information centre services.

Transport is one of the main elements of both travel agents' and tour operators' activities and the first link in the tourism supply chain between the guest and the destination. Transport implies air, land and sea travel. Travel agents as well as tour operators interrelate with:

- Air companies/flights
- Taxis
- Car hire
- Bus/shuttles
- Train
- Ferries/cruise ships

<u>Accommodation</u>
The accommodation services that travel agents and tour operators interact with are described above in sections 4.2 – 4.4. As part of their services, tour operators often check the quality of the accommodation services that they sell to their customers. This may include site visits by managerial staff to assess and review the accommodation performance using pre-defined check lists. Issues of relevance include legal compliance with national safety regulations, e.g. fire safety, and whether these are up to international standards.

Activities

Representatives of the tour operators may be based in the destination and meet their customers at the hotels at predefined times. The reps may also pick up and deliver back their customers at the point of arrival. Representatives answer questions and provide assistance. In addition the reps help their customers to arrange trips and excursions as well as other activities. Examples include guided tours of cultural heritage, diving, golfing, skiing and day trekking.

METHODOLOGY

Project Phases

The project to develop the Sectoral Reference Document for Tourism has been implemented by Grontmij | Carlbro using three core elements:

1. Identification of environmental aspects of tourism,
2. Review and analysis of best environmental management practices, and
3. Review and analysis of performance indicators and benchmark/rating systems.

This section presents the methodology used for each element.

Environmental Aspects of Tourism

Much has already been done to investigate the direct and indirect environmental aspects of tourism, and the project team has analysed potential information sources throughout the project (see list of sources in Appendix 1). The data collection strategy for this element is thus a mix of primary and secondary information sources, combined with Grontmij | Carl Bro experiences.

Best Environmental Management Practices

A questionnaire was developed in order to extract information on environmental management practices currently in use in the European tourism sector in order to address direct and indirect environmental aspects. The questionnaire was distributed to key stakeholders, primarily sectoral representative organisations at the national and European levels.

The distribution of the questionnaire unfortunately resulted in very limited feedback. Therefore information on best environmental management practise had to be sourced by additional research of the literature, i.e. from secondary information sources.

The following criteria were used for the identification of best environmental management practices; to be included the BEMP should be:

- Environmentally sound – i.e. no detrimental environmental effects
- Currently used in the sector
- Proven performance characteristics
- Technology is feasible – i.e. does not entail excessive cost
- Technology is transferable

Performance Indicators and Benchmark/Rating Systems

The project has also reviewed and analysed environmental performance indicators (EPI) and selected relevant EPIs for inclusion in this reference document. Furthermore an assessment has been made of the performance levels within different resource areas put forward by various sector stakeholders. These are put forward in the reference document as indicative guideline values and to give users a reference for their environmental performance.

It is recommended that further research is implemented across Europe to determine what levels are achievable over time based on best environmental management techniques. In the questionnaire, stakeholders were also requested to identify EPIs and benchmark/rating systems that they use, although the questionnaire resulted in very limited response. The questionnaire results were therefore supplemented with additional research conducted by the project team. The work of EPI development was also guided by ISO standard 14031 on Environmental Performance Evaluation.

STRUCTURE

Following a brief description of the context and scope of this document (current section), Part 1 ('GENERAL INFORMATION') provides some background information on the European tourism sector in short chapters:

- Chapter 1.1 regarding turnover and employment
- Chapter 1.2 regarding environmental aspects
- Chapter 1.3 regarding sector uptake of environmental management

More comprehensive background information on relevant tourism activities and environmental aspects are provided in part 2 of the document ('BEST ENVIRONMENTAL MANAGEMENT PRACTICES') , in chapter 2.1 to chapter 2.5.

Part 2 represents the main body of document, and is divided into five main chapters, one over-arching and four dealing with a particular sub-sector of tourism. Each section focuses on groups of operations and activities over which retailers have, or could reasonably be expected to have, a significant degree of control and that have important consequences for environmental performance or impact:

- Chapter 2.1 is cross-cutting and deals with environmental management in all of the sectors of interest
- Chapter 2.2 deals with serviced accommodation, and includes the following:
    - Improving the energy efficiency of accommodation, including all energy consuming processes within buildings (e.g. insulating properties of building envelopes, refrigeration, lighting, ventilation, etc), and optimising heating, ventilation and air conditioning systems.
- Chapter 2.5 focuses on non-serviced accommodation and includes the following:
    - To be updated by IPTS in final version.
- Chapter 2.4 addresses the food and beverage sector and includes the following:
    - To be updated by IPTS in final version.
- Chapter 2.5 provides information for the tour operator sector and includes the following:
    - Best environmental management practice for optimising environmental management in the offer though techniques such as placing environmental demands on suppliers.

Part 3 of the document provides information on emerging techniques

Part 4 of the document summarises the main conclusions on best practice, relevant indicators, and proposed performance benchmarks.

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1 GENERAL INFORMATION

1.1 Turnover and Employment

1.1.1 Main Economic Data

Europe is the largest tourism region in the world enjoying 53% of market share in terms of international tourist arrivals. Ranked according to international tourist arrivals, Europe has five destinations within the global top ten: France, Spain, Italy, United Kingdom and Germany (in order of magnitude). Looking at the sub-regions in Europe in the table below, it can be seen that there has been incremental growth since 1990, with a near doubling in total international tourist arrivals[2]:

Table 1: Sub-regional results, Europe

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

Source: UNWTO, Tourism Highlights, 2009 edition

The regional level average annual tourism growth rate is relatively steady at 2.8% which is slightly lower than the world average of 3.8%. Looking at the national level results in the table below, it can be seen that the 5 destinations in the global top 10 dominate, however, it should be borne in mind that these statistics do not include domestic tourism, which can be a significant part of national tourism.

Table 2: National results, Europe

	International Tourist Arrivals		International Tourism Receipts
	(1000)	Share (%)	Share (%)
	2008	2008	2008
Austria	21,935	4.5	4.6
Belgium	7,165	1,5	2.6
Bulgaria	5,780	1.2	0.8
Czech Republic	6,649	1.4	1.6
France	79,300	16.2	11.7
Germany	24,886	5.1	8.4
Greece	-	-	3.6
Hungary	8,814	1.8	1.3
Ireland	8,026	1.6	1.3
Italy	42,734	8,7	9.7
Netherlands	10,104	2.1	2.8
Poland	12,960	2.6	2.5
Portugal	-	-	2.3
Spain	57,316	11.7	13.0
Sweden	-	-	2.8
United Kingdom	30,182	6.2	7.6

Source: UNWTO, Tourism Highlights, 2009 edition

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

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

Tourism is an important economic sector in Europe. In 2006 there were 1.7 million enterprises in the EU-27 hotels and restaurants sector, employing some 9.3 million people. This corresponded to 8.3% of the non-financial business economy's enterprise population and 7.1% of its workforce[3]. In 2006, EU-27 hotels and restaurants generated EUR 433.7 billion of turnover, of which EUR 181.9 million was value added, which represented 3.2% of the total for the non-financial business economy[4].

1.1.2 Structural Profile of Sector

In the EU-27, restaurants, bars, catering and canteens was the largest of the 2 aggregates that make-up the hotels and restaurants sector, contributing 64% of the value added in 2006 while employing 75% of the workforce. Apparent labour productivity by subsector was considerably higher for hotels, camping sites and other provision of short-stay accommodation than for restaurants, bars, canteens and catering – see table below.

Table 3: Structural profile of hotels and restaurants, EU-27, 2006

	Number of enterprises	Number of persons employed	Turnover	Value added	Apparent labour productivity
	(1000)		(EUR million)		(EUR 1000/pers. Emp.)
Hotels and restaurants	**1,682**	**9,266**	**433,696**	**181,912**	**19,6**
Hotels, camping sites, other providers of short-stay accommodation	259	2,287	135,108		28,6
Restaurants, bars, canteens and catering	1,423	6,978	298,588	116,499	16,7

Source: Eurostat, Statistics in Focus, 2009

Details for the member states, as presented in Table 4, show that the hotels and restaurant sector in the UK is the largest in the EU. With a value added of EUR 41.7 billion, the UK contributed over a fifth of the EU-27 total. The UK also reported the largest workforce with 1.9 million people working in the hotel and restaurant sector. The average personnel costs per employee are among the lowest recorded in the non-financial business economy. This reflects the high use of part-time and seasonal labour, and the relatively low or unskilled workforce. The contribution of the hotels and restaurants sector to non-financial business economy value added was consistently lower than the corresponding share of employment, reflecting the labour-intensive nature of these activities[5].

Table 4. Hotels and restaurants in the EU Member States, 2008

	No. of persons employed	Turnover	Value added	Average personnel costs	Apparent labour productivity	No. of hotels & similar	Average no. of bed places per establishment	Nights spent	Tourism intensity
	(1000)	(EUR million)		(EUR million)		Units		(1000)	Per inhabitant
				(/employee)	(/person empl.)				

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

[4] Eurostat, 2009

[5] Eurostat, 2009

EU-27	**9,266**	**433,696**	**181,912**	**15.6**	**19.6**	**202,353**	**58**	**1,578,148**	**3.2**
Austria	243	13,143	6,390	21.0	26.3	14,204	40	79,167	9.6
Belgium	166	10,179	3,723	18.1	22.4	2,013	62	16,197	1.5
Bulgaria	115	1,077	328	1.6	2.9	1,526	152	16,736	2.2
Cyprus	38	1,683	919	17.8	23.9	735	119	14,298	18.4
Czech Republic	158	3,969	1,259	6,7	7,9	4,559	54	27,044	2.6
Denmark	105	5,352	2,298	16.8	22.0	477	154	11,080	2.0
Estonia	19	434	160	5.7	8.6	346	83	3,843	2.9
France	915	66,493	28,529	26.9	31.2	18,135	69	204,269	3.2
Finland	55	4,855	1,806	27.1	32.8	909	131	15,817	3.0
Germany	1,316	48,989	23,225	12.6	17.7	35,941	46	214,675	2.6
Greece	304	9,475	3,457	14.3	11.4	9,207	76	64,086	5.7
Hungary	127	2,569	702	5.3	5.5	1,999	77	16,297	1.6
Ireland	149	8,531	3,407	18.0	22.9	4,087	38	28,282	6.6
Italy	1,115	60,364	21,993	19.5	19.7	34,058	63	254,329	4.3
Latvia	31	509	225	3.3	7.4	318	65	2,759	1.2
Lithuania	39	476	165	3.3	4.3	348	63	2,591	0.8
Luxembourg	16	1,027	492	24.6	31.7	273	53	1,438	3.0
Malta	-	-	-	-	-	160	250	7,917	19.4
Netherlands	345	15,578	6,610	12.9	19.2	3,196	63	34,159	2.1
Poland	231	4,504	1,518	5.1	6.6	2,443	78	24,307	0.6
Portugal	276	8,880	3,072	8.9	11.1	2,031	130	39,737	3.7
Romania	122	2,030	564	2.6	4.6	4,163	55	19,756	0.9
Slovakia	22	453	174	5.2	8.0	1,249	54	7,233	1.3
Slovenia	32	1,228	462	12.8	14.4	396	83	5,546	2.8
Spain	1,259	58,406	25,172	17.6	20.0	17,827	92	271,689	6.1
Sweden	124	8,688	3,294	24.9	26.5	1,893	110	15,817	3.0
United Kingdom	1,927	94,309	41,710	13,5	21,6	39,860	31	169,484	2.8

Source: Eurostat, Statistics in Focus, 2009

The largest number of hotels and similar establishments in 2007 were in the UK, Germany and Italy. Malta had the highest result in average number of bed places, with Spain, Germany and Italy recording the highest overnight figures. Tourism intensity is a ratio of the number of overnights per inhabitant. This figure is highest for the island destinations of Malta and Cyprus, as well as Austria, Ireland and Spain. In terms of average length of stay, the popular summer destinations (Bulgaria, Cyprus, Malta and Greece) were notably higher at 5 days or more on average.

Generally, micro- and small enterprises dominate the tourism sector in Europe. As Table 5 shows, a large proportion of the value added created in the EU-27 hotels and restaurants was concentrated in organisations with less than 49 employees. Together, micro and small enterprises generated 63% of the sector's value added in 2006 and employed 72% of its workforce in 2005.

Table 5: Share of value added & persons employed by enterprise size class, EU-27(%)

	Value added		**Persons employed**	
	Non-financial business econ. (06)	Hotels and restaurants (05)	Non-financial business econ. (06)	Hotels and restaurants (05)
1 to 9 employed	20.2	35.5	29.5	44.7
10 to 49 employed	18.8	27.2	20.8	26.8
50-249 employed	17.8	13.8	16.8	10.9
250 or +employed	43.1	23.5	33.0	17.6

Source: Eurostat, Statistics in Focus, 2009

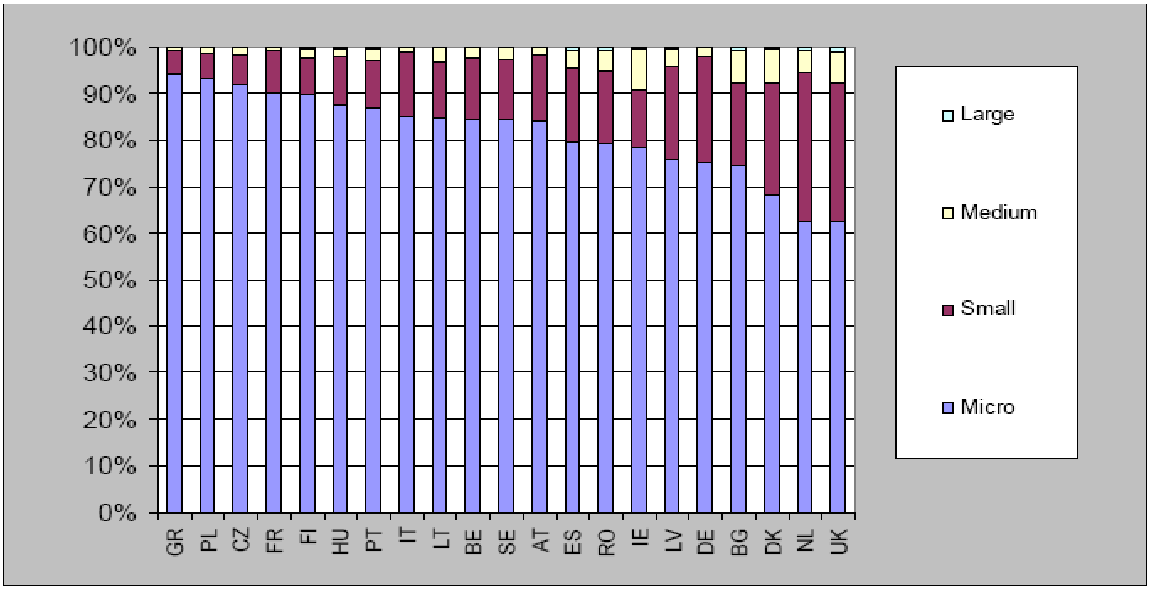
Among the member states the UK, and to a lesser extent the Netherlands, stood out from other countries as large enterprises (over 250 employees) make significant contributions (45% and 35% respectively) to total value added within the hotels and restaurant sector.

The International Federation of Tour Operators, outbound tour operators represent 12 percent of international arrivals, while in Europe they represent 35 percent of leisure air holidays. This figure does not take into account packages sold by inbound tour operators, or incoming agents, directly to tourists in destinations[6].

1.1.3 Size Distribution

In 2009, the European Commission conducted a study on the competitiveness of the European tourism industry. This showed that the accommodation sub-sector is almost exclusively populated by SMEs (see Figure 7)[7]. Especially micro-enterprises (employing 1 to 9 employees) are strongly represented. This group of enterprises represents in all Member States (except for UK, Netherlands and Denmark) at least 75% of the total number of enterprises in the industry. In certain countries like the Czech Republic, Poland and Greece, the share of micro-enterprises in the total number of enterprises exceeds 90%. In all countries, the share of medium (employing more than 50 people) and large companies (employing more than 250 people) is below 10%. In some countries like France, Italy and Greece, the proportion of these medium and large companies is very small.

Figure 7: Accommodation size distribution of enterprises per Member State (in %), 2006



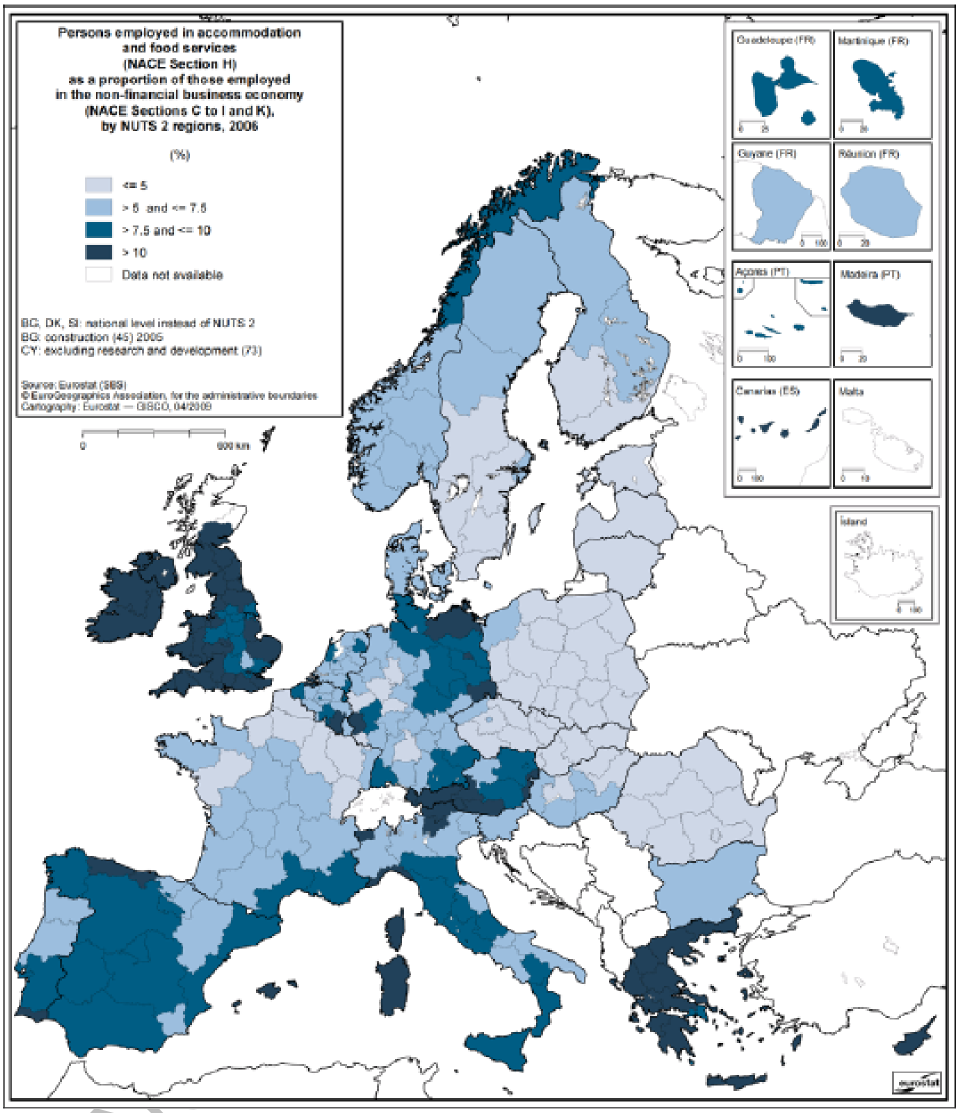
Source: EC DG Enterprise & Industry, 2009

1.1.4 Geography of EU27 Tourism

Specialisations within tourism (hotels and restaurants) are strongly related to climate, natural or man-made attractions (beaches, mountains, castles etc) as well as proximity to a critical mass of potential customers.

[6] Tour Operators Initiative for Sustainable Tourism Development, Sustainable Tourism: The Tour Operators Contribution, Paris, 2003
[7] EC, DG Enterprise & Industry, Study on Competitiveness of the EU tourism industry, Brussels, 2009

Figure 8: Regional employment in hotels and restaurants



Source: EUROSTAT, Statistics in Focus, 2009

As Figure 8 shows, the highest proportions of non-financial business economy employment within the hotels and restaurants sector were mostly recorded in the Mediterranean region. It peaked in several regions of Greece, followed by regions in Portugal, Spain and Italy (often holiday islands). The sector also provided 15% or more of employment in a few regions in UK, Ireland, Austria and Germany, as well as Cyprus.

1.2 Environmental Issues of the Tourism Sector

The tourism services within the sectors that are the focus of this reference document – accommodation, food and beverage and tour operators and travel agents – contain a wide range of environmental aspects which result in one or more environmental impacts. An environmental aspect is element of an organisation's activities, products or services that has or can have an impact on the environment, both the natural environment and people, while an environmental impact is the impact that the environmental aspect has on the natural environment and people.

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

Indirect environmental aspects are elements of an organisation's activities, products or services over which the organisation does not have full management control, and thus cannot influence directly. These may include aspects related to products used, transportation, and other factors in the supply chain. Although these aspects may not be within direct control of the accommodation facility operators, they can still have significant implications for the environmental impacts of the services, seen from a lifecycle perspective. Indirect aspects can be addressed via dialogue with the responsible actors.

Table 6 below provides examples of the connections between typical environmental aspects and the environmental impacts that they have.

Table 6. Connection between environmental aspects and impacts

Environmental Aspect	Environmental Impact
Use of fossil fuels (including emission of greenhouse gases, sulphur dioxide and NOx) *For example for heating of building, transport of materials to and from organisation*	Shortage of non-renewable materials, contribution to global warming, acid rain, smog
Use of non-renewable materials *For example metals on outdoor construction (e.g. copper drainpipes, aluminium for façade)*	Shortage of non-renewable materials
Use of drinking water *For example sanitation facilities*	Water shortage
Emission of volatile organic compounds (VOCs) to air *For example during painting and maintenance activities*	Health effects
Lack of recycling *For example use of non-recyclable materials, or lack of waste sorting*	Shortage of non-renewable materials, increased energy consumption, increased landfilling
Noise *For example from outdoor music, nightclubs etc*	Disturbance of neighbours, disturbance of wildlife
Light *For example outdoor lighting*	Disturbance of wildlife e.g. nesting turtles

This section provides an overview of environmental aspects, which are likely to be considered important in the sectors covered in this document. It is important, however, that each company does identify, assess and prioritise their environmental aspects and associated environmental activities, as these may differ depending on the exact nature of the companies' operations.

Figure 9 provides an overview of the main environmental aspects of a tourism service.

Figure 9. Tourism service inputs and outputs

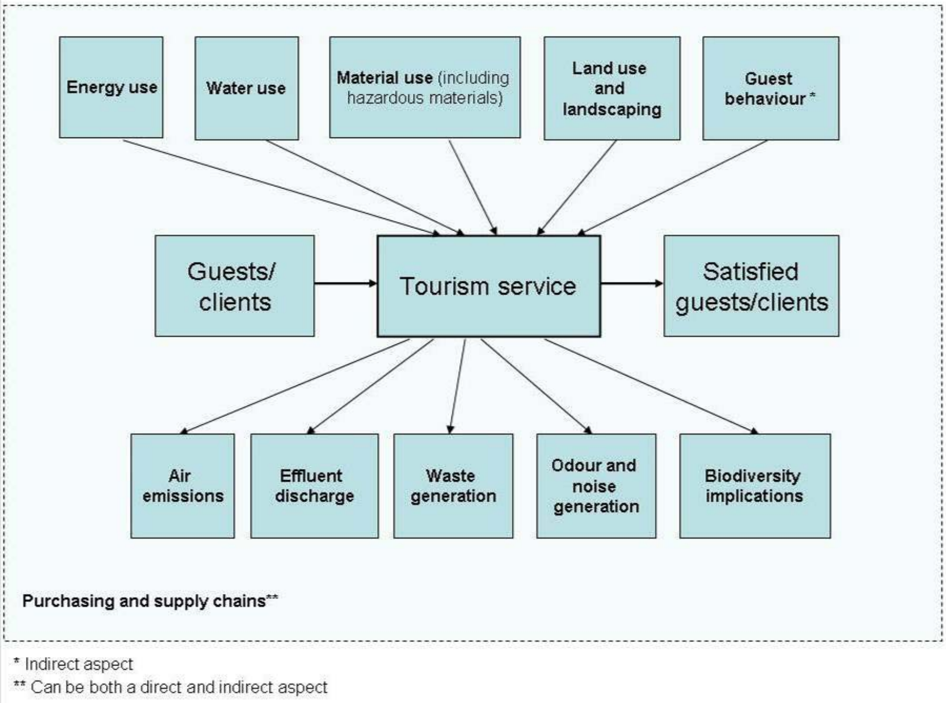


Table 7 further breaks these aspects down according to where they occur in the tourism service[8].

Table 7. Standard set of activities in tourism enterprises (hotels, restaurants and tour operators)

Service/Activity	Description	Main Environmental Aspects
Administration	▶ Office Management ▶ Reception of clients	▶ Energy, water and raw materials (mainly paper) consumption ▶ Generation of municipal waste (large amounts of paper) and hazardous waste (e.g. toner cartridges)
Technical services	▶ Equipment for producing hot water and space heating/cooling ▶ Lighting ▶ Elevators ▶ Swimming pools ▶ Green areas ▶ Pest and rodent control ▶ Repair and maintenance	▶ Energy and water consumption ▶ Consumption of a range of hazardous products ▶ In some cases use of CFCs and HCFCs ▶ Air emissions ▶ Generation of a wide range of potentially hazardous waste types such as empty chemical containers ▶ Generation of waste-water
Restaurant/bar	▶ Breakfast, dinner, lunch ▶ Beverages and snacks	▶ Energy, water and raw materials consumption ▶ Generation of significant amounts of packaging waste, bottles etc
Kitchen	▶ Food conservation ▶ Food preparation	▶ Important consumption of energy and water

8 Adapted from: Anguera et al, 2000

	▶ Dishwashing	▶ Generation of significant amounts of packaging waste ▶ Generation of vegetable oil waste ▶ Generation of significant amounts of organic waste ▶ Generation of odours
Room use	▶ Use by guests ▶ Products for guests' use ▶ Housekeeping	▶ Energy, water and raw materials consumption ▶ Use of a wide range of hazardous products ▶ Generation of waste packaging and small amounts of municipal waste ▶ Generation of waste water
Laundry	▶ Washing and ironing of guests' clothes ▶ Washing and ironing of	▶ Important consumption of energy and water ▶ Use of hazardous products ▶ Generation of waste-water
Purchasing	▶ Selection of products and suppliers ▶ Storage of products	▶ Generation of packaging waste ▶ Hazardous substance leakages
Activities	▶ Indoor activities ▶ Outdoor activities	▶ Energy, water and raw materials consumption ▶ Local impacts on ecosystems ▶ Noise ▶ Generation of municipal waste
Transport	▶ Transport of guests ▶ Transport of employees ▶ Transport by suppliers	▶ Energy (fuel) consumption ▶ Air emissions
Additional services	▶ E.g. medical services, supermarkets, souvenir shops, spa and wellness, hairdresser, etc.	▶ Energy, water and raw materials consumption ▶ Generation of municipal waste, and some specific hazardous waste types (e.g. sanitary waste)
Building and construction	▶ Construction of new areas or services ▶ Repair of existing areas or services	▶ Energy and water consumption ▶ Significant consumption of raw materials and hazardous products ▶ Significant generation of construction waste ▶ Generation of hazardous waste

The key environmental aspects which are likely to be of primary significance for most tourism operators in a given sector, are listed below and is based on e.g. work done by the Nordic and European eco-labels (Nordic Swan and EU Flower), and other stakeholders:

Accommodation services

1. Energy use
2. Water use
3. Materials use (including chemicals)
4. Waste generation

Food and beverage services

1. Energy use
2. Materials use
   - Chemicals

- Food and beverages

3. Water use
4. Waste generation

Travel agents and Tour operators

1. Energy use and emissions related to transport

1.3 Sector Uptake of Environmental Management

1.3.1 EMAS

Table 8 shows that as of 2010, 254 tourism organisations have achieved EMAS registration.

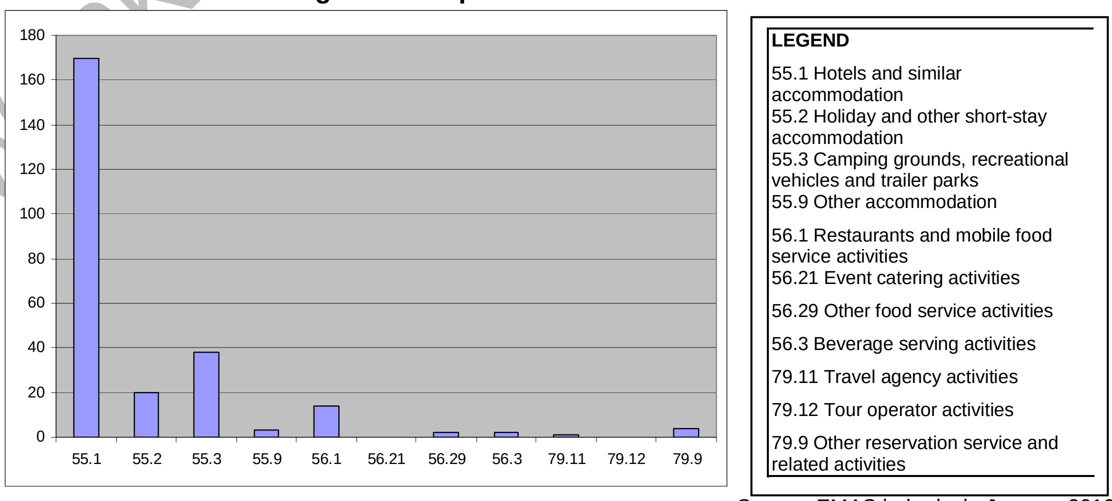
Table 8: Overview of EMAS registrations per tourism sub-sector

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

Source: EMAS help desk, January 2010

The “hotels and similar accommodation” category has the largest number of EMAS registrations within the tourism sector, as shown in Figure 10.

Figure 10: Breakdown of EMAS registrations per tourism sub-sector



Source: EMAS help desk, January 2010

According to Table 9, three countries – Spain, Italy and Germany – account for nearly all of the EMAS registrations in the tourism sector.

Table 9: Breakdown of EMAS registrations per tourism sub-sector per country

	55.1	55.2	55.3	55.9	56.1	56.21	56.29	56.3	79.11	79.12	79.9	Total
Austria	1				1							**2**
Belgium												**0**
Bulgaria												**0**
Cyprus												**0**
Czech Republic												**0**
Denmark												**0**
Estonia												**0**
Finland												**0**
France												**0**
Germany	11	2	9	2	5		1	1				**31**
Greece	1											**1**
Hungary												**0**
Ireland												**0**
Italy	14	9	11		6		1	1				**42**
Latvia												**0**
Lithuania												**0**
Luxembourg												**0**
Malta												**0**
Netherlands												**0**
Poland												**0**
Portugal	5											**5**
Romania									1			**1**
Slovakia												**0**
Slovenia												**0**
Spain	138	9	18	1	2						4	**172**
Sweden												**0**
United Kingdom												**0**
Total	**170**	**20**	**38**	**3**	**14**	**0**	**2**	**2**	**1**	**0**	**4**	**254**

Source: EMAS help desk, January 2010

1.3.2 ISO 14001

Table 10. Known ISO 14001 certified hotels and restaurants

EAC Code Nos.	ISO 14001 BY INDUSTRIAL SECTORS	1998	1999	2000
21	Aerospace	49	309	391
22	Other transport equipment	312	445	589
23	Manufacturing not elsewhere classified	70	118	272
24	Recycling	109	333	463
25	Electricity supply	298	258	462
26	Gas supply	36	68	82
27	Water supply	47	107	191
28	Construction	298	500	1 035
29	Wholesale & retail trade; repairs of motor vehicles, motorcycles & personal & household goods	129	340	452
30	Hotels and restaurants	105	51	66

Source: ISO Survey of ISO 9000 and ISO 14000 certificates (2001)

Unlike EMAS, there is no requirement in the ISO 14001 standard on environmental management that national competent bodies register organisations that have been certified according to the standard. For this reason, it is not possible to obtain data at the national or European level on uptake of ISO 14001 in the tourism sector. The most recent information is from the ISO Survey of ISO 9000 and ISO 14000 Certificates (2001) from which Table 10 is an extract. According to this information, ISO 14001 certification did not have broad international uptake in 2000, with 66 certifications noted internationally in 2000.

1.3.3 Ecolabels

Box 1-2 Types of eco-labels

There is no simple way of categorising all green labels according to what they cover. But the **International Organization for Standardization** (ISO) has developed a classification system for environmental product claims and labels, based on the nature of the claim:

- ISO 14024 is for what are known as **Type I claims** - declarations which meet criteria set by third parties (not by the manufacturer or retailer themselves), and are based on life cycle impacts, like the EU Ecolabel and national ecolabelling schemes. These are award-type labels. As they require the product to meet independently set criteria, they should in theory be fairly demanding, but this depends on how strict the criteria are, and on the body which controls the criteria.
- ISO 14021 covers **Type II claims**, which are manufacturers' or retailers' own declarations, sometimes called “green claims”. These can be useful, but much depends on the type of claim that the manufacturer or retailer makes.
- ISO 14025 is for **Type III claims**, which consist of quantified information about products based on life cycle impacts (or Environmental Product Declarations – EPDs). Type III claims should enable products to be compared easily, for example for public procurement purposes, because they consist of quantified information about aspects such as energy output.

Source: DEFRA, UK: http://www.defra.gov.uk/environment/business/marketing/glc/types.htm

Research identified 10 tourism-related ecolabels in the EU-27. These are almost entirely exclusive to the accommodation sector, with the exceptions being the category in Austria for gastronomy services, and the category in France for tourist offices. Table 11 below breaks the environmentally-related labels for tourism companies in Europe down according to the ISO 14020 series of standards:

- Type 1 environmental labels are criteria-based labels with criteria provided by a third party (e.g. EU flower, Nordic Swan)
- Type 2 environmental labels are self-declared environmental claims, with no third party
- Type 3 environmental declarations are LCA based labels with verification provided by an independent third party (EPD on e.g. a photocopier)

Table 11: Environmentally-related labels for tourism companies in Europe

	Product group(s)	Regional level	National level	No. of companies labelled (2009)
Type 1				
EU Ecolabel http://ec.europa.eu/environment/ecolabel/index_en.htm	“Tourist accommodation service”	✓		Campsites: total 80; Austria 12, Sweden 1, Denmark 20, Czech Rep 1,

Table 11: Environmentally-related labels for tourism companies in Europe				
	Product group(s)	**Regional level**	**National level**	**No. of companies labelled (2009)**
	"Campsite services"			Finland 1, Italy 19, Spain 1, Germany 14, France 11 Tourist Accommodation: total 397; Switzerland 29, Denmark 6, Ireland 24, Austria 12, UK 3, Czech Rep 8, Spain 8, Liechtenstein 1, Slovenia 2, France 65, Finland 3, Portugal 4, Greece 7, Northern Ireland 4, Belgium 1, Netherlands 5, Hungary 2, Latvia 3, Malta 1 Norway 2, Romania 2 Albania 4, Poland 1, Sweden 1, Cyprus 1, Turkey 1, Italy 197
Nordic Ecolabel www.svanen.nu	"Hotels and youth hostels"	✓		Total: 219
Das Österreichische Umweltzeichen, Austria www.umweltzeichen.at	"Tourism companies"		✓	653 total 504: accommodation 41: camping 108: gastronomy
Type 2				
El Distintivo de Garantia de Calidad Ambiental, Catalonia, Spain	"Service sector" http://mediambient.gencat.net/esp//empreses/ecoproductes_i_ecoserveis/distintiu.jsp		✓	Accommodation businesses: 70 total; 26 hotels, 16 camping sites, 20 youth hostels and 8 rural farmhouses (2004 data)
Green Key International (In Europe: Belgium, Cyprus, Denmark, Estonia, France, Greece, Italy, Latvia, Lithuania, Netherlands, Portugal, Sweden)	"Tourism facilities" (Hotels, youth hostels, conference- and holiday centres, campsites, holiday houses and leisure facilities) www.green-key.org	✓		Total: 1,031 Belgium: 51 total, 5 hotels, 14 campsites, 7 guest rooms, 21 lodgings, 3 residencies Cyprus: 3 total, 3 hotels Denmark: 54 total, 48 hotels, 6 youth hostels Estonia: 23 total, 20 hotels, 1 farm, 1 motel, 1 tourist board France: 527 total, 255 campsites, 215 hostels, 57 lodges and cottages Greece: 51 total, 50 hotels, 1 guesthouse

Table 11: Environmentally-related labels for tourism companies in Europe				
	Product group(s)	**Regional level**	**National level**	**No. of companies labelled (2009)**
				Italy: 10 total, 8 hotel, 2 camping Latvia: 4 total, 4 hotels Lithuania: 9 total, 6 hotels, 3 farms Netherlands: 232 total, 82 hotels, 93 campsites, 21 bungalows, 6 carting, 15 group accommodations, 12 charter, 3 beach pavilion Portugal: 22 total, 3 hostels, 7 hotels, 12 rural spaces Sweden: 45 (7 mountain lodges, 9 campsites, 15 hostels, 2 hotels, 12 hotel/conference)
Green Tourism Business Scheme, UK www.green-business.co.uk	"Green places to stay" (hotels, B&B etc), "Green places to visit" (visitor attractions, TICs etc), "More Green businesses" (activity centres, tour operators etc)		✓	1,952 total 1,368 Green places to stay, 453 Green places to visit, 131 More Green businesses
Lauku Celotajs, Latvia www.eco.celotajs.lv	Rural tourism providers		✓	Latvia 76 guesthouses/farmsteads
Legambiente Turismo, Italy www.legambienteturismo.it	Tourism facilities		✓	192 hotels and 46 other accommodation businesses, 42 bathing establishments and 20 camping sites (2004 data)
Steinbock Label, Switzerland www.steinbock-label.ch	Hotels and restaurants		✓	15 facilities in 6 cantons (2004 data)
NF Mark www.marque-nf.com	Tourist office reception services		✓	77 certified facilities
Travelife www.travelife.eu	Supplier-based (primarily accommodation facilities) for tour operators	✓		88 facilities certified in bronze, silver and gold system
Type 3				
The International EPD	Food products and	✓		None identified -

Table 11: Environmentally-related labels for tourism companies in Europe

	Product group(s)	Regional level	National level	No. of companies labelled (2009)
system http://www.environdec.com/pageId.asp?id=800	beverages Textiles Wood and wood products Chemicals and chemical products Office machinery and computers Electric machinery Furniture Electric, gas and water supply Construction Land transport and transport equipment Post and telecommunication Refuse disposal and sanitation services			unknown

Source: web-based research including www.yourvisit.info

As can be seen from Table 11, there are approx. 4,870 tourism facilities in Europe that have been certified according to an ecolabel of type 1 or 2. No tourism organisations with certifications according to Type 3 ecolabels were identified.

1.4 Reference Literature

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2 BEST ENVIRONMENTAL MANAGEMENT PRACTICES

2.1 Cross-cutting

2.1.1 Best Environmental Management Practices for Managing the Environmental Aspects of Tourism Organisations

A1. Management

Description

An Environmental Management System (EMS) provides an organisation with a framework for managing its environmental responsibilities efficiently, and in a manner which is integrated into its overall operations[9]. As service sector operations, the majority of businesses in the tourism supply chain are not directly regulated by environmental authorities and any decision to adopt an environmental management is likely to be done on a voluntary basis.

There are various **international standards for environmental management systems**, among the most widespread in the tourism sector being ISO 14001 and EMAS (see section 1.3). Certification or registration of an EMS to one of these standards means that a third party has assessed that it meets the requirements set out in the standard.

As described further in the *Driving Forces* section of this chapter, there are a variety of factors that may play a role in an organisation deciding to go for certification or registration against an international environmental management standard including that they allow organisations to:

- Demonstrate a commitment to achieving legal and regulatory compliance to regulators and government
- Demonstrate environmental commitment to stakeholders
- Demonstrate an innovative and forward thinking approach to customers and prospective employees
- Increase access to new customers and business partners
- Better manage environmental risks, now and in the future
- Potentially reduce public liability insurance costs
- Enhance reputation[10]

Tourism facilities that want to demonstrate their environmental commitment to stakeholders also have the option of selecting **tourism ecolabels** to certify that they have reached the level of environmental performance stipulated in the ecolabel criteria. With reference to section 1.2, ecolabels may or may not operate with third party certification.

Ecolabels may include components of an environmental management system as part of their criteria, as is the case in the EU ecolabel for accommodation and the Green Key. Table 12 provides a breakdown of the related environmental management requirements between EMAS, the Green Key and the EU ecolabel for accommodation.

9 British Standards Institute, 2011
10 Ibid

Table 12. Overview of differences between ISO 14001/EMAS and The Green Key for Hotels

ISO 14001 and EMAS[11]	Environmental management related criteria in	
	EU ecolabel accommodation[12]	**The Green Key for Hotels[13]**
Organisation of environmental management		
The organisation's top management shall appoint a specific management representative(s), who irrespective of other responsibilities shall have defined roles, responsibilities and authority for the functioning of the EMS, and reporting to top management	No criteria	Management must appoint an environmental manager
Environmental policy		
Top management shall define the organisation's environmental policy and ensure that, within the defined scope of its EMS.	The management shall have an environmental policy and draw up a precise action programme to ensure application of the environmental policy. Declaration of compliance, copy of the environmental policy and action programme, procedures for taking into account input from guests. The tourist accommodation must provide information to guests on its environmental policy.	The business must have an environmental policy, finished no less than 6 months after the business has been awarded the Green Key. The business must establish and maintain a binder containing relevant information on the Green Key.
Legal compliance		
The environmental policy must include a commitment to comply with applicable legal requirements and with other requirements to which the organisation subscribes which relate to its environmental aspects. Organisations shall demonstrate that they: Have identified and know the implications to the organisation of all applicable legal requirements relating to the environment Provide for legal compliance with environmental legislation including permits and permit	The physical structure respects Community, national and local laws and regulations; and the enterprise is operational and registered as required by national and local laws. The physical structure is built legally and respects all relevant laws or regulations of the area on which it is built especially any related to landscape and biodiversity conservation.	The business must comply with the environmental legislation of the respective country. The firm must not be placed on a perimeter that is recognised to be polluted by the national authorities and that present a major risk for the health and security of the guests.

[11] Regulation (EC) No 1221/2009 on EMAS
[12] Summarised from Commission Decision of 9 July 2009 establishing the ecological criteria for the award of the Community eco-label for tourist accommodation service (Annex A Mandatory Criteria)
[13] The Green Key, International Baseline Criteria for Hotels, 2009-10, v1.2

limits Have procedures in place to enable the organisation to meet these requirements on an ongoing basis.		
Staff training		
Organisation shall acknowledge that active employee involvement, and that commitment, responsiveness and active support from the side of the management are prerequisites for continuous and successful environmental improvements Any persons performing tasks with the potential to cause a significant environmental impact(s) shall be competent on the basis of appropriate education, training or experience The organisation shall identify training needs associated with its environmental aspects and shall provide training to meet these needs Procedures shall be in place to make workers aware of the environmental implications of their work	Provide information and training to staff including written procedures or manuals to ensure the application of environmental measures and to raise awareness of environmentally responsible behaviour. In particular taking into account: energy saving, water saving, chemical substances, and waste. Adequate training shall be provided to all new staff within 4 weeks of starting, and for all staff at least once a year	Management must have a meeting with the staff where they are briefed on issues concerning existing and new environmental initiatives. The environmental manager must take part in meetings with management with the purpose of presenting the environmental developments of the business. The environmental manager and other staff members working with environment tasks must participate in a training course concerning environmental issues. The Environmental manager must ensure that the employees have knowledge about the environmental assignments and issues concerning the business
Stakeholder relations		
Procedures shall be established for receiving, documenting and responding to relevant communication from external interested parties Organisations shall be able to demonstrate an open dialogue with the public and other interested parties including local communities and customers	At least one of the main suppliers shall be registered with EMAS or ISO 14001. Where additional services of food or leisure/fitness are subcontracted those shall comply with all mandatory criteria that apply to that specific service (optional criteria)	The business should establish active collaboration with relevant stakeholders (optional criteria)
Data collection		
The organisation shall have procedures to monitor and measure on a regular basis the key characteristics of its operations that can have a significant environmental impact. The procedures shall include the	Accommodation shall have procedures for collecting and monitoring data on energy consumption, electricity and other energy consumption and water consumption. Also chemical consumption. These	The environmental manager of the company must ensure a yearly procedure of the Green Key

documenting of information to monitor performance, applicable operational controls and conformity with the organisation's environmental objectives and targets.	are to be collected at least annually and reported to the competent body annually.	

Although ecolabels include may include a variety of environmental management components, they should not be confused with an environmental management system approach, such as EMAS. Whereas ecolabels inform consumers about a product or service's environmental qualities and guarantee that it takes consideration of the environment without affecting its quality or function, the EMAS logo is linked to an organisation's processes and assures the consumer that the environmental management system is credible and verified, and that the organisation is committed to year-on-year environmental improvements that go beyond legal requirements[14]. The main environmental management requirements that are not included in either of the ecolabels in comparison with EMAS are:

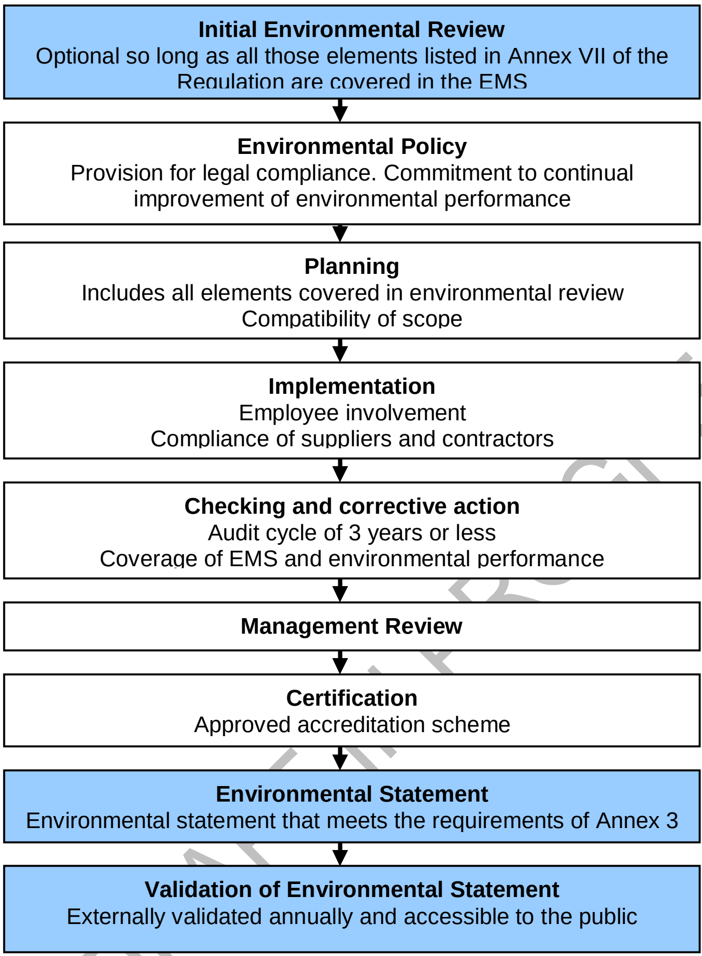
- Environmental review to identify and evaluate environmental aspects before planning commences
- Procedures for identifying direct and indirect environmental aspects, and determination of those aspects that are significant
- Documented environmental objectives and targets at relevant functions and levels within the organisation
- Management commitment to ensuring the availability of resources for the environmental management system
- Training needs assessment of staff
- Operational control
- Emergency preparedness and response
- Procedures for dealing with actual and potential non-conformity and for taking corrective and preventive action
- Conducting internal audits of the EMS at planned intervals
- Top management review of EMS at planned intervals
- Verification of EMS by an external verifier

Thus best environmental management practice for managing the environmental aspects of tourism companies is the implementation of formalised environmental management systems such as EMAS or ISO 14001. However, it could be said that working with an ecolabel that contains environmental management components is a **good step on the way** to EMAS registration. Implementing an ecolabel for a product or service is less resource intensive than implementing an environmental management system, and can help instil a culture of environmental management in the organisation that will come to good use in future progress towards EMAS.

In 1998 EMAS adopted the ISO 14001 standard as the management system element of EMAS in recognition that ISO 14001 could become a stepping stone for EMAS and avoid duplication of efforts. The main differences between ISO 14001 and EMAS are portrayed in the diagram below.

[14] Danish Environmental Protection Agency, 2011 www.mst.dk

Figure 11. EMAS Implementation Route for an ISO 14001 certified organisation



EMAS requirement

Source: EMAS Factsheet, 2008

Establishing an environmental management system and improving environmental performance in an organisation can be seen as a change process, involving both (i) **organisational factors** to build the capacity for environmental management among staff, and (ii) **development of the procedures and written documentation** upon which the EMS is based. Generally companies find it easier to make changes in technology and develop procedures, rather than in organisational factors and company culture. However, experience shows that focused efforts are required in both areas in order to improve environmental performance.

Organisational factors such as **employee involvement, training and awareness raising** are central to *EMAS* and of primary importance for ensuring the successful outcome of environmental management efforts within organisations. Employee participation provides a good way of motivating action towards environmental improvement and is vital for embedding the environmental work in the organisation. Management should thus emphasise employee involvement in the environmental work and invest in training. At the same time it is important to be aware of potential problems that may make employee participation difficult to maintain in the long run, to avoid pitfalls.

Without employee participation, the environmental management effort faces a higher risk of fading out over time due to lack of broad ownership and engagement at different levels of the organisation. Environmental improvements in a company require a collective effort, and it is important to raise awareness among all employees through training and communication about the environmental work, procedures, habits and progress on a regular basis. Examples of the benefits that involving staff in environmental management efforts include:

- Employee involvement and training can lead to improved employee morale and better implementation of the Environmental Management System.
- Helps to obtain information about environmental problems related to operations, that may not be visible to top managers
- Helps to gather suggestions and good ideas about improvement initiatives
- Shared ownership of environmental initiatives helps to integrate and embed environmental efforts in the organisation
- Motivates staff through training and assignment of new job functions
- Increases awareness among employees about environmental issues, efficient use of resources and overall good environmental conduct

Organisations should involve employees actively in[15]:

- The formulation of environmental policies of the organisation
- The initial environmental review and in the analysis of the state of the art and in collecting and verifying information,
- The establishment and implementation of an environmental management and audit system improving environmental performance
- Environmental committees to gather information and to ensure the participation of environmental officer/management representatives and employees and their representatives
- Joint working groups for the environmental action programme and environmental auditing
- The elaboration of the environmental statements.

As an example, the EMAS-registered Hotel Ivory Playas in Majorca took its staff to visit the landfill where all un-recyclable materials were disposed of, and received a presentation from the local authority. This really helped to focus staff awareness about one of the main issues of their environmental management system[16].

Building competence including training employees is a key part of environmental management so it is important that management and employees consider at an early stage what experience and knowledge need to be acquired, either from internal or external sources. When planning competence building, it is important to consider what kind of knowledge and support is needed by employees, i.e. is it technical knowledge, process support, or environmental knowledge[17]? Although employee participation is of great benefit to enhance environmental management efforts, it is important to be aware of possible pitfalls that can counteract the participation, and consider the following when planning employee participation in environmental work:

[15] EC DG Environment. Guidance on employee participation within the framework of EMAS: http://www.idec.gr/etiv/documents/Guidance%20on%20employee%20participation%20within%20the%20framework%20of%20EMAS.pdf
[16] Information received from Hotel Director of Ivory Playas, 2010
[17] Forman et.al., 2002

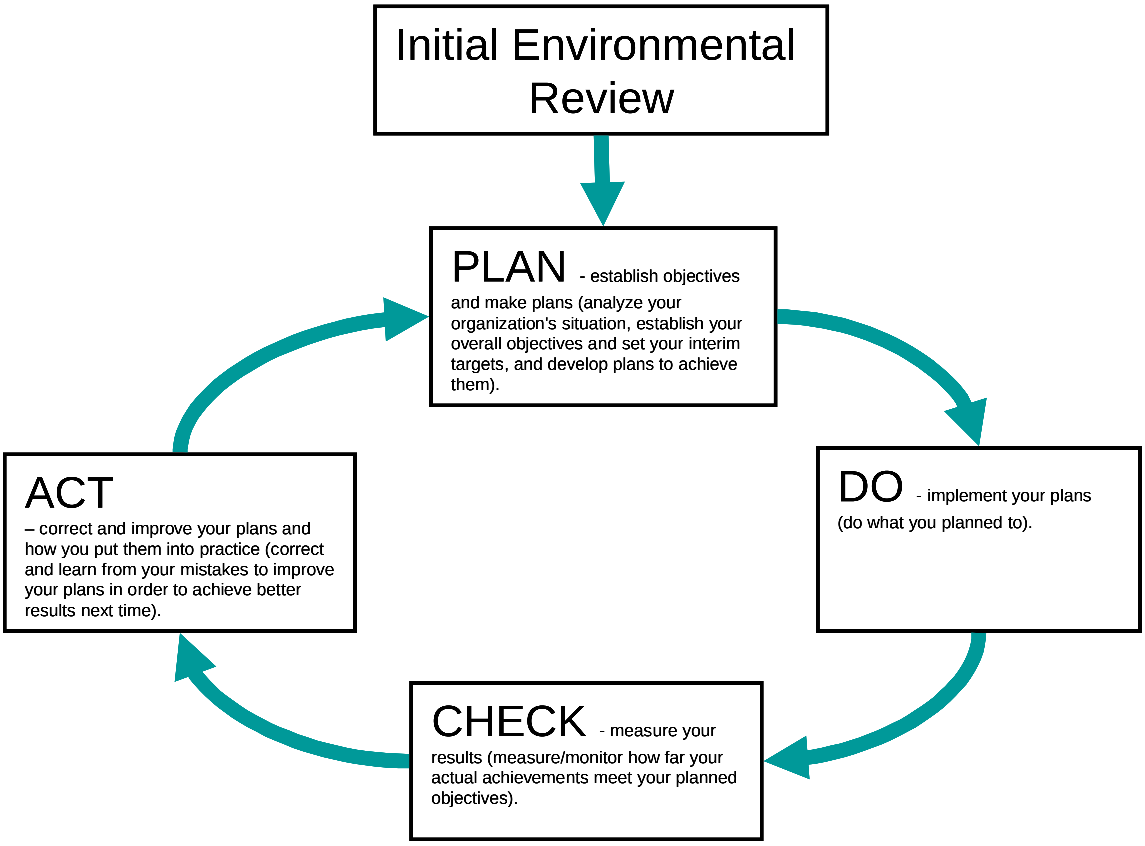
- Are problems regarding environmental work brought forward for discussion?
- Does the employee group have the possibility of developing their competence through support from the environment manager, consultants or through continuing training?
- Do employees experience the methods in connection with environmental work as being easy to understand, and is it possible for the employees to use their experiences from their daily work?
- Is there focus on the problems which can arise when results from environmental projects are to be embedded?
- Do employees have time to participate in new activities such as registering of environmental data, development of environment proposals, etc.?
- Has the distribution of work regarding the environmental work between the environmental co-ordinator, managers, and employees been clarified and made visible? Lack of clarity with regards to time that can be spent on the environmental management, can create confusion about whether the environmental efforts are prioritised, and thus undermine the environmental management efforts.
- Are there information channels ensuring employees access to environmental data and knowledge?
- Do employees have access to support for their environmental work from internal and external resource persons – also after the termination of an environmental project?
- Do environmental co-ordinators follow up on how initiated activities and new routines are experienced by managers and employees?
- Are new projects established quickly, and do they take over focus and resources from the environmental work?
- Are employees involved in planning of changes, and do they get a possibility of using their competence to contribute to the prevention of new environmental problems[18]?

The other core pillar in the construction of an environmental management system is the **development of the procedures and written documentation** upon which the EMS is based. The main building blocks of an EMS are a coherent policy demonstrating top management commitment, identification of significant environmental aspects resulting from business operations, the setting of targets and goals to address these aspects, an action plan, a series of procedures for key work areas and measuring and monitoring. The core approach to environmental management applied in ISO 14001 and EMAS is largely based on the Plan-Do-Check-Act management system. This systematic approach is illustrated in Figure 12, and provides a framework for management to instil a culture of continual improvement in their organisations.

EMAS differs slightly from ISO 14001 in that an initial environmental review is obligatory when it is the first time that an organisation sets its environmental status. ISO 14001 on the other hand recommends an initial review but it is not required[19]. In this process the organisation identifies its key environmental issues that are to be the focus of its environmental management and this activity really kick starts the PDCA cycle. The EMAS-EASY tool has been developed by DG Environment to assist SMEs implement EMAS. EMAS-EASY uses an approach called “ecomapping” to help organisations identify and prioritise their environmental aspects based on the initial environmental review. Ecomapping is a systematic method that builds up a picture of key environmental information by using symbols on a simple plan of the site[20].

[18] Forman et.al., 2002
[19] EC, EMAS Factsheet, May 2008 Third Edition
[20] EC, EMAS-EASY for SMEs, www.emas-easy.eu accessed January 2011

Figure 12. The Plan-Do-Check-Act cycle



Source: Adapted from ISO, 2011

Table 13. Stages of PDCA as applied to ISO 14001

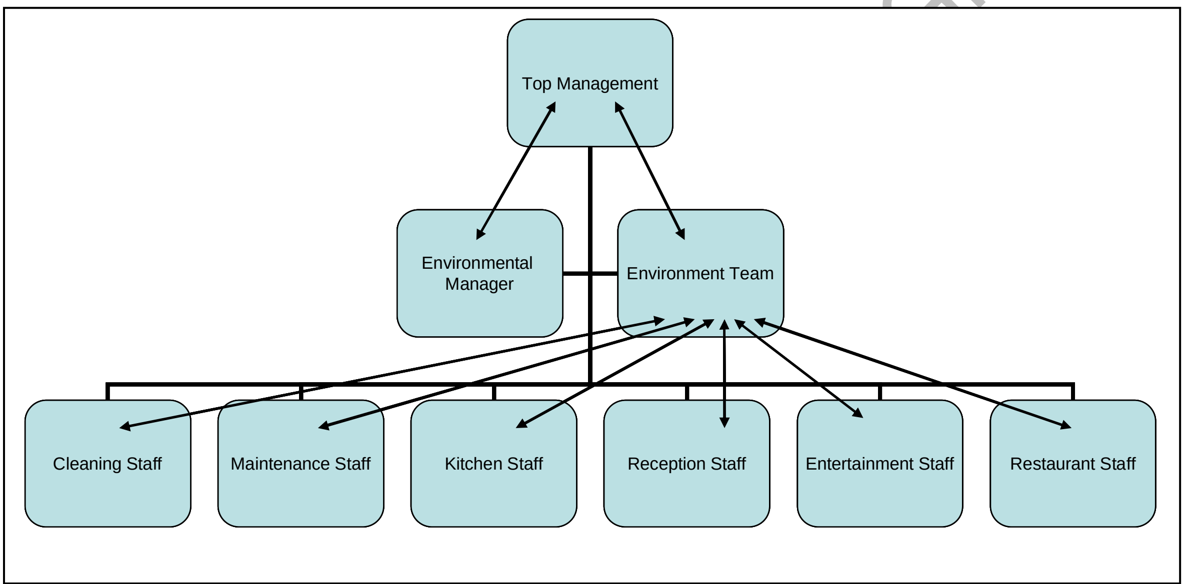
Cycle stage	Management activities/steps	Relevant environmental management tool
Plan	• Identify priority issues (significant aspects) • Establish/modify policy to address issues • Identify performance standards/improvement opportunities (legal requirements, best practice solutions) • Allocate specific responsibilities • Set objectives and targets to meet performance levels • Prepare action plans, programmes and procedures for achieving performance/meeting objectives and targets	Environmental review (initial or subsequent)
Do	• Those responsible implement plans, programmes and procedures	Standards and procedures
Check	• Monitor results • Evaluate performance against policy aims, objectives, targets, plans, programmes and procedures • Determine reasons for deviations, eg non-conformances	Environmental monitoring and management audit
Act	• Take corrective action for non-conformances • Consider performance and adequacy of system elements in delivering desired performance • Ensure changing circumstances are identified • Modify system elements: policy; objectives and targets; responsibilities; plans; programmes; procedures, as necessary	Management review

Source: IOSH, 2009

The table above breaks down the EMS steps according to the PDCA phases. One of the first activities in the planning phase will be for the management to **organise its environmental team and assign responsibilities**. The size of the team is highly reliant on the size of the organisation and will also have resource implications, as discussed further in the Economics section of this chapter. Generally it is advisable to establish a working group to coordinate the environmental work, inform, support and motivate the entire staff. The group should include representatives from each key department, people responsible for training. Ideally the group is chaired by a highly motivated "champion" who is deeply committed to the environmental management program, with good knowledge of the business, have respect from staff, good communication skills and full backup from general management[21].

The organogram below depicts an idealised environmental management set-up, driven by an environment team consisting of the responsible manager and representatives or champions from each of the relevant staff departments.

Figure 13. Basic EMS organisation



Another important aspect of the planning phase is the **development or modification of the organisation's environmental policy** which provides the basis upon which the environmental management system is built. It provides the overall vision and ideals that give the framework for how the environmental management will function. It should also identify those significant environmental aspects of its operations that the business wants to address through its EMS. Ideally the environmental policy will be made publicly available in an area visible to guests and customers.

Often environmental policies function as stand-alone documents, i.e. the company has developed a policy but without a formal environmental management system. Sometimes a policy may be developed for a specific priority area. These are typically developed by companies to dictate their response to key issues that are in the public eye, and to demonstrate their commitment to reducing their contribution to the issue. Examples include a climate policy. Management systems may then be specifically developed for these areas as a result of the policy being developed (see section on Emerging Techniques within this chapter).

[21] ITP, 2008

For a tour operator, effectively integrating sustainability into its supply chain will require the establishment of a coherent company policy and accompanying management system that set out clear targets and actions on economic, environmental and social performance. Building this system on already existing internal processes will help keep down the costs of implementation and promote integration within a company's overall operations[22].

The following is an example from the UK based adventure and activity tour operator Exodus, which developed its Responsible Tourism Policy in 2000. The Policy consisted of 2 key components: a Mission Statement and a Code of Practice[23]. The policy was rooted in 3 key areas: the company's own operations, customer awareness of the issues and destination sustainability. The company created a Responsible Tourism Manager position in the UK and seminars were held for its entire UK staff in order to raise awareness and to contribute to the development of the policy. Since its inception, Exodus' Responsible Tourism Policy has evolved into the following:

We will design and operate our holidays in a way that gives the highest degree of long-term economic benefit to the host communities, whilst also maintaining and/or improving the environment.

- We aim to use local suppliers wherever possible.
- We aim to develop long-term relationships with our partners overseas so that the economic benefit is ongoing.
- We aim to work with our overseas partners to increase the skill sets of our local staff.
- We aim to ensure that our type and scale of tourism is appropriate to local conditions and does not overload local infrastructure.
- We will take into consideration economic, environmental and cultural issues when looking at new destinations.
- We aim to minimise water and atmospheric pollution from any specific tourism development we use.
- We aim to achieve zero litter policies everywhere.
- We aim to work closely with all relevant local bodies and authorities to help preserve or improve the environment and deliver a long-term benefit for the host community.
- Where possible we will encourage local involvement and provide financial support for economic, social or environmental projects that will benefit the local communities.

We will attempt to operate our holidays in a way that encourages positive cultural exchanges.

- We will encourage our clients, through our literature, staff and leaders, to act in a socially responsible way.
- We will attempt to impart an insight and understanding of the host culture and community to our clients so that they can gain more from visiting them.
- We will encourage and train our local partners and staff to gain an insight into the culture and way of life of our clients.

We will attempt to integrate the ethos of responsible tourism throughout our organisation.

- We will run our head office in a responsible manner by using fair-trade products, monitoring, and where possible reducing, our energy usage, as well as recycling.

[22] TOI and CELB, 2004
[23] TOI, 2003

- We will provide regular and ongoing training in the principles and practices of responsible tourism, both to our office staff and those employed directly or indirectly around the world[24].

The policy is implemented through a range of activities including:

- Training of all new staff in the policy
- Training of tour leaders in responsible tourism principles and local cultural importance
- Coordination unit of staff in charge of policy implementation
- Regular reporting and feedback on policy related issues at weekly departmental meetings
- Direct contributions to conservation and development projects in destinations such as installation of solar cookers in Nepal and the Smokeless Stove Programme in Tanzania

Based on the information received, it does not seem that Exodus' Responsible Tourism Policy is supported by an environmental management system based on the PDCA model. This makes it difficult to measure and monitor performance, and to communicate that to interested parties. Table 14 provides examples of environmental policies developed by tourism businesses in the accommodation, restaurant and tour operator sectors.

Table 14. Environmental policy examples

Scandic Hotels	"No company can avoid taking responsibility for the environment and focusing on environmental issues. Scandic shall, therefore, lead the way and work continuously to promote both a reduction in our environmental impact and a better environment. Scandic shall contribute to a sustainable society[25]".
London Bridge Hotel	"At London Bridge Hotel we are committed to the implementation of proactive measures to help protect and sustain the environment for future generations. We recognise the impact of our operations on the environment and aim to minimise any detrimental effects that may occur. By working together we can contribute to making a cleaner and safer environment and ensure environmental issues remain a focal point and receive proper attention. In delivering our commitment we will :- ▪ Comply with relevant environmental legislation and take a proactive approach to future requirements and obligations. ▪ Seek to conserve natural resources through the responsible use of energy, water and materials but also maintaining the quality of service expected by our guests. ▪ Monitor performance and aim for continued improvement by reducing re-using, and recycling in areas such as energy consumption, reduction of waste materials and water consumption. ▪ Work with suppliers who have compatible policies for managing their impact on the environment. ▪ Through our active environmental team we will ensure that our efforts are continually reviewed , updated and communicated to all staff[26]".
St Columba Hotel, Isle of Iona	"At this time in world history we believe that as a business we have a responsibility not only to minimise our impact but also to make environmental policy a key and integral part of our business strategy. For us this translates in to three main areas of action and planning. 1. On an immediate level we are committed to day to day policy which will minimise our environmental impact. Examples would be that we recycle

[24] Exodus http://www.exodus.co.uk/responsible-travel/responsible-tourism-policy?

[25] Scandic Hotels, Scandic Environmental Refurbishment Equipment and Construction Standard (SERECS)

[26] London Bridge Hotel http://www.londonbridgehotel.com/environmental-policy.html

	glass, tin and cardboard and that we use energy saving bulbs wherever possible. 2. In the medium term we are implementing strategies which we see as over and above the basic day to day policies. Examples of these strategies would be the recent setting up of our own facility to recycle used cooking oil into bio-diesel. Also, in the winter of 2007 we replaced all of our sunlounge windows with double glazed units. 3. We are also looking at the long term. For us this involves looking at ways in which we can run the hotel using an increasing amount of renewable energy sources. In January 2009 we fitted solar panels which will help with heating our water. We are watching the developments in wind energy with interest[27]".
Hotel Svendborg, Course and Conference Centre, Denmark	▪ "We will be in regular contact with an energy consultant in order to realise energy efficiency measures ▪ We will ensure that new equipment (fridges, minibars, washing machines) will be low energy consumption ▪ Where possible, we will use water saving shower heads, and water saving equipment such as toilets and taps[28]"
Sindal Camping, Denmark	▪ "As owners of Sindal Camping it has always been our conviction that the campsite is to be run in harmony with nature and the environment. ▪ It is essential to us that the seasonal staff follow this principal. In practical terms they are instructed in correct dosing of detergents etc. ▪ We will try and keep aware of new and alternative opportunities for site maintenance, weed and pest control and use these if sustainable ▪ In our marketing and also on the campsite we will provide information on our initiatives to guests in order to inspire them to be more green ▪ Sindal Camping has a comprehensive use of energy saving measures: low energy lighting, movement sensors and automatic ventilation and will continue to follow developments in these areas ▪ Sindal Camping has entered into an agreement with AVV I/S Hjørring with regard to waste management and sorts into glass, paper, batteries, plastics and cardboard categories[29]."
Camping Casa di Caccia, Italy	"This Environmental Policy is the commitment to "Camping Casa di Caccia" to the environment having the form: **Prevention**: The property is committed to the 'identify the activities that generate significant environmental impacts, plan their treatment to eliminate, or where this is not possible, reduce pollution resulting from these activities. **Compliance with laws**: The property is committed to meet the legal requirements laid down by law, and those in any commitments made by the property. **Programming**: the property agrees to identify environmental targets for improvement for the management of significant aspects.. **Control**: The establishment is committed to regularly and systematically monitor its activities with significant environmental impact. **Technical-economic opportunities**: the structure is committed to pursuing continuous improvement of its performance with the use of best available technology, provided that appropriate and economically feasible. **Communication**: The Structure is committed in improving communication,

[27] St Columa Hotel, http://www.stcolumba-hotel.co.uk/?pid=35
[28] Svendborg Hotel http://hotel-svendborg.dk/index.php?page=182
[29] Sindal Camping http://www.sindal-camping.dk/index.php?id=329&L=1

	transparency and awareness raising to staff, customers and local communities on environment for collaboration and strengthen confidence in their services[30]."
Burton Hill Camping and Caravanning, UK	"We are committed to our aim to provide our visitors and residents with an environmentally friendly campsite; it is our aim to provide recycling facilities, to use renewable energy where possible, to provide a haven for wildlife, in fact to be as energy efficient and 'green' as we can[31]."
The Dining Room at Purchase's (Restaurant), UK	▪ "To make the business accountable for it's own actions in regard to the impact on the environment ▪ To comply with all relevant legislation and be proactive in promoting others, customers, supplier and staff to follow our example. ▪ To continually monitor and act upon our usage of energy and recycling and to look for improvements, producing graphs to illustrate usage/wastage and possible savings32".
Rob Roy Tours, UK	"At Rob Roy Tours Ltd, we are committed to working in a sustainable way. We are undertaking the following actions in order to achieve this. ▪ We have joined the Green Tourism Business Scheme ▪ We aim to be energy efficient - our appliances and boiler are A or B rated, we have good loft insulation and our lighting is low energy. ▪ We use water wisely – we have low flush toilets and a water butt. ▪ We buy recycled products and eco-friendly products. ▪ We have native trees in the office garden and put up bird boxes in the grounds. ▪ We minimize our waste as well as recycling and composting what we can ▪ We publish our catalogue and detailed tour literature only on the Internet, to avoid waste. ▪ We have public transport information for customers. ▪ Transport on tours is by minibus for small groups and coach for larger groups. We also use train connections and ferries. We support public transport. ▪ We use local wherever possible. We support small communities by using small family owned B & B's wherever possible. ▪ We look for similar commitment for the businesses we deal with, such as hotels and tourist attractions. We look for Green Partners. ▪ We ask customers to observe the Countryside code. On our walks we are careful to avoid causing damage or disturbance to wildlife[33]."
TUI Travel PLC Group Sustainable Travel Policy	"As a leading leisure travel company, we recognise that the environment, communities and cultures within which we operate are vital to the success of our business. Responsible Leadership is one of the company's core values, and underlines our commitment to sustainable development and to making a positive impact on society. We therefore commit in the long term to: ▪ Embed sustainable development principles into core business practices throughout TUI Travel ▪ Use the collective influence of TUI Travel to drive sustainability within the leisure travel industry ▪ Understand and respect the needs of our stakeholders, including customers,

[30] Camping Casa di Caccia http://www.campingcasadicaccia.com/en/policy-campsite.asp
[31] Burton Hill Camping and Caravanning http://www.burtonhill.co.uk/index.html
[32] The Dining Room at Purchases http://www.thediningroom.biz/environmental_policy.html
[33] Rob Roy Tours http://www.robroytours.com/robroytours/content/view/81/103/lang,en/

	colleagues, shareholders, suppliers, industry partners and local communities ▪ Comply with all relevant legislation, act in advance of it where possible, and keep pace with best practice ▪ Deliver long-term strategic benefit and shareholder value by maximising the opportunities that sustainable development presents ▪ In support of the above, we will work to: ▪ Prevent pollution wherever possible, and continually improve our environmental performance, specifically by reducing our carbon emissions through work programmes with our aircraft, water transport, hotels, ground transport and office premises ▪ Optimise our holidays' environmental, economic and social impact, by embedding sustainability into our supply chain and initiating activities that protect and restore the natural environment and enhance local livelihoods ▪ Provide information, training and support to colleagues, gaining their commitment to taking action on sustainable development issues ▪ Encourage our customers to choose more sustainable leisure travel options, and to take action to reduce their negative impacts and maximise their positive impacts in destinations ▪ Responsibility for ensuring that each operating business complies with the Group's policy on sustainable development is with the Managing Director of each business[34]."

The relevant key aspects and impacts identified in the Environmental Policy indicate **where activities should be focussed**. For example, if the environmental aspect considered most relevant is energy use, it would make sense to prioritise activities to reduce the energy consumption before starting up other improvement activities. The possible energy initiatives must also be prioritised, and those activities implemented where most improvements can be made with the least cost and/or highest payback. When prioritising and deciding which of these or other activities should be implemented, it is often advisable to bring in external experts to help analyse and come with recommendations on feasibility of investment options. In any case, it is valuable to consider the following:

- How much the activity cost and what is the expected payback time?
  - Make a cost-benefit analysis comparing the costs and benefits of implementing certain activities, considering life cycle costs (see section on responsible purchasing below).
- Does the activity increase or decrease customer comfort and/or satisfaction?
  - Consider trade-offs between environmental improvements and customer satisfaction. Often environmental improvements and increased customer satisfaction go hand in hand. Sometimes however, there is risk that activities could be perceived negatively by the customer, due to e.g. less comfort. An example could be limitations on control over e.g. heating, water use, lighting etc. Therefore seek ways to improve environmental performance without reducing guest comfort and satisfaction. It is also important to communicate with the customer on how he/she is participating in reducing environmental impacts, to raise awareness and encourage positive perception of the initiatives taken.

[34] TUI Travel PLC, Group Sustainable Tourism Policy, http://sd2008.tuitravelplc.com/tui-sd/pages/ourapproach/embedding/grouppolicy?whoareyou=add&customer=true&submit=Submit

Another important element is the identification of the **environmental targets** that the company is to strive to achieve through its environmental management. Table 15 presents examples of environmental targets that have been developed by tourism companies.

Table 15. Examples of environmental targets of tourism companies

Hotel Svendborg, Denmark	"During 2007 we will change all light bulbs on the fourth floor so that there are energy saving light bulbs in all rooms. We will have completely installed energy saving light bulbs in the whole hotel by 2010. In conjunction with the renovation of the second floor we will purchase minibars with a low energy consumption. We will change employee behaviour to make sure that they remember to turn-off lights, hearing and ventilation when rooms and common areas are vacated[35]".
Hilton Hotels	Hilton Hotels has set a range of sustainability targets it aims to reach by 2014. These include: Reducing energy consumption from direct operations by 20 percent; Reducing CO2 emissions by 20 percent; Reducing output of waste by 20 percent; and Reducing water consumption by 10 percent[36].

In order to complete the planning phase of the PDCA cycle, the company must then prepare action plans, programmes and procedures for achieving performance/meeting objectives and targets. The EMAS toolkit is a useful guide in this work and is provided by the EMAS website: http://ec.europa.eu/environment/emas/toolkit/toolkit_1.htm. This explains in detail what must be done at the different stages of the PDCA cycle, for example in relation to document control.

The **Management Review** is a critical part of any EMS. In this review, selected representatives of the top management evaluate the management system against the pre-defined environmental targets, addressing any possible need for changes to policy, objectives and other elements of the EMS.

The EMAS toolkit provides a useful template for the Management Review report, as presented overleaf:

[35] Svendborg Hotel website accessed at http://hotel-svendborg.dk/index.php?page=182 January 2011
[36] http://www.environmentalleader.com/2008/06/05/hilton-sets-target-of-20-co2-reduction-by-2014/ Jan 2011

MANAGEMENT REVIEW

Participants:

Documents examine:

- Control panel and indicators
- Report on legal changes
- List of documents – records – logbook
- Results of the internal audits

1) Internal audits (efficiency of corrective and preventive actions)

Nonconformities observed	Corrective Action /Preventive Action taken (Y/N)	Reasons

2) Document efficiency

	OK	Necessary changes
Procedures		
Forms		
Other		

3) Complaints analysis

Complaints received	Response to the complaint

4) Environmental policy efficiency

YES/NO	Reasons

Develop a new environmental policy ? YES / NO

5) Change in the EMS

Type of change	Document	Duration	Person in charge

Achieved environmental benefit

The environmental benefits achieved from implementing an environmental management system are related to the savings achieved in resource and material consumption, as well as replacement of existing infrastructure with less polluting alternatives. Making improvements in these input parameters will also contribute to environmental benefits in terms of reduced impacts from their use. For example, reducing heat energy consumption will not only lead to lower use of fuels such as natural gas, it will also lead to reduced air emissions from the combustion of the fuel in the use phase. Examples of what can be done are explored further in the other best environmental management practice sections of this reference document.

Appropriate environmental indicator

Environmental indicators can be divided into:

- Environmental performance indicators: Monitor the company's environmental performance. Typical examples are an organisation's energy consumption, amount of waste per unit of output, total volume of transportation. They are often divided into materials, energy, infrastructure and transportation indicators.
- Environmental management indicators: Present the actions taken. Examples could be the hours of employees' environmental training, number of audits conducted, number of supplier assessments, ...
- Environmental condition indicators: Describe the quality of the environment surrounding the organisation. Makes sense only if the organisation is the main cause of an environmental problem[37].

The EMAS Toolkit provides the following examples of environmental management indicators:

Environmental Management Indicators	**Goodhousekeeping**	
	Number of actions realised	
	Number of new ideas	
	Financial benefits realised	
	Training	
	Number of training hours per worker	
	Total hours of training per year	
	Purchasing & Subcontracting	
	% green criteria	
	Dialogues with suppliers	
	Transport of goods	
	Legal issues and market place	
	Number of legal checks	
	Number of enquiries to subcontractors	
	Environmental management system	
	Number of internal audits	
	Number of spotchecks	
	Corrective actions closed	
	% of targets achieved	
	Social issues	
	Insertion of unemployed workers	
	Apprentices	

[37] EMAS Toolkit

Cross-media effects

Not only do tourism organisations, from accommodation to restaurants to tour operators, sell a service to their customers, but they also aim to sell an experience of a sufficient quality that will encourage the customers to use their services again and again. Through environmental management an organisation identifies its significant environmental aspects and what it can do to reduce these, including work with electricity consumption, heating and cooling. These factors are also of paramount importance for the quality of the customer experience in the service that they have purchased. One potential cross-media risk that needs careful attention is that reductions in resource and material consumption directly affect the quality of the product. Obtaining feedback from guests on the quality of their experience is an essential means of checking that the environmental management is contributing to, rather than detracting from, the quality of the experience.

An example of a basic on-line guest questionnaire from the Atlas City Hotel in Budapest is provided below[38]. In addition a questionnaire format like this can be extrapolated to include good advice from guests for the environmental management.

The Management of Atlas City Hotel

Service	Excellent	Good	Average	Below Average
Helpfulness of Receptionists				
Room Amenities				
Cleanliness				
Quality of Breakfast				
Staff, Services				
Transfer or taxi service				
Would you stay in our hotel again if returning to Budapest?	yes		no	
Would you recommend Atlas City Hotel to any of your friends?	yes		no	
What was the aim of your trip?	Individual trip			
Where did you hear about our hotel?				
Name of Hotelportal:				
Internet Advertisement, please specify:				
Advertisement, which magazine:				
Name of Travel Agency:				

38 http://www.atlashotelbudapest.com/eng/guest_questionnaire/10_guest_book.html accessed January 2011

Recommendation from a friend:	☐	
Other:	☐	
Please select your country.	choose	
Sex:	male ○	female ○
Age:	choose	
Comment:		

Operational data

Insufficient information was located on operational data relating to typical management systems in use in the tourism sector. Operational data related to the costs of implementing an EMS are presented in the section below on Economics.

Case Studies

The information presented in this section is taken from a presentation of the EU LIFE sponsored GREENTAS project, which sought to develop methods and tools for good environmental performance in Jordan's tourist accommodation sector[39]. Two Mövenpick hotels, the Mövenpick Resort Petra with 183 rooms and suites and the Mövenpick Resort and Spa Dead Sea with 346 rooms (Figures 14 and 15), were selected to function as pilot studies for the project.

During the project, full EMSs were implemented at the two hotels, and these were verified against EMAS. Furthermore a series of environmental initiatives were taken to address the identified significant environmental aspects. Economic data was gathered throughout for the purpose of developing a cost benefit analysis.

[39] Vatyliotou, M., 2008

Figure 14. Mövenpick Resort & Spa Dead Sea

Source: www.seejordan.org/.../DeadSea-Movenpick.htm

Figure 15. Mövenpick Resort Petra

Source: http://images.hotels-world.com/2//org/131/hotelPhoto/1483_Movenpick_Resort_Petra.jpg

Table 16 provides a breakdown of the costs involved in the EMAS implementation and verification process for both hotels. The larger hotel at the Dead Sea resort required more resources for the EMS set-up phase (e.g. hiring of a part timer) and for the verification phase.

Table 16. Breakdown of costs related to EMAS implementation in Jordan

Action	**Total Cost at Mövenpick Resort Petra (EUR)**	**Total Cost at Mövenpick Resort and Spa Dead Sea (EUR)**
1. Consultancy to set up the System	10,000	10,000
2. Hiring of temporary part timer to assist in the EMS set-up	-	2,300
3. Invitation of verifiers	8,000	10,000
4. Training invested in the setting up of EMS	4 full days x 20 trainees Total cost of 10,000	4 full days x 60 trainees Total cost of 10,000
5. Designating an environmental manager (part of his job description) to work on the EMS at 15% of his monthly time	(3.3 human days per month × 6 months = 19.8 hours) Cost per month = 272 Total cost of 1,600	(3.3 human days per month × 6 months = 19.8 hours) Cost per month = 272 Total cost of 1,600
Totals (EUR)	29,600	34,000

Source: Vatyliotou, M., 2008

The table also shows that the most significant costs were related to the use of consultants, invitation of verifiers and environmental training of staff. During the action phase of the Plan-Do-Check-Act EMS cycle, both hotels implemented a range of environmental measures to address significant environmental aspects. The economics are summarised below for these measures.

Table 17. Economics of environmental actions

Environmental aspect	Mövenpick Resort Petra	Mövenpick Resort and Spa Dead Sea
Energy	Replacement of diesel oil fired boilers with LPG fired boilers at a cost of 31,500 EUR giving a saving per year of 18,800 EUR and a pay back period of 1.7 years. In addition a 30% CO2 reduction was achieved. Introduction of key card system in rooms at a cost of 13,200 EUR. Saving per year was 39,000 EUR giving a pay back period of 4 months. Furthermore, hotel electricity consumption was reduced by 20%.	Replacement of diesel oil fired boilers with LPG fired boilers at a cost of 63,000 EUR giving a saving per year of 54,000 EUR and a pay back period of 1.2 years. In addition a 30% CO2 reduction was achieved.
Waste separation	-	Purchased bins to encourage waste separation at a cost of 2,700 EUR. Staff costs to ensure waste separation were put at 540 EUR per month. Basically the hotel was able to reduce its solid waste fraction and achieve its EMS targets.
Air pollution	-	At a cost of 180,000 EUR the hotel replaced its bus fleet. The savings per year gave a 6 year pay back period. At the same time CO2 emissions were nearly halved.
Maintenance	Maintenance actions were put at 1,800 EUR per month. The Environmental Manager cost a further 270 EUR per month. The main benefit was the continuation of the work on the EMS.	Maintenance actions were put at 5,400 EUR per month. The Environmental Manager cost a further 270 EUR per month. The main benefit was the continuation of the work on the EMS.

As is further discussed in the Economics section within this chapter, the costs were greatest in the first year of operation of the EMS. This was largely a result of a series of one-off costs such as training and verification.

Applicability

Environmental management systems are relevant to every organisation with an environmental impact. They are applicable for use by single site to large multi-national companies[40]. Based on the data on EMAS uptake presented in section 1.3 of this reference document, it would be fair to say that EMS are most widespread in the serviced accommodation sector, and are less common among food and beverage and tour operators. This could be because of the relative size of the latter organisations, and the fact that their direct environmental aspects are likely to be less significant to that of accommodation. Furthermore, it is likely that there is more pressure on accommodation services, both within the supply chain and from customers, to work with EMS.

Economics

There are economic costs and benefits related to EMS implementation and maintenance. The **costs** are related to the time needed to build the Plan-Do-Check-Act components of the system from own staff and potentially from external consultants, as well as the costs associated with registration or certification of the system against a formal standard such as EMAS or ISO 14001. An organisation may be able to access various **incentive programmes** that authorities in particular put in place to encourage uptake of EMS standards – in which case these will help to reduce the costs associated with either development of the system or its maintenance or both. The **benefits** that the organisation may realise based on its EMS are both tangible and intangible. This section will explore these issues in further detail.

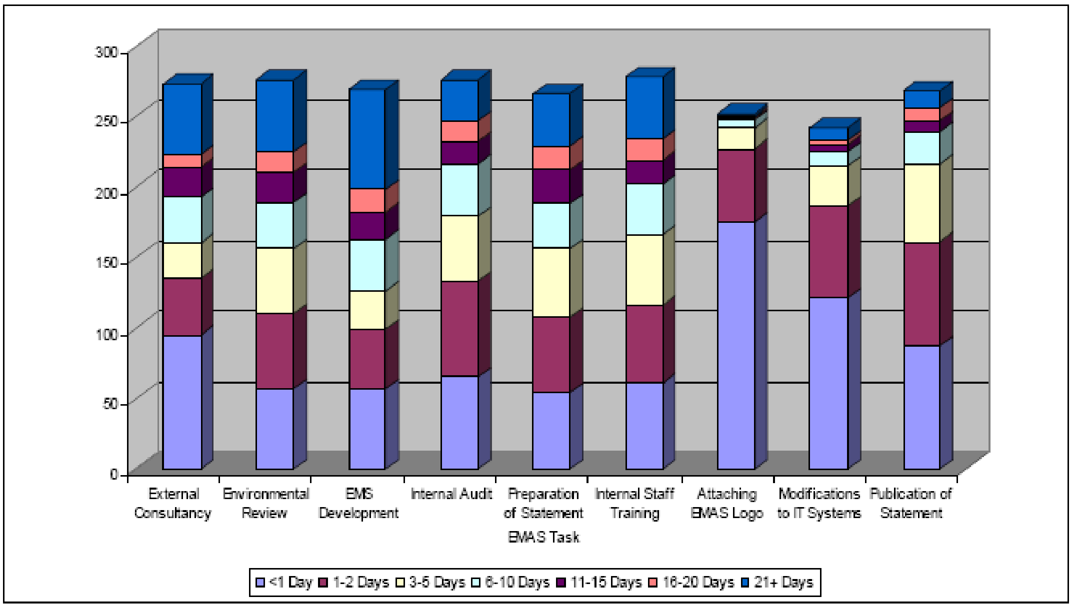
In terms of costs, the main cost is the time needed to implement the EMS. The time needed is a reflection of the size of the company and the complexity of its operations. Accor is one of the world's largest hotel chains and in 2007 it managed 4,121 hotels under 13 different brand names world wide (Sofitel, Pullman, Novotel, Mercure, Suitehotel, Adagio, Ibis, All Seasons, Etap, Formule 1, Motel 6, Accor Thalassa). In 1994 Accor set up its environmental department which now consists of 56 correspondents worldwide and is led by one designated environmental manager[41].

At the other end of the scale, the EC has developed the EMAS EASY toolkit specifically for SMEs. This has been tried and tested and results show that companies can realise EMAS registration based on 10 days of work, by 10 people, developing 10 pages of documentation though on the proviso that they have already made some headway on their EMS. EMASeasy is typically facilitated by a consultant in clusters of, perhaps, five to ten organisations[42].

[40] British Standards Institute www.bsi.com accessed January 2011
[41] Sustainability in the Hospitality Industry: Principles of Sustainable Operations, 2009
[42] www.emas-easy.eu

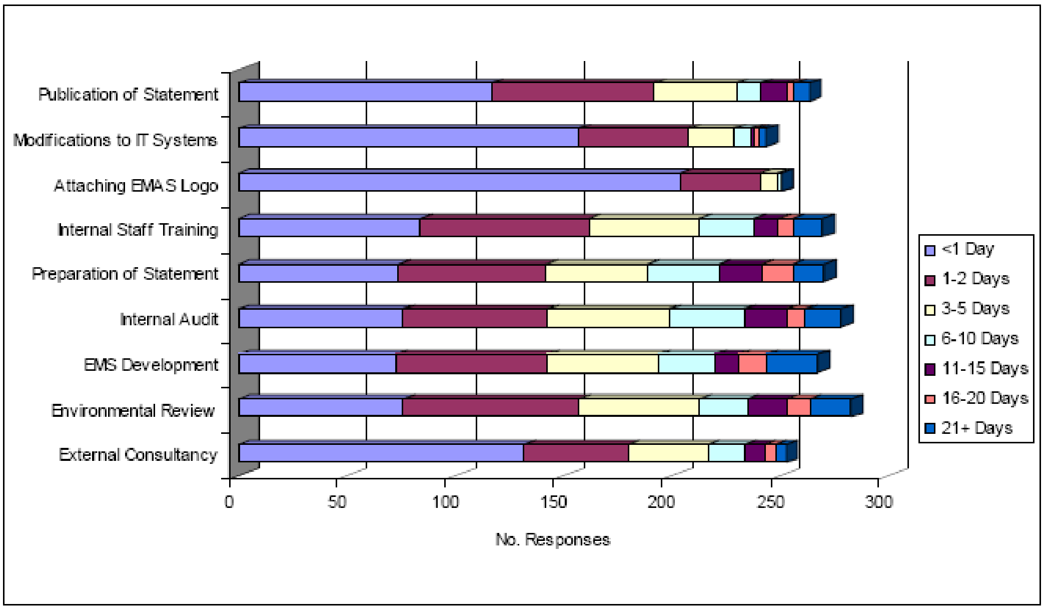
In a recent study on the costs and benefits of EMAS, registered companies in both the private and public sectors were asked to indicate the number of person-days (of either their own staff or outside contractors) required to first implement EMAS, which gives a good indication of the time needed. The range of responses was quite varied. External consultancy was used by most respondents to implement EMAS (59%). There may be a trade-off between the complexity of the EMAS system (higher in larger organisations) and the expertise available (also likely to be higher in larger organisations). The most time-consuming tasks for internal staff are the environmental review, EMS development and internal audit. A summary of the person days required to maintain and implement EMAS by each task is provided in Figures 16 and 17.

Figure 16. Person days to implement EMAS by task



Source: EC, 2009

Figure 17. Person days to maintain EMAS by task

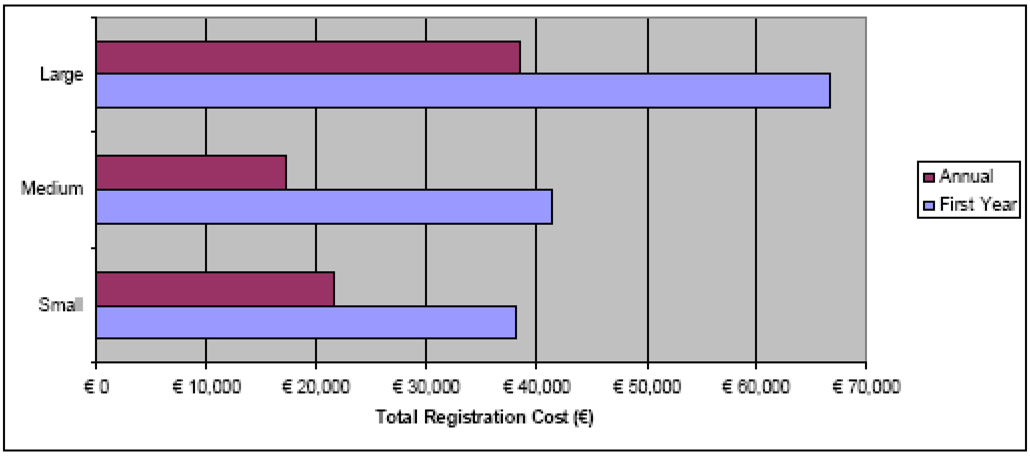


Source: EC, 2009

In general it can be seen that the time consumption for the various tasks associated with EMAS decreases substantially after the implementation phase had been completed. This is also the general experience with other environmental management systems. It could however be concluded that the time needed for an organisation to implement and maintain an ISO 14001 certifiable EMS would be less than the time needed for the same organisation to implement and maintain EMAS.

The higher costs during the implementation period in relation to following years are borne out by the results of the EMAS survey. Based on the completed questionnaires, the estimated average costs of a typical EMAS organisation amount to around 48,000 EUR for the first year and 26,000 EUR annually for subsequent years. Thus costs in subsequent years are around half of those in the first year, on average. The average total costs estimated for organisations of different sizes are presented in the figure below.

Figure 18: Total average cost of maintaining and implementing EMAS by organisation size



Source: EC, 2009

Some countries offer **incentive programmes**, either broadly targeted at the private sector or specifically for tourism establishments, to go for EMAS. The Government of the Balearics launched its Ecologia y Turismo (ECOTUR) programme in 1997, which is an umbrella programme for the environmental improvement of the tourism sector. To start with different initiatives were directed at the main tourism products: destinations, facilities, promotion and applications, which were able to get involved in voluntary environmental management. A year later the regional authorities issued a decree for subsidies to be granted for 30 tourism facilities implementing EMAS: 25 hotels, four marinas and one golf course. This model was since followed by the public administration of Catalonia and the Spanish Ministry of Economy[43].

[43] Anguera et al, 2000

Accommodation facilities on the island of Majorca enjoy tax reductions if they have EMAS[44]. Another example is the municipality of Valencia which offers free training on environmental management in hotels to SMEs and independent professionals. Participants acquire the knowledge and tools necessary to implement an environmental management system that can lead to an EMAS registration or certification in accordance with the ISO 14001 standard. The course "Environmental Management in Hotels" is part of a wider initiative that aims to help SMEs and independent professionals capitalize the environmental aspects of their businesses in order to strengthen and improve their competitiveness. Other courses on offer deal with areas such as: environmental legislation, eco-efficiency, eco-design, waste management and environmental risk management. The programme is co-financed by the European Social Fund[45].

An EMS brings both **tangible and intangible benefits** to the implementing organisation. The techniques presented in this reference document are examples of some of the initiatives that can be launched in conjunction with an EMS and therefore contribute to the tangible benefits to the company bottom-line that an EMS brings, for example installation of heat pumps. Of course, an EMS is not a prerequisite to install renewable energy installations, but the EMS generates and makes transparent to top management the kind of background data on which investment decisions such as these are made. Often hotels find that they are able to consume 20% less water and energy through simple resource-saving measures[46]. Furthermore experiences from Scandic show that an investment made in environmental training can result in a payback period per team member of less than six months[47].

In terms of the intangible benefits, there are a range of benefits that EMS brings to the company that it is difficult to put a price on. As discussed before, implementation of an EMS is an exercise in risk management which has inherent implications for protection of the company brand. As researchers have pointed out, company image and credibility is of particular importance for the tourism sector. This is because "tourism is a high-involvement, high-risk product involving physical, social, and psychological risk (Kotler, 1999), so people may make the final purchase decision based on security and credibility of the tourist business"[48]. Implementation of an EMS may bring other intangible benefits such as increased ability to attract and retain staff who want to work for an employer who reflects their own beliefs, and help build good relationships with the local community[49].

Driving force for implementation

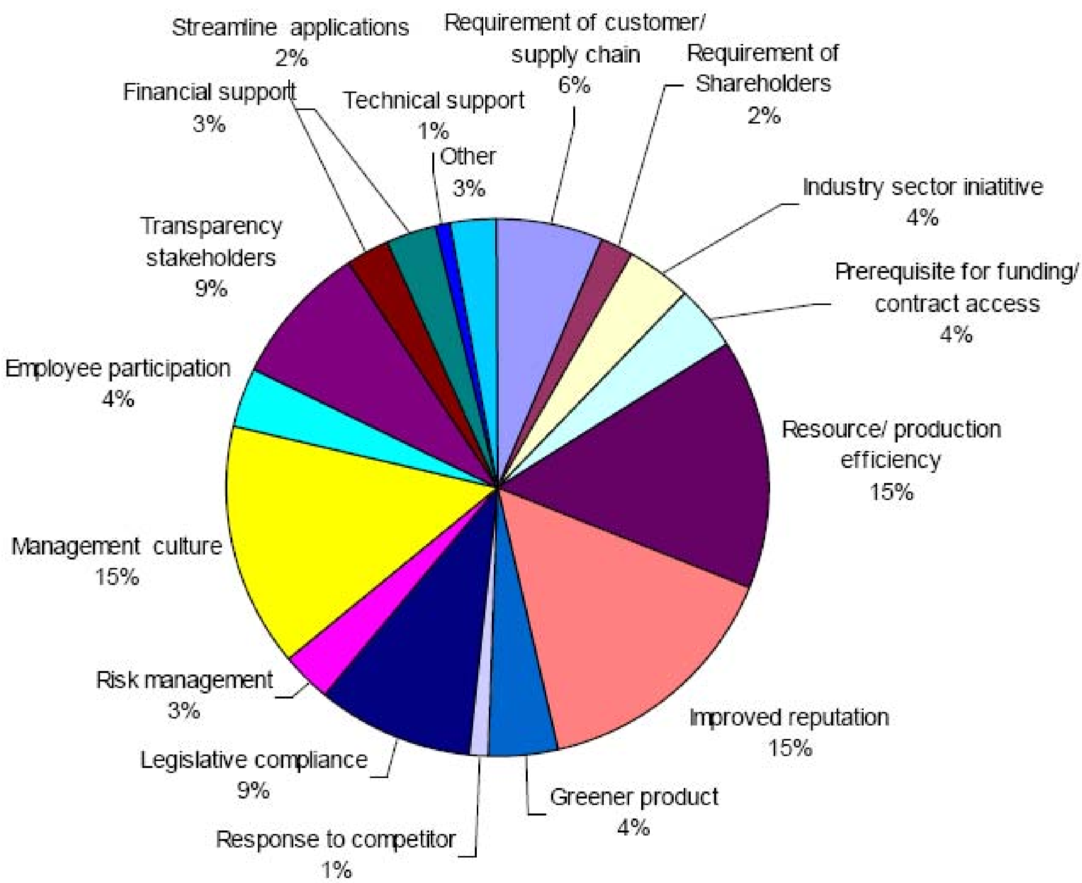
Researchers have pointed out that the hospitality and tourism industry is under pressure to become more environmentally friendly from the following forces: (a) consumer demand, (b) increasing environmental regulation, (c) managerial concern with ethics, (d) customer satisfaction, (e) maintenance issues related to the physical plant, and (f) the need for aesthetics. An additional two factors have also been identified exerting pressure for change: the increase in influence of the "green" investor including banks that want to limit exposure to environmental risk, and the influence of environmental pressure groups on consumer behaviour[50].

[44] Information from EMAS registered hotel: Ivory Playas, Majorca, 2010
[45] EC DG Environment Archives Tourism (NACE Code 55)
[46] ITP, 2008
[47] ITP, 2008
[48] Saskia Faulk, E., 2000
[49] ITP, 2008
[50] Saskia Faulk, E., 2000

The benefits for businesses implementing an environmental management system are manifold. A set of examples of these benefits are provided below which are akin to driving forces pushing or pulling a company to work with EMS[51]:

- Image profiling – showing engagement as a responsible business
- Tool for dialogue – the EMS reinforces partner confidence (consumers, investors, communities, associations and organisations for environmental protection, public authorities etc.).
- Prevention – a possible return on investment in regard to consumption and waste management
- Internal motivation – the employees join in a project that has direct impact on their professional lives (health, safety)
- Anticipating environmental and sustainable development trends – the rise in awareness of the concept of sustainable development allows companies having anticipated environmental protection development to profit from a first-mover advantage
- Marketing – a positive image of a caring, environment friendly organisation can be developed and can be used to differentiate itself from the competition

Figure 19. Private sector reasons for adopting EMAS



Source: EC, 2009

[51] Sustainability in the Hospitality Industry: Principles of Sustainable Operations, 2009

In a recent study on the costs and benefits of EMAS, registered companies in both the private and public sectors were asked to indicate which of a list of impacts of EMAS had been the most positive for them (Figure 19). The most positive impact for the private sector, identified by 29% of respondents, was energy/resource saving[52]. This was followed by improved stakeholder relations and reduction in negative incidents. The figure above provides a breakdown of the private sector reasons for adopting EMAS. The main reasons given by respondents was resource and production efficiency (15%), improved reputation (15%) and the influence of the management culture (15%). This is assessed to be a good reflection of the main driving forces for systematic environmental management.

Emerging Techniques

An emerging technique is the likely evolution of the existing ISO international standard on Social Responsibility ISO 26000 into a management standard which companies can be certified against. ISO 26000 both adds value to existing work on social responsibility (SR) and extends the understanding and implementation of SR by:

- Developing an international consensus on what SR means and the SR issues that organizations need to address
- Providing guidance on translating principles into effective actions
- Refining best practices that have already evolved and disseminating the information worldwide for the good of the international community[53].

Dansk Standard has developed DS 26001, a social responsibility management system standard, and DS 26004 Guidance on SR. Corporate Social Responsibility is of particular interest to tourism, which has often been criticised for its social and cultural impacts. It therefore makes sense for tourism companies to consider integrating CSR into their management systems or having one management system that covers environment, CSR and quality.

Reference tourism companies

As documented in section 1.3, a number of tourism companies have implemented environmental management systems in accordance with international standards such as EMAS and ISO 14001. Some of them are:

- Terceira Mar Hotel, Portugal
- Hotel Ivory Playas, Mallorca
- Strandcamping Wallnau, Germany
- Bibione Mare, Italy
- Stiftung Internationales begegnungszentrum St. Marienthal, Austria
- Gran Hotel Conde Duque, Spain
- Camping Stieglitz, Germany

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[52] EC, Study of the Costs and Benefits of EMAS to the Registered Organisations, 2009
[53] ISO, 2011

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A2. Monitoring and Maintenance

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

2.2 Serviced Accommodation

2.2.1 Best Environmental Management Practice for Improving the Energy Performance of Serviced Accommodation

SA1. Retrofitting the Building Envelope for Optimal Energy Performance
To be completed by IPTS.

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

SA2 Optimising Heating, Ventilation and Air Conditioning

> Installation of Heat Pump for Heating, Cooling, and Hot Water

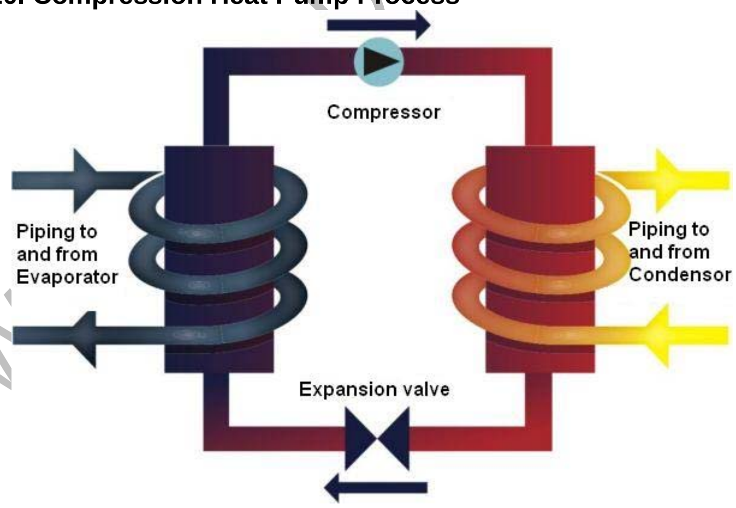
Description

A heat pump can utilise the low grade renewable heat that is stored in the surroundings, including the air, groundwater, ground, bedrock, lakes, as well as waste energy from a cooling storage or stored in wastewater or process energy from production facilities for use in heating of buildings and for hot water. Heat pumps can also provide cooling by sinking heat in the surroundings. To transport heat from a heat source to the place where heating is needed or to the heat sink external input energy is applied to drive the heat pump. The amount of external energy needed to drive the heat pump is lower than the amount of heat energy the heat pump can deliver or sink. Therefore, the installation of a heat pump can reduce the amount of input energy required to heat a building, produce hot water, or produce cooling.

Compression heat pumps are the main type of heat pumps used for HVAC application in buildings.[54] A compression heat pump consists of four main components – an evaporator, a compressor, a condenser, and an expansion valve. The process that takes place in the heat pump consists of the phases of evaporation, compression, condensation, and expansion. In heating mode the working fluid in the evaporator obtain heat energy from the heat source. Subsequently, the compressor increases the pressure and temperature of the working fluid to the condensation level. The working fluid is liquefied in the condenser and releases usable heat, which is transferred to the heating system or applied for water heating. After releasing its heat the working fluid is passed through the expansion valve, where pressure and temperature are lowered before the working fluid again is passed through to the evaporator to repeat the process.

The figure below provides an overview of the process in a Compression heat pump.

Figure 20. Compression Heat Pump Process



Source: Adapted from http://www.trvarmeteknik.dk/Jordvarme.asp?id=34693

[54] For larger installation with bigger heating and cooling loads absorption heat pumps may provide higher efficiencies. Complex systems with absorption and compression heat pump systems working in parallel, depending on the loads, may provide even higher efficiencies. It is considered outside the scope of this section to deal with absorption heat pumps and complex systems.

The efficiency of heat pumps - heat pumps make it possible to utilise a low grade heat by applying an amount of primary energy to drive the pump and transfer heat from the heat source to the heat output. The efficiency of the heat pump taken as the ratio between the total heat output and the primary energy input vary dependent on the system performance. The performance of the system can be expressed in different ways. The most common way to rate the efficiency of the heat pump is the COP – the coefficient of performance – which indicates the ratio of heat output to energy input.

COP = Heat Output/Energy Input

The heat pump cycle follows a Carnot Cycle and the theoretical COP_{max} can therefore be calculated by using the temperature difference between the heat source (evaporator) and the heat output (condenser). In other words; the efficiency can be calculated based on the input temperature and the output temperature.

$COP_{max} = T/\Delta T$

Where T is the temperature of the environment whereto the heat is distributed (the condenser temperature) and ΔT is the temperature difference between the warm and the cool side (the evaporator and the condenser)[55]. From the formula is given that the relation between COP_{max} and the temperature difference is inverse proportional.

To illustrate the calculation of the COP_{max} we can take an example where the heat source is groundwater at 10 degrees C and the heat distribution system is a low degree radiator system, which requires supply water at 50 degrees C.

$T = 50°C = 323 K$
$\Delta T = 50°C - 10°C = 40 K$ $COP_{max} = 323 K / 40 K = 8.075$

If the heat distribution system is not a low degree radiator system, but requires supply water at 60 degrees C, the calculation would be as follows:

$T = 60°C = 333 K$
$\Delta T = 60°C - 10°C = 50 K$ $COP_{max} = 323 K / 50 K = 6.46$

It should be clear that the temperature difference between the input and the output has a significant impact on the theoretical COP_{max} of a heat pump. In other words the heat pump operates most efficiently when the required thermal rise is small. This means that the heat source temperature preferably should be relatively high and the temperature of the useful heat output relatively low.

The COP_{max} as calculated above is a theoretical value for an ideal process. In reality thermal, mechanical, and electrical losses will impact the COP. The achieved COP can, as a rule of thumb be taken as half of the Carnot Efficiency[56].

The COP does, however, only provide an indication of the performance of the heat pump in steady-state condition. The achieved COP of the heat pump will vary over the year depending on two main factors:

[55] Ochsner 2008: 13f
[56] Ochsner 2008: 14

- The temperature variations over the year
- The variation in load on the heat pump

The temperature in the heat source and the required temperature of the output may vary over the year and affect the COP. The load on the heat pump will also vary significantly over the year. The variation in load on the heat pump is influenced by various aspects. As a rule of thumb the most efficient operation is achieved when the heat pump is operating at its maximum capacity. A number of factors influence the system efficiency in relation hereto:

- Centralised/decentralised systems
- Maximum capacity of the heat pump in relation to peak load
- Installation of a buffer system

A critical factor involved in ensuring that the heat pump system is operating at highest possible capacity is to install a centralised heat pump system, rather than a decentral system. Higher average efficiencies may also be achieved by installing a heat pump with capacity below the peak load (but with redundancy in the system). The installation of a buffer system may also help to optimise the operation of the heat pump by ensuring that it mainly operates at maximum capacity. This points to water-based systems as water has much higher heat capacity and therefore has a much higher potential in a buffer system.

The temperature variations influence different types of heat pumps differently. The COP of air-source heat pumps varies significantly more over the year than ground or water-source heat pumps, because ground and water temperature vary less over the year than air temperature. Other factors that add to weaker performance of the air-source heat pump in winter is that it may be required to defrost the coils and that the air-source heat pumps, because of their lower heat capacity are unable to deliver the required heating on cold winter days. Therefore, a back up heating system may be required in winter[57].

The tables below provide an overview of temperature levels in heat sources and temperatures required for various applications. In the planning phase of a heat pump installation an assessment of the available heat sources and input temperatures will together with the output parameters given by the specific application of the planned system provide an overall estimation of the potential performance of the system and hence the economy in the investment.

Table 18. Temperature levels in heat sources

Heat source	Temperature Range (°C)
Ambient air	-10-15
Exhaust air	15-25
Groundwater	4-10
Lake water	0-10
River water	0-10
Sea water	3-8
Bedrock	0-5
Ground	0-10
Wastewater and effluent	>10

Source: http://www.heatpumpcentre.org/en/aboutheatpumps/heatsources/Sidor/default.aspx

[57] Dinçer 2003: 218

Table 19. Delivery temperatures for various application

Application	Delivery Temperature (°C)
Space cooling (chilled water)	5-8
Space cooling (cooled air)	10-15
Warm air heating	30-50
Warm water floor heating	30-50
Warm water radiators (low temperature)	45-55
Warm water radiators (forced convection)	55-70
Warm water radiators (free convection)	60-90

Source: Typical Delivery Temperatures for Various Heat and Cold Distribution Systems**:** http://www.heatpumpcentre.org/en/aboutheatpumps/heatpumpsinresidential/Sidor/default.aspx

A commonly used measure to describe the efficiency of a heat pump over the heating season is the Heating Seasonal Performance Factor (HSPF). The HSPF is a heat pump's estimated seasonal heating output divided by the amount of energy that it consumes.[58]

HSPF = Total Seasonal Heating Output/Total Energy Input

The HSPF will vary depending on the local conditions. The higher the HSPF, the more efficiently the heat pump operates.

The cooling efficiency of a heat pump is measured by its Seasonal Energy Efficiency ratio (SEER). The SEER is the ratio of the total cooling required by the heat pump divided by the amount energy that it consumes.

SEER = Total Seasonal Cooling Output/Total Energy Input

The SEER will vary depending on the local conditions. The higher the SEER the more efficiently the heat pump operates[59].

When installing a combined system both the HSPF and the SEER of the heat pump will have to be evaluated against the specific heating and cooling requirements in the location. As a general rule the HSPF should be given higher consideration when evaluating a system for installation in a colder climate with relatively high heating requirements, whereas the SEER should be given more consideration when evaluating a system for installation in a warmer climate with relatively high cooling requirements.

Heat pumps can utilise a variety of **heat sources** in the aerothermal, geothermal or hydrothermal heat available in the surroundings. Solar energy can also be utilised as a heat source. Waste energy and process energy may have a very significant potential if production facilities, a wastewater treatment plant, or cooling storage is located nearby the hotel.

[58] The term seasonal performance factor (SPF) is used in the Directive 2009/28/EC on renewable energy. The SPF can be defined as the average ratio between the heat output of the heat pump and the auxiliary energy input (in final energy terms, e.g. kWhs of electricity) used to run it.
[59] Dinçer 2003: 220

When evaluating the potential heat sources it is key to look at the whether sufficient heat energy is present in the heat source concurrently with the heat load. This can be estimated for the yearly variation in the heat source and heat sink and for the daily variation in the heat source and heat sink. For example solar energy may not be optimal for heating as the heat load is high in winter where the solar radiation is low, but it may be a good source for warm water in a hotel operating in the summer months. If production facilities are located nearby waste energy from production may be a good source for heating, but if production closes down during holiday periods where the hotel is fully booked it may not be good solution.

In the section below, the advantages and disadvantages of heat sources of air, solar, water, ground/soil, and waste energy are discussed and an overview is presented in table format at the end of the section.

Ambient air is readily available and can be utilised for both heating and cooling via a heat pump without digging into the ground and laying of pipes. Therefore, air is also a very convenient source if a decentralised system is installed, because the availability of air makes it possible to install individual units for each room for example. As such it provides an interesting option as a heat source.

There are, however, a number of issues associated with the use of air as the heat source. The annual temperature variations are higher compared with other heat sources and, moreover, the air temperature in winter when the heating load is highest, may be below what is required to provide sufficient heating capacity. Furthermore, in cooler and humid climates humidity may gather on the outdoor heat transfer coil and evaporator surface. This will lead to a not insignificant reduction of the capacity of the heat pump, which may require defrosting[60]. The combination of significant temperature drops in winter and the significant rise in heating requirements in this period can make it necessary to operate the air-based heat pump in a bivalent heat system with an oil or gas boiler or electrical heating. If the air-based heat pump is installed as part of a refurbishment the existing heating system may be kept as the auxiliary heating system[61].

Solar radiation can be utilised as the heat source and has similar characteristics to air. However, there is even higher daily and yearly variability and a heat-store will be required[62]. Utilisation of the solar energy stored in the surroundings may be a more promising path for heat pumps. Solar cooling potential is being investigated, but has far not reached performance or economy to become interesting for practical application[63].

Water-based heat pump systems may utilise groundwater or various surface water sources, including rivers, canals, lakes, and the sea as the heat source. Wastewater may also be used as the heat source, but is mainly used for industrial application rather than serviced accommodation. Groundwater-based heat pumps may be open systems, where the water after heat extraction is pumped back into a separate well or returned to surface waters. In these open systems there may be issues with the water quality (e.g. corrosive salts, iron ochre sedimentation in the pipes, etc.) and there may also be issues with lowering of the water table and risk of pollution. Otherwise, most systems will be closed systems, where a brine is circulated in pipes, which are lowered in the heat source.

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[60] Dinçer 2003: 229
[61] Dinçer 2003: 229
[62] Dinçer 2003: 232
[63] Ochsner 2008: 95

The temperature of the water heat source will generally vary much less over the heating season than for air. For example for groundwater a fairly stable temperature can be expected at relatively low depths. Surface waters may freeze during winter and there may therefore be issues with freezing of the evaporator. Sea water will generally have less fluctuation in temperature and will due to the salinity have a lower freezing point. However, use of sea water will require that corrosion-resistant material is used in heat exchangers and pumps.

Water-based heat pump systems have significant advantages compared to air-based systems, because of the lower degree of temperature fluctuations and the higher year-round average temperature. Therefore, the average temperature difference between source and sink is significantly lower. Surface-based systems may, however, suffer from freezing. Issues with water-based systems include that they are relatively costly, that they require space and access to the heat source, and that the system will have higher cleaning and maintenance requirements[64].

Ground source heat pump systems utilise the ground and soil as a heat source, which in many countries at relatively small depths remain above the freezing point and with reference to heat pump systems, thus have relatively high annual temperatures. Pipes are either laid horizontally or sunk vertically in the ground. For horizontally laid pipes the space required may be rather large. As a rule of thumb the area required is twice the area, which requires heating. This significantly limits the applicability of the horizontal systems. In addition the laying of pipes will damage the outdoor space and may, therefore, mainly be considered in connection with new construction or refurbishment, which involves outdoor areas/gardens. Another issue, although perhaps less critical, is that the ground temperature will be lowered during the heating season and therefore will take longer time to warm up again at the end of the heating season.

The vertical sinking of pipes may incur difficulties due to unknown geological structures or soil thermal properties. Generally, the cost of establishing the vertically sunk system is significantly higher than the horizontal system, although this varies greatly case to case as the horizontal system incurs other costs associated with e.g. the availability of outdoor areas and the reestablishment of outdoor areas and from location to location. In Sweden, for example, the market for vertical sinking of pipes has reached a more mature level and the costs are significantly lower than elsewhere.[65] For both the horizontal and the vertical systems the design and installation require experts trained in heating/cooling as well as in laying the pipe work, which may increase the price[66]. However, it should be noted that although the cost of establishing the systems may be high the operational costs are typically 80-90% of the Life-Cycle Costs, understood as the cumulative total of implementation, operating, and maintenance costs.

Waste energy from a wastewater treatment plant, cooling storage facilities, or process energy may be utilised as the heat source. The waste energy may be in the form of extract air, as cooling water, wastewater, waste heat or similar. The potential for application of waste energy will depend largely on the location of the hotel, but it should be noted that the hotel itself will produce significant amount of waste energy from the cold storage and freezer and from the exhaust air from air conditioning and cooling. This energy may be utilised as heat source.

[64] Dinçer 2003: 230f
[65] Discussion with Senior Sales Manager for Heat Pumps at Danfoss, December 2010
[66] Dinçer 2003: 230f

The potential for utilisation of waste energy from surrounding industries may be significant, but will require cooperation with these industries and the analysis of the concurrency of the heat source with the heat load may be more complex as it will have to incorporate other potential variations than seasonal flux due to climatic conditions. Therefore, a thorough analysis of the yearly variations in the potential heat energy form the heat source will have to be conducted and compared with the yearly variations in the heat demand. The potential heat energy may, however, be significant if wastewater from a treatment plant is available at >10°C throughout the year or if cooling water from production facilities is available at 40°C. In many cases it may even be necessary to lower the temperature of industrial wastewater before discharge to surface waters or to a treatment plant and this energy may then be utilised via the heat pump.

The table below lists the advantages and disadvantages associated with heat pumps, depending on the heat source. Solar has not been included due to disadvantages as discussed above.

Table 20. Heat sources and their advantages and disadvantages

Heat Source	Advantages	Disadvantages
Air	• Readily available and easy to establish • Decentralised systems • Relatively low establishment cost • An auxiliary heating system may function as a backup heating system	• May require auxiliary heating system in winter • High temperature variations and low temperatures in winter • Lower HSPF due to temperature conditions • May require defrosting of evaporation coils • Potential noise emissions (decentral systems)
Water	• Stable and relatively high temperature • Relatively low temperature difference between source and sink over the year • Higher HSPF due to the temperature conditions	• For groundwater systems: risks of water quality issues, water table issues, risk of polluting or deteriorating the water source • Corrosion due to salts/saline sea water • Relatively high establishment costs • Freezing of evaporation coils (mainly for surface waters or low saline sea water) • Less accessible as heat source, especially in urban areas
Ground and soil	• Stable and relatively high temperature • Relatively low temperature difference between source and sink over the year • Higher HSPF due to the temperature conditions	• Large outdoor space requirements for horizontal systems + reestablishment of outdoor areas, e.g. gardens • Relatively high establishment costs and high costs of vertical systems (but low as percentage of Life-Cycle Costs) • Unknown geological structures or soil thermal properties • Risk of leakage from evaporation coils and soil pollution • Lowering of soil temperature during heating season and prolonged lowering of temperature at the end of the heating season
Waste energy	• High temperatures and significant heat capacity • Low thermal rise for heating and high HSPF • Lowering of wastewater temperature	• Complex annual variations in the heat source • Availability will vary significantly • Status as long term heat source may be difficult to determine

Heat Source	Advantages	Disadvantages
	before discharge	

Source: Dinçer (2003)

Types of heat pumps can be categorised according to their operational functions and four main types can be distinguished:

- Heat pumps for heating only, including space heating and/or water heating application.
- Heat pumps for heating and cooling, including space heating and cooling applications.
- Integrated heat pumps systems for space heating, cooling, water heating, and sometimes exhaust air heat recovery.
- Heat pump water heaters for water heating[67]

The operational functions of the heat pump will typically require different temperature levels. Depending on the temperature of the heat source, different work will therefore be required of the heat pump for the different operational functions and this will impact on the efficiency of the heat pump.

Heat pumps can be distinguished according to their heat source and heat sink. In the table below heat pumps are described according to their heat source and heat sink and along with their typical application and their advantages and disadvantages. Heat pumps may also operate in reversible mode, so that the heat source becomes the heat sink.

Table 21. Types of heat pumps – typical application and advantages and disadvantages

Type of heat pump	Description	Typical application	Advantages	Disadvantages
Air-to-Air	• Air is used on both sides • Can provide both heating and cooling through heating- and A/C mode	• Space heating • Space cooling • Commercial and residential application • Especially useful in regions where temperatures do not drop significantly in the winter or in bivalent systems	• Low maintenance costs • Uncomplicated installation • Require no outdoor space	• Defrosting of evaporation coils may be required in cooler climates • Auxiliary heating may be required in cold periods
Air-to-water	• Extracts heat from ambient or exhaust air to heat or pre-heat water for space or utility water heating • May also operate in reversible mode to provide cooling	• Space heating • Water heating • Space cooling • Commercial and residential application • Smaller buildings or in a bivalent system with other heating source	• Low maintenance costs • Uncomplicated installation • Require no outdoor space	• For ambient air-based systems defrosting of evaporation coils may be required in cooler climates • Auxiliary heating may be required in cold periods • Low capacity and the

[67] Dinçer 2003: 222

Type of heat pump	Description	Typical application	Advantages	Disadvantages
		• Especially useful in regions where temperatures do not drop significantly in the winter or in bivalent systems		temperature of output water may be too low for utility water • The efficiency may fall to an unsatisfactory level at low ambient temperatures (-12 degrees C)
Water-to-water	• Heat source and heat sink are both water • Can be used both for heating and cooling • Wide range of water heat sources, including groundwater, surface water, sea water, wastewater, etc.	• Space heating • Water heating • Space cooling • Where there is access to water heat sources • Commercial application and larger buildings • Increasingly residential application	• High performance and low electricity consumption • Relatively stable and high temperature of most water heat sources • High heat transfer coefficient of water	• Relatively high maintenance costs and consequently operating costs • Requires access to the water heat source • High investment costs • Potential freezing problems with surface water (and brackish sea water)
Water-to-air	• Heating of air with water as the heat source • May also operate in reversible mode to provide cooling • Wide range of water heat sources, including groundwater, surface water, sea water, wastewater, etc.	• Space heating • Space cooling • Commercial application and larger buildings • Industrial application, e.g. from waste heat	• Higher performance than air-to-air	• Lower performance than water-to-water
Ground-to-water	• A brine is circulated in the ground in pipes and the heat in transported to water, which can be used for space or water heating. • The pipes are usually laid	• Space heating • Water heating • Space cooling • Where there is access to large outdoor space for horizontal pipes or access to outdoor space for vertical sinking	• High performance and low electricity consumption • Relatively stable and high temperature of the heat source • High heat transfer	• For horizontal pipes a large outside area is required – as a rule of thumb twice the size of the indoor area, which requires heating. • May cool down the ground

Type of heat pump	Description	Typical application	Advantages	Disadvantages
	horizontally in the ground, but can also be sunk vertically in the ground • The system can also be reversed to provide cooling in summer	of pipes • Commercial application, larger buildings, and residential application	coefficient	further in the heating season • Some systems are using refrigerants with high GWP and/or which may potentially pollute the soil
Ground-to-air	• As above except the heat is transported to air, which is used in space heating • The system can also be reversed to provide cooling in summer	• Space heating • Space cooling	• High performance and low electricity consumption • Relatively stable and high temperature of the heat source	• As above

Source: Based on Dinçer (2003) & the Heat Pump Association: http://www.heatpumps.org.uk/TypesOfHeatPumpSystems.htm

Achieved environmental benefits

Installing a heat pump will lead to the achievement of the following environmental benefits:

- Reduction in primary energy consumption compared with a number of other heating options.
- Reduction in CO2 emissions compared with a number of other heating options.

The reduction in primary energy consumption will depend on the efficiency of the installed system. The efficiency will be influenced by a number of factors, but especially the temperature lift required to reach the supply temperature will have a significant impact. As conventional radiators and hot water require high temperatures such application can reduce the efficiency of the heat pump and thus reduce the environmental benefits. Therefore, it is important to consider low temperature applications to maximise the environmental benefit. Another way of increasing the system efficiency is to install a buffer system that can ensure that the heat pump is operating at a high capacity when operating.

The efficiency can, as discussed earlier, be considered as corresponding to the seasonal performance factor of the system over the heating season and – if a combined system – also over the cooling season. For example for a heating system, if the ratio of the heat output to the primary energy input over the heating system is four the system will only require 25% of the primary energy that would have been required in a conventional boiler. The remaining 75% is extracted from the heat source and can be considered renewable energy.

The input energy used to drive the heat pump is most often based on fossil fuel or electricity and may, therefore, not be counted as the renewable energy supplied by the heat pump – only the difference between the total energy supplied and the input energy may be considered renewable energy as a direct result of the use of the heat pump.

When evaluating the environmental benefits of a planned heat pump installation the potential reductions in CO2 emissions can be assessed by comparing the average emissions from grid electricity in the particular country with the potential emissions from other heating option and adjust for the efficiency of the heat pump. As an example the installation of a heat pump in the UK can be evaluated against natural gas. The average CO2 emission from grid electricity is 0.544 kgCO2/kWh, whereas the CO2 emission form natural gas is 0.184 kgCO2/kWh (Carbon Trust 2009: 3). It follows that the efficiency of the heat pump should reach approximately 3 or higher to reduce CO2 emissions in comparison with natural gas.

Appropriate environmental indicators

The relevant environmental indicators depend on the functions of the heat pump that is installed. For space heating and cooling the appropriate indicator is the energy consumption per square metre and year. When evaluating water heating the appropriate environmental indicator may be the energy consumption per cubic meter. However, as it is important to evaluate the absolute consumption of hot water in relation to occupancy a more appropriate indicator may be the energy consumption per guest night.

The measuring of energy consumption has to give weight to the source of the energy. The difference between the consumption of primary energy required to drive the heat pump and the heat output is equal to the amount of energy, which is considered renewable energy. The renewable energy should be abstracted from and only the consumption of primary or input energy should be considered. The measurement of the area which require heating and cooling should consider the height of the indoor space and other building characteristics (e.g. whether one storey or multiple) and the specific use of the indoor space as the heating/cooling demands will differ and include a correction factor. The duration of building use during the year and considerations of whether primarily in the heating or cooling season should also be considered – certain hotels may only be occupied during the heating season, e.g. ski resorts and others may have their main occupancy during the cooling season, e.g. beach resorts.

When evaluating the heat pump itself a number of issues have a role to play in relation to the efficiency of the heat pump. As discussed in the section Efficiency of heat pumps the most appropriate indicator of the heat pump may not be the Coefficient of Performance (COP) as it only provides an indication of the efficiency in a steady-state situation rather than considering the average performance of the heat pump over the year. The average seasonal performance can be looked at from the point of view of heating and from the point of view of cooling and two different factors are used to indicate the ration between the output (for heating or cooling) and the auxiliary energy input.

The efficiency of a heat pump over the heating season is the Heating Seasonal Performance Factor (HSPF), which indicates a heat pump's estimated seasonal heating output divided by the amount of energy that it consumes. The cooling efficiency of a heat pump is measured by its Seasonal Energy Efficiency ratio (SEER), which is the ratio of the total cooling required by the heat pump divided by the amount energy that it consumes. Both the HSPF and the SEER will vary depending on the conditions and when evaluating a combined heat pump for a specific location the annual heating load and the annual cooling load will have to be weighted in relation to the assessment of the overall performance of the heat pump.

Criteria and benchmarking

Various criteria are used in the benchmarking of the performance of heat pumps. The Commission Decision 2007/742/EC of 9 November 2007 establishes the ecological criteria for the award of the Community eco-label to electrically driven, gas driven or gas absorption heat pumps up to a maximum heating capacity of 100kW. Thereby, the Decision give minimum requirements to heat pumps on efficiency in heating and cooling mode, the GWP of the refrigerant used, as well as requirements related to a number of other criteria. The Decision concern:

- The efficiency of heating and/or heating/cooling of buildings,
- Reducing the environmental impact of heating and/or heating/cooling buildings,
- Reducing or preventing the risks for the environment and for human health related to the use of hazardous substances,
- Ensuring that proper information on the heat pump and its efficient operation is provided to the customer and the installer of the heat pump (2007/742/EC: Annex)

As part of the work programme under the European Committee for Standardisation a shared standard for Heat pumps and air conditioning units is under development - CEN/TC 113.[68]

A common EU standard has been published for the design of the whole heat pump system – the EN 15450: Heating systems in buildings – Design of heat pump heating systems. There are, however, large climatic and geological differences between the EU member states and, furthermore, there are regional traditions for heating and cooling systems. Therefore, the standard is more likely to provide a general minimum framework for design and installation.

The GROUND-REACH project, which targets ground source heat pumps for heating and cooling of buildings to identify potential for reducing CO_2 emissions and primary energy demand and compiles and evaluates best practice information from across Europe, has compiled and analysed benchmark information at the European level for heat pump systems. The table below shows the information compiled at European level. In addition benchmark information from Austria, France, Germany, Poland and Romania are available at their website.[69]

Table 22. Overview of energy efficiency, environmental impact and economic efficiency benchmarks

68 http://www.cen.eu/cen/Sectors/Sectors/HVACetc/Pages/WorkprogrammeOthers.aspx
69 http://groundreach.fiz-karlsruhe.de/en/baustein/bs16/

No.	Subject	Benchmarks	References	Comments
1. Energy efficiency				
1.1	EN 15450	**Min. SPF** (new buildings): **W/W = 3,8; B/W = 3,5;** A/W = 2,7 **Target value SPF**(new buildings): **W/W = 4,5; B/W = 4,0;** A/W = 3,0 **Min. SPF** (retrofit buildings): **W/W = 3,5; B/W = 3,3;** A/W = 2,5 **Target value SPF**(retrofit buildings): **W/W = 4,2; B/W = 3,7;** A/W = 2,8	European Standard EN 15450 , October 2007: Heating systems in buildings - Design of heat pump heating systems	- SPF for space heating and domestic hot water production - Calculation method for estimating the SPF according to prEN 15316-4-2 - Table C.3: **SPF values for hot water production only**
1.2	**Guidelines from the European Heat Pump Association (EHPA)**	**Default value SPF** (new buildings): **W/W = 4,5; B/W = 4,0;** A/W = 3,5 **E/W = 4,2 (DX)** **Default value SPF** (retrofit buildings): **W/W = 4,0; B/W = 3,5;** A/W = 3,0 **E/W = 3,7 (DX)**	European Heat Pump Action Plan, version 1-2008	Average Seasonal Performance Factors (SPF) of heat pumps with state-of-the-art technology
1.3	**EU Eco Label**	**Min. COP / PER**: Table 1 Heating **W10/W35 = 5,1/2,04; W10/W45 = 4,2/1,68** **W15/A20 = 4,7/1,88; W20/A20 = 4,4/1,76** **B0/W35 = 4,3/1,72; B0/W45 = 3,5/1,40** **B0/A20 = 3,4/1,36** A2/W35 = 3,10/1,24; A2/W45 = 2,60/1,04 A2/A20 = 2,9/1,16	COMMISSION DECISION of [...] establishing the ecological criteria for electrically driven, gas driven or gas absorption heat pumps	- Electrically driven, gas driven or gas absorption heat pumps for heating and cooling. - Maximum heating capacity 100 kW. - Table 2 Cooling: **Min. EER values**
1.4	**Quality Label (EHPA/DACH)**	**Min. COP: W10/W35 = 4,5; B0/W35 = 4,0;** A2/W35 = 3,0 **E4/W35 = 4,0 (DX)**	Reglement zur Erteilung des Internationalen Gütesiegels für Heiz-Wärmepumpen, Version 1.3 (Ausgabe vom 25.07.2007)	Effective since 1 December 2007
1.5	EU Energy Label	Under preparation	EuP Directive	
2. Environmental impact				
2.1	**EU Eco Label**	- The GWP potential for the refrigerant **must not exceed GWP value > 2000** over a 100 year period. - If the refrigerant has a **GWP of less than 150** then the minimum requirements of the COP and PER in heating mode and the EER in cooling mode, as set out in criteria 1 and 2 of this Annex, shall be reduced by 15%.	COMMISSION DECISION of [...] establishing the ecological criteria for electrically driven, gas driven or gas absorption heat pumps; ANNEX ECOLOGICAL CRITERIA	
3. Economic efficiency				

Abbreviations:

Definition:

COP coefficient of performance

The ratio of useful heat output (in kW) of a heat pump to the (electric) power input (in kW), at defined rating conditions (e.g. B0/W35, according to Standard EN 14511).

EER	energy efficiency ratio	The ratio of useful cooling output (in kW) of a heat pump to the (electric) power input (in kW), at defined rating conditions.
SPF	seasonal performance factor	The ratio of useful heat output (in kWh) of a heat pump system to the (electric) energy input (in kWh), averaged over an entire heating season.
SEER	seasonal energy efficiency ratio	The ratio of useful cooling output (in kWh) of a heat pump system to the (electric) energy input (in kWh), averaged over an entire heating season.
PER	primary energy ratio	The ratio of useful heating (and cooling) energy delivered (in kWh) to the primary energy input (in kWh), considering the whole supply chain.

Source: http://groundreach.fiz-karlsruhe.de/en/baustein/bs16/

Cross-media effects

The main cross-media effect associated with the installation of a heat pump is related to the type of refrigerant used as a working fluid in the heat pump. Traditionally, the Greenhouse Gases fluorocarbons have been used as refrigerants. These are synthetic chemicals which usually have a high GWP, and some also have an Ozone Depletion Potential (ODP). Various surveys have shown that in average 10% of the refrigerant charge is leaking per year – for new plant less, for older higher. This leakage is a significant environmental impact. Increasingly, the refrigerants used in heat pumps are natural refrigerants – so called because the substances also occur in nature. These alternatives include ammonia, carbon dioxide, and hydrocarbons. Natural refrigerants are characterised by having none or low GWP and no ODP. To reduce leakage it should be considered to:

- Use natural refrigerants
- Limit the amount of refrigerant used in the system

Both of these ways point to centralised systems as the preferred option as centralised systems better can accommodate the use of natural refrigerants (e.g. CO2 operates at much higher pressure) and centralised systems will reduce the amount of refrigerant used. Furthermore, centralised systems can better accommodate a buffer system to improve the overall efficiency of the plant.

The shift to the use of natural refrigerants (hydrocarbons, carbon dioxide or ammonia) implies changes in the components and in the control systems in heat pumps. The SHERPA-Project deals with the development of heat pumps that are in line with future environmental regulations. The new environmental regulations, concerning greenhouse gases and the protection of the ozone layer, will lead to the phase out of conventional refrigerants. In the EC the 'Freon' R22 phase out is scheduled in 2010. Under the SHERPA-Project components and subsystems (heat exchangers, controllers, ground coupling system, heat recovery) will be developed, tested and optimised. In the second phase of the project prototypes will be developed and tested.[70]

Heat pumps may also have issues with noise levels as fans and compressors make noise.

[70] For further information see: http://sherhpa.fiz-karlsruhe.de/en/themen/thema1.html

For air-based systems the outdoor unit should be located away from windows and a heat pump with a low outdoor sound rating should be selected. Alternative measures include mounting the unit on a noise-absorbing base. It should be noted that although the unit comply with noise regulations, hotel guests may be exceptionally adverse to noise and it may increase their sense of discomfort. Noise emissions will be easier to control if a centralised system is installed as the centralised system can be located away from guest rooms and services areas.

It should also be noted that although heat pumps are considered a renewable energy source[71] this relate only to the free energy part, not the auxiliary or input energy driving the pump, which may be fossil or electric energy.[72] Therefore, the heat pump may still consume a significant amount of non-renewable energy, depending on the energy source used for input energy.

Operational data

This section will provide a brief discussion on localised factors which influence the performance of heat pumps, information on a current attempt to develop a common methodology for field measurement of heat pump systems and calculation of seasonal performance factor in the building sector across Europe, and operational data from field testing of heat pump systems.

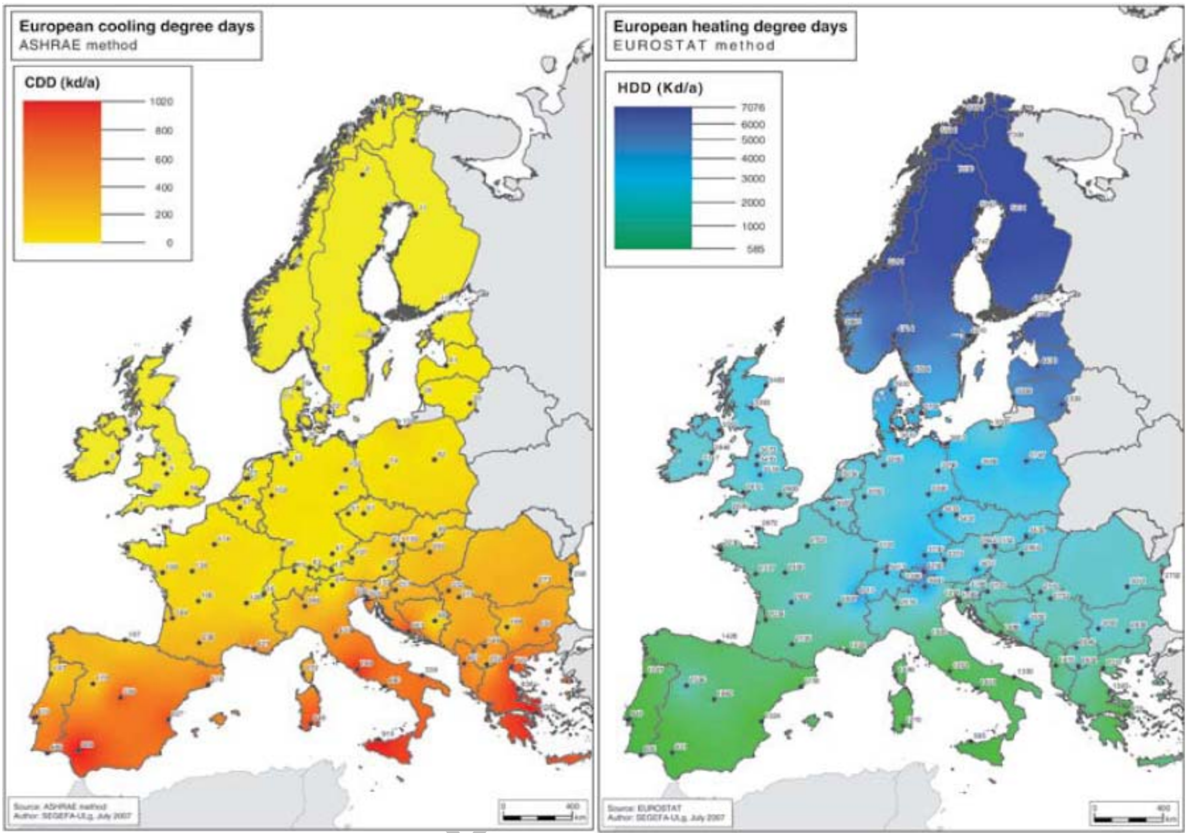
The performance of heat pumps is measured separately for cooling mode and heating mode. In heating mode the measure to describe the efficiency of a heat pump over the heating season is the Heating Seasonal Performance Factor (HSPF). The HSPF is a heat pump's estimated seasonal heating output divided by the amount of energy that it consumes. In cooling mode the efficiency of a heat pump is measured by its Seasonal Energy Efficiency ratio (SEER). The SEER is the ratio of the total cooling required by the heat pump divided by the amount energy that it consumes. Both the HSPF and the SEER will vary depending on the local climatic conditions. When installing a combined system both the HSPF and the SEER of the heat pump will have to be evaluated against the specific heating and cooling requirements in the location. As a general rule the HSPF should be given higher weight in the evaluation if the heat pump is to be installed in a colder climate with relatively high heating requirements and the SEER is to be given higher weight in a warmer climate with relatively high cooling requirements. The main factors affecting the heating and cooling requirements are:

- The climatic conditions in the locality
- The building insulation and hence the heat losses and the heat gains respectively

The Heating Degree Day (HDD) is a measure designed to reflect the energy required for heating for a building at a specific location. The heating requirement of a building will depend on the HDD at the location. The measure Cooling Degree Day (CDD) in a similar manner reflects the energy required for cooling for a building at a specific location. The HDD and the CDD can therefore be utilised to assess heating and cooling requirements in a location. The figures below provide European CDD and HDD respectively.

[71] 2009/28/EC
[72] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:en:PDF

Figure 21. European CDD and HDD



Source: Boermans et. al 2006: 16f

Proper insulation of a building can greatly reduce the heat loss and the heat gain during the heating season and the cooling season respectively.[73] Schlenger (2009) provides data on the energy consumption of office buildings in various European locations and the share of energy used for heating:

Table 23. Energy consumption of office buildings

City	Energy consumption kWh/m^2 per year	
Oslo	144	Heating: 48 %
London	122	Heating: 30 %
Brussels	130	Heating: 43 %
Milan	215	Heating: 64 %
Madrid	180	Heating: 53 %

Source: Schlenger (2009) as presented in *EMAS - Draft Pilot Reference Document on Best Environmental Management Practice in the Retail Trade Sector*, October 2010

As shown in the data provided buildings in locations with fewer heating degree days may actually have higher heat energy consumption. The reasons are found in local (national) traditions and regulations regarding building insulation.

[73] For further information see the section on Retrofitting the building envelope for optimal energy performance

The performance of the heat pump depends on the temperature difference between the heat source and the heat sink. Therefore, the climatic conditions and the temperature variations will have a significant impact on the operational performance of the heat pump over the year. Secondly, the performance of the heat pump will depend significantly on the heat loss from the building in heating mode and the heat gain in cooling mode. As a general rule it will be more cost effective to improve the insulation to reduce heat loss for heating or heat gain for cooling than to size the heat pump to higher loads.[74]

Developing reliable and easy to compare data on the efficiency of heat pump systems across Europe - currently, there is a gap in the availability of reliable and easy to compare data on the efficiency of heat pump systems at a European level.[75] The project "SEasonal PErformance factor and MOnitoring for heat pump systems in the building sector (SEPEMO-Build)" focuses on developing a common methodology for field measurement of heat pump systems and calculation of SPF in the building sector. The common methodology will be tested through a monitoring programme for more than 40 heat pump installations in six European countries. These include geothermal, hydrothermal and aerothermal energy sources. Thereby the project aims at providing background information on the key parameters influencing efficient heat pump systems.[76]

The main factors influencing heat pump systems efficiency and which the SEPEMO project is incorporating in the harmonised approach to field measurement of heat pump system efficiencies are:

1. Efficiency of the heat pump unit
2. Quality of installation (influencing the efficiency „in situ")
3. Design of the system
4. Temperature level of the heat distribution system
5. Heat losses of the building envelope
6. Climatic condition where heat pump is employed.

To different degrees these factors are incorporated in existing calculation and measurement approaches towards heat pump (system) efficiency.

The table below provides an overview of existing measurements, the type of efficiency determination, the associated norms, and list the factors (1-6), which are included in the measurement.

Table 24. Measurement of heat pump efficiency

	Type of efficiency determination	Required norm	Include factors
Unit efficiency "Coefficient of Performance" / COP	Laboratory measurement of energy output over auxiliary energy input at defined rating points	EN 14511 EN 255 Ecolabel for heat pumps EHPA quality label	1, 4
Unit efficiency including climate data input "seasonal COP" / SCOP	Laboratory measurements of energy output over auxiliary energy input at defined rating points Weighting of results according to existing climate data	prEN 14825 (temp. bin)	1, 4, 6

[74] 2007/742/EC
[75] http://www.ehpa.org/uploads/media/EHPA_Newsletter_10_2.pdf
[76] http://www.sepemo.eu/

Systems efficiency including energy losses of the building "calculated systems performance factor" / cSPF	Calculation of efficiency based on input data from unit measurements (COP), building and climate data	VOI 4650 EN 15316	1, 3, 4, 5, 6
Measured systems performance "Seasonal Performance Factor" / SPF	Field measurement of energy output over total energy input. Different systems boundaries are used.	-	1, 2, 3, 4, 5, 6

Source: EHPA Newsletter, Issue 10, December 2010: 6

Operational data from field testing of heat pump systems - as discussed above there is a lack of robust directly comparable data on the performance of heat pumps in various European locations. The EHPA Newsletter, Issue 12, 2 August 2010 provides an overview of existing field trials of heat pumps in Europe where the number of tested systems have been 20 or more.

Figure 22. Existing field trials of heat pumps in Europe

Existing field trials of heat pumps in Europe (with N>= 20 units)

Name of study	Duration	capacity	sample size	Energy sources included	Function	Buildings included	Regional coverage	Test standards	operator	Link
FAWA	1995–2004	up to 20kW	221	Air-water/ brine-water units in series production	Heating, heating & hot water	New and existing	Switzer-land	EN 255	Swiss federal office of energy (BFE)	[1]
Fawa "best of class"	1995–2005	Up to 60kW	20	Air-water/ brine-water units in series production	Heating, heating & hot water	New and existing (best in class selected)	Switzer-land	EN 14511, EN 255.3	Swiss federal office of energy (BFE)	[2]
Fraunhofer "Effizienz" Neubau			75	Air-/water-/ ground-source	Heating, heating & hot water	New buildings	Germany	Acc. to system boundary	Fraunhofer ISE	[3]
Fraunhofer "WP im Ge-bäudebestand			110	Air-/water-/ ground-source	Heating, heating & hot water	Existing buildings	Germany	Acc. to system boundary	Fraunhofer ISE	[4]
Heat pump field trial	2008–2010		83	Air source and ground source	Heating, heating & hot water	New and existing	UK		Energy savings trust	[5]
SEPEMO	2009–2012		Approx. 40	Air source and ground source	Heating, heating & hot water		Austria, Germany, Greece, Sweden, Netherlands	Acc. to system boundary: SPF 1-4	SP and partners	[6]

[1] www.fws.ch/dateien/WP-Tagungsband_2004.pdf | [2] www.waermepumpe.ch/fe/Jahresbericht_2005BFE_Effizienzsteigerung_Bestanlagen.pdf
[3] http://wp-effizienz.ise.fraunhofer.de/german/index | [4] www.wp-im-gebaeudebestand.de | [5] www.energysavingtrust.org.uk/Generate-your-own-energy/Heat-pump-field-trial
[6] www.sepemo.eu

Source: http://www.ehpa.org/uploads/media/2010_2_ehpa_newsletter_field.pdf - p7

Below results from two field tests of the performance of heat pump systems are included. As a heat pump system performs differently depending on a number of site specific factors the results are not directly transferable. It should also be noted that the data is generally from testing of heat pump systems installed in homes and therefore generally applies to smaller buildings.

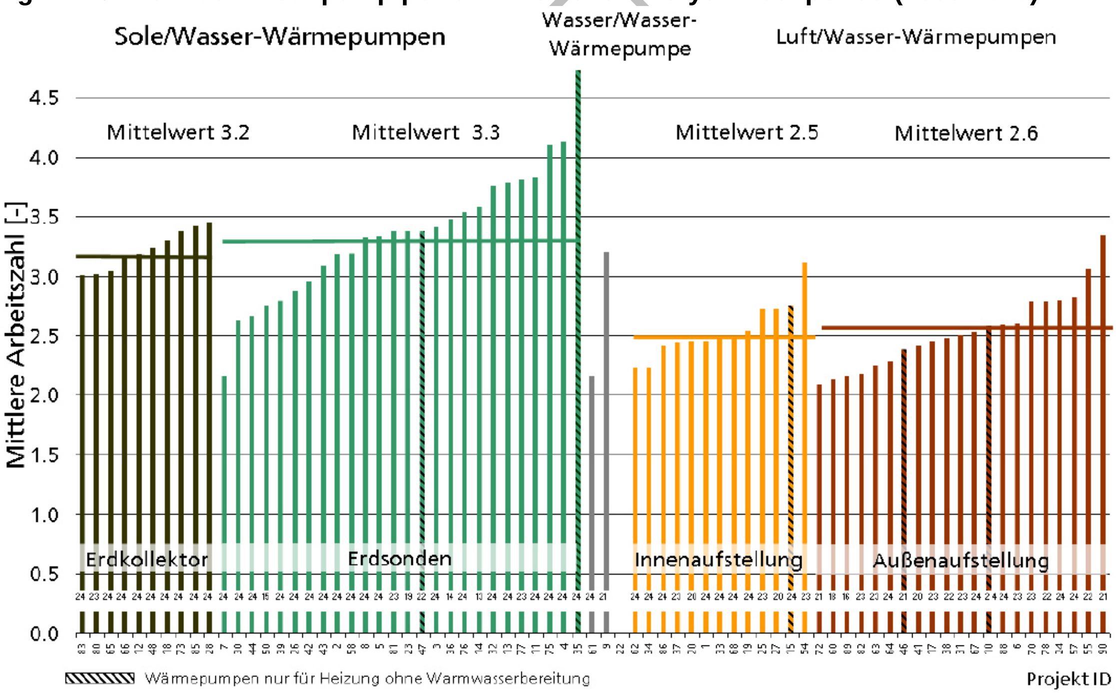
Field testing of heat pumps in Germany - the Fraunhofer Institute for Solar Energy Systems ISE, Germany has been evaluating the efficiency and the system behaviours of heat pump systems under authentic conditions for a number of years.

In the assignment “Feldmessung Wärmepumpen im Gebäudebestand” from E.ON Energie AG[77], which ran from December 2006 to December 2009, about 70 heat pumps, installed to replace oil boilers for heating and utility water, were monitored for performance. The study included 36 brine-to-water heat pumps and 35 air-to-water heat pumps.[78]

The heat pump systems were installed in one-, two-, and three-family houses – 59%, 37%, and 4% respectively. Of the houses 29% were build between 1919 and 1957, 41% between 1958 and 1981, and 27% between 1982 and 1996. The heated space averaged at 181m² and varied between 90 m² and 360 m². The energy consumption for heating and hot water was, based on the oil consumption over the previous 5 years, calculated at an average energy consumption of 177 kWh/m²a of heated space. According to German standards for building insulation the heat energy consumption was calculated to be between 85 kWh/m²a and 340 kWh/m²a. In the analysis of the performance factor the annual heat output energy included space heating and warm water and the input energy included the electrical energy used in the heat pump as well as additional electrical heating.

In the brine-to-water heat pumps with ground heat collecting the seasonal performance factor averaged at 3.2 with the individual systems being between 3.0 and 3.4. The geothermal brine-to-water heat pumps averaged at 3.3 with much higher variations between the individual systems. The air-to-water heat pumps average around 2.6. The figure below shows the individual performance of the heat pumps over the two-year test period (2008-2009), divided into type of heat pump with the brine-to-water heat pumps divided according to heat source and the air-to-water heat pumps divided according to in- or out-door installation. The dashed lines indicate the heat pump systems, where a separate warm water heater was installed.

Figure 23. Individual heat pump performance over two-year test period (2008-2009)



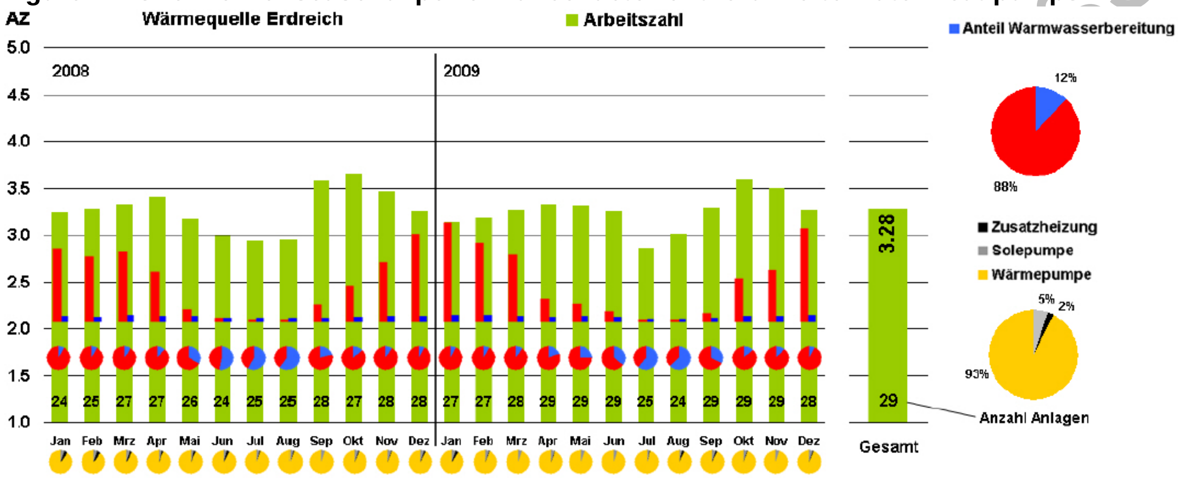
Source: http://wp-im-gebaeudebestand.de/german/index/

77 Russ, Christel et. al. August 2010
78 http://wp-im-gebaeudebestand.de/german/index/

The report also includes an overview of the monthly performance of the heat pumps over the two-year test period. In the warmer period the heat pumps will use relatively more energy for warm water than for heating, whereas in the heating period the heat pump will use the majority of its energy on heating compared with warm water. As the required heat output temperature for heating is significantly lower than for warm water, the overall performance of the heat pump will be affected negatively during the warm period.

The figure below provides an overview of the seasonal performance factor of the brine-to-water heat pumps, based on the produced heat energy for heating and hot water and the power consumption in the period 2008 and 2009.

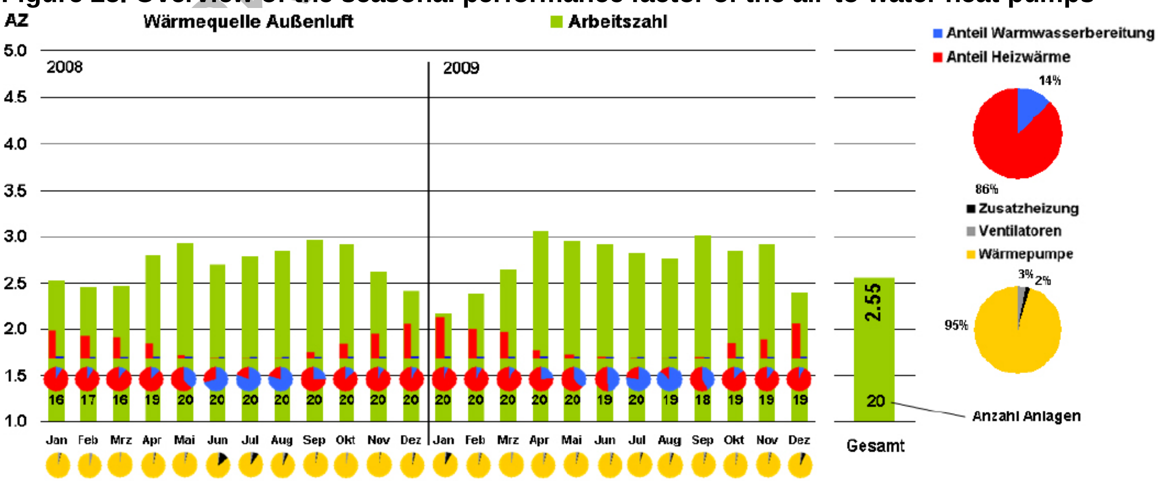
Figure 24. Overview of seasonal performance factor of the brine-to-water heat pumps



Source: http://wp-im-gebaeudebestand.de/german/index/

For the brine-to-water heat pumps on average 12% of the energy consumed was spent on hot water production and the remaining 88% on heating. The SPF averages at 3.28 over the test period. Of the electricity consumed over the test period 92% was consumed by the heat pump, 5% by the brine pump, and 2% by the additional electrical heating. The figure below provides an overview of the seasonal performance factor of the air-to-water heat pumps, based on the produced heat energy for heating and hot water and the power consumption in the period 2008 and 2009.

Figure 25. Overview of the seasonal performance factor of the air-to-water heat pumps



Source: http://wp-im-gebaeudebestand.de/german/index/

For the air-to-water heat pumps on average 14% of the energy consumed was spent on hot water production and the remaining 86% on heating. The SPF averages at 2.55 over the test period. Of the electricity consumed over the test period 95% was consumed by the heat pump, 3% by the ventilation, and 2% by the additional electrical heating.

Case Studies

NH Laguna Palace Hotel in Mestre facing Venice, Italy
Decentralised water-to-water compact heat pump units and packaged water-to-air roof-top units, both using river water as heat source, were installed to provide heating and cooling for the NH Laguna Palace Hotel in Venice. The installed system is fully electric and does not need boiler for winter HVAC operation or cooling towers in summertime.

The WSHP (Water Source Heat Pump) system is based on high-efficiency water-to-air and water-to-water heat pumps that utilise water from the environment as thermal exchange source to the refrigeration circuit. The refrigeration circuits on the WSHP units include rotary/Scroll compressors, 4-way valves, heat exchangers user-side (either finned coil or plate, according to the unit model), expansion device (electronic thermostatic valves on larger models), heat exchangers source-side, air handling sections on water-to-air versions, and both electronic controls and automatic safety devices.

The hotel is made up of Building A and Building B that accommodate 384 hotel rooms, including 31 Suites and 21 Junior-Suites and a third building housing a congress centre and a 600 m2 open space. Total cooling capacity requested was 3,200 kW.

The design constraints were:

- High flexibility for each kind of area served
- Full integration into the innovative architecture
- Minimising noise perceived by both guests and neighbours
- Reduced running costs
- Use of renewable energy sources and reduction of environmental impact

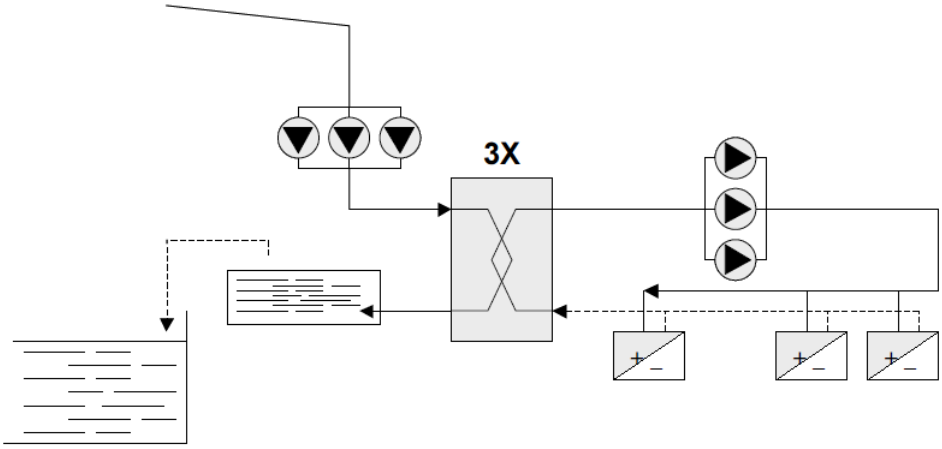
The different zones of the hotel have different needs; the average occupancy of the hotel rooms is stable, and therefore the HVAC plant solution is based on modular air-cooled chillers, boilers and terminal units. The Suites and the Conference Centre have variable occupancy. For this reason, a de-centralised WSHP plant solution was chosen, in order to produce heating or cooling energy only when and where needed.

The source is an underground duct that in the 60's was used to provide fresh water from a river to a petrochemical pole. The water intake line is located two metres below the public road and supplies the plate exchangers in the underground technical room. Heat pumps are connected to the secondary loop. This secondary circuit feeding the heat pumps is of the variable-flow type to reduce energy consumption and operation cost when running part-load.

Different heat pump versions have been selected according to the specific use:
Water-to-water compact units for each Suite. These units are the size of a washing machine and are concealed in technical rooms in the corridor, so they can be accessed and maintained without entering the room.

Packaged water-to-air "roof-top" units for high attendance zones with high fresh air rate, serving Restaurants, Meeting rooms, Conference Centre. The units also include a built-in heat recovery system that increases the global unit efficiency and avoids the typical major operating cost of plate heat exchangers recovery systems due to pressure drops airside. It is an active type based on an air-to-air heat pump circuit that operates on the fresh air intake and exhaust, and therefore it also reduces the water consumption. The IAQ (indoor quality control) is managed by the "pulsing" activation of the heat recovery system, according to the CO2 values detected by the relevant probe. Furthermore, the units include low consumption fans, powered by direct current (dc) motors with electronic airflow control, and hot-gas free re-heating for summer humidity control.

Figure 26. Water source heat pump plant layout



NB: The water intakes are on the right, the skimming fountain in the centre, and the hotel dock and jetty basin on the left.

Source: http://www.ehpa.org/fileadmin/red/Home_Images/Climamed_2007_Clivet.pdf

Hotel Crowne Plaza Copenhagen Towers, Orestaden, Denmark

Crowne Plaza Copenhagen Towers was built in 2009 and phase 1 and 2 cover 58,000 m^2. The heat pumps installed for cooling and heating are using the ATES (Aquifer Thermal Energy Storage) technology, which utilises groundwater as the heat source and heat sink. The technology can lead to energy savings of up to 90% compared with mechanical cooling and up to 60% when compared with traditional heating of buildings. The payback time has typically been between 0-6 years on the energy savings.[79]

Crowne Plaza Copenhagen Towers was built according to the Danish Low Energy Class 2 standard, which means that the energy consumption must not exceed 42.6 kWh per m2 per year. This corresponds to energy savings of 53% when compared with conventional buildings. Copenhagen Towers is estimated to save 1,373 tons of CO2 on an annual basis and is operated as a CO2 neutral building.

One of the key initiatives is the installation of a groundwater heat pump which provides both heating and cooling to 366 hotel rooms, the conference room section, kitchen, restaurant and the ancillary office building. Frequency converters regulate the speed of the heat pumps needed to control the heat in the groundwater-based cooling and heating system. This system saves up to 90% of the energy used for cooling the hotel and approximately 60% of the energy used for heating when compared with traditional heating and mechanical cooling.

79 Discussions with Managing Director, Enopsol Aps.

Cold groundwater is pumped up during the summer and directed to the hotel's basement where it cools down the water in the internal cooling-heating system. The groundwater is then returned into the ground, where the water accumulates heat during the summer for use in the winter. During winter, the water which was heated during the summer is pumped up again and distributed through the heating system and back into the ground. While the groundwater was used for cooling during the summer, it is now used for heating. The heat energy is sent through two heat pumps which raise the temperature to heat the hotel rooms and offices. Frequency converters adjust the heat pump capacity by regulating the speed to optimise the energy-efficiency. The pumps used to circulate the water in the building are variable speed controlled by frequency converters contributing further to the energy savings on the pump system.

The peak cooling need was calculated at 4.1 MW and the peak heating need was calculated at 2.9 MW. The system is designed for supply temperatures at 18°C/12°C (cold water temperatures) and 60°C/30°C (warm water temperatures). Two heat pumps were installed in phase 1 and 2 with the following specifications:

- Heating capacity and COP(Heating) at 1183 kW and 4.0 respectively
- Cooling capacity and COP(Cooling) at 1100 kW and 8.3 respectively[80]

The Zetter Hotel, Clerkenwell, London

The Zetter Hotel in Clerkenwell, London has installed seven heat recovery air conditioning units using the natural underground lake deep below the city streets as a cooling source to save on energy consumption. The selected option for the air conditioning system not only allowed for a sustainable and energy efficient design, but also avoided losing valuable roof space that has now been used for penthouse suites. With standard air conditioning units at least one penthouse suite would have been lost at the 59-bedroomed hotel. The main 5-storey atrium provides natural ventilation and the air conditioning is cooled by water pumped from the bore-hole which sinks 130m below the building. Along with the installation the building was refurbished to reduce heating requirements.

The heat recovery air conditioning units can supply simultaneous cooling and heating to up to 16 individual indoor units from each condensing unit, which are sited in small service rooms on each floor. The units link to a building's water loop and transfer heating or cooling energy between them. This allows the units to offer efficient double heat recovery, producing heat recovery from indoor units on the same refrigerant circuit in addition to using the water circuit to transfer energy between different WR2 circuits.

[80] GEA Grenco : Case Story Copenhagen Towers, 2009
http://www.danfoss.com/SolutionsReady/NewsAndEvents/News/Climate-friendly_hotel_in_Denmark/2A69C0A8-F810-4830-8424-3391BB037563.html
http://www.cphpost.dk/news/scitech/92-technology/50204-city-hotel-named-worlds-greenest.html
http://www.energiforumdanmark.dk/fileadmin/Artikler/blad_4-2010/Energiforum_Danmark_4-2010.pdf

The air conditioning is controlled by a central controller which links to the overall Building Management System, although each room has an individual controller. When a guest enters the room and places their VIN card (room key) in the slot, which controls all lights and services, the air conditioning will come on and will automatically switch off when the room is vacated. Because of the building's large sash windows, a dominant feature of every room and particularly on the south side of the building, rooms can be hot as the guests walk in, so the installed air conditioning was selected to be able to cool quickly to a comfortable level. The air conditioning system has also been connected to sensors on the sash windows so that if they are opened, the air conditioning will switch off to stop energy being used when it is not needed[81].

Applicability

Heat pump technology has a wide application range. With reference to hotels the main applications include:

- Space heating
- Water heating
- Space cooling

The decision to install a heat pump, the selection of the preferred type of heat pump, and the specific application of the heat pump will depend largely on the local conditions and the other options available. The planning of the installation of a heat pump system should take a systematic approach and carefully consider the options and specific applications.

The following key decisions are involved when planning for the installation of a heat pump system:

- Heat source (and heat sink) selection
- Heating (and cooling) system selection
- Heat pump selection, based on heating, cooling, and hot water demand as well as operation configuration (Ochsner 2008: 35-45)

These can be broken down further to be based on the following key questions and considerations:

- What alternative heating and cooling options are available?
- Which overall type of distribution system is wanted?
- What supply temperatures are required?
- What heat sources are available and at what temperatures?
- What are the heating and the cooling demands?
- How much energy is available in the heat source or can be transferred to the heat sink to satisfy these demands?
- Is there yearly (and daily) concurrency between the loads and the capacity (for heating and cooling)? Can buffer systems be installed to balance out variations?

81 http://www.heatpumps.org.uk/CaseStudies.htm#CaseStudy9

These questions and considerations can provide an indication of the achievable COP of the system based on temperature differences between source/sink and supply, which can used to select the heat source/sink and further evaluate the type of distribution system. And they can also be used to assess the heating and cooling demand which can be covered by installing the heat pump system and thereby provide an estimate of the potential savings achievable through the installation. Below the questions and considerations are dealt with in more detail.

When assessing the alternative heating and cooling options key aspects to consider include energy consumption and costs as well as lifetime of the existing system (if an existing facility), but also which other alternative systems may be available. For example, if the serviced accommodation is located in an area with district heating and/or district cooling available this may be the preferred option. The savings (if any) on operational costs on installing a heat pump compared to district heating/cooling will generally only be marginable and the investment costs associated with the heat pump will generally be considerably higher than those for district heating/cooling.

When deciding on the distribution system key aspects include whether the system should be air-based or water-based. A hydronic system may be more efficient, but an air-based system may utilise existing ductwork and air handlers. If an air-based system is preferred it can further be evaluated whether the system should be centralised or decentral, i.e. operating at the level of the entire hotel or at room level. Centralised systems will have significant advantages as they are more efficient, emit less noise near guests, and concentrate and reduce the amount of refrigerant for better control (less risk of leakage).

Decisions regarding the distribution system will also determine the supply temperatures, which will be required of the heat pump. Examples of supply temperatures were listed in the section on the efficiency of heat pumps and are here repeated in the table below.

Table 25. Delivery temperatures for various application

Application	Delivery Temperature (°C)
Space cooling (chilled water)	5-8
Space cooling (cooled air)	10-15
Warm air heating	30-50
Warm water floor heating	30-50
Warm water radiators (low temperature)	45-55
Warm water radiators (forced convection)	55-70
Warm water radiators (free convection)	60-90

Source: Typical Delivery Temperatures for Various Heat and Cold Distribution Systems**:** http://www.heatpumpcentre.org/en/aboutheatpumps/heatpumpsinresidential/Sidor/default.aspx

If an air-based system is installed the supply temperatures are 10-15°C for cooling and 30-50°C for heating. In a hydronic system there are a number of options. For heating low temperature solutions exist as for example floor heating which can operate at 35°C or lower. By having large surface areas for heat transfer these solutions can lower the heating system transfer. Similarly, for water-based space cooling solutions exist that can operate at much higher temperatures than the 5-8°C listed in the table, e.g. supply temperatures of 16-18°C can maintain surface temperatures of floor and walls at 19-21°C, maintaining room temperatures at 22-26°C with outdoor temperatures of 32°C (Ochsner 2008: 90f). That is, however, for a well insulated building without large heat gains from large windows.

The assessment of heat sources and their temperatures will depend largely on the conditions in the locality. Is there access to large outdoor areas where a horizontal ground-source heat pump can be installed, is lake located nearby, or is there a production facility or a cooling storage with waste heat energy, which can be utilised. This is a highly localised analysis, which should consider all available options, including at the serviced accommodation itself – e.g. nearly all hotels have their own restaurants and therefore have cooling facilities, which produce waste heat. However, the temperatures of heat sources normally fall within certain ranges and when evaluating the available heat sources these temperatures can guide the assessment. Examples of heat source temperatures were listed in the section on the efficiency of heat pumps and are here repeated in the table below.

Table 26. Temperature levels in heat sources

Heat source	Temperature Range (°C)
Ambient air	-10-15
Exhaust air	15-25
Groundwater	4-10
Lake water	0-10
River water	0-10
Sea water	3-8
Bedrock	0-5
Ground	0-10
Wastewater and effluent	>10

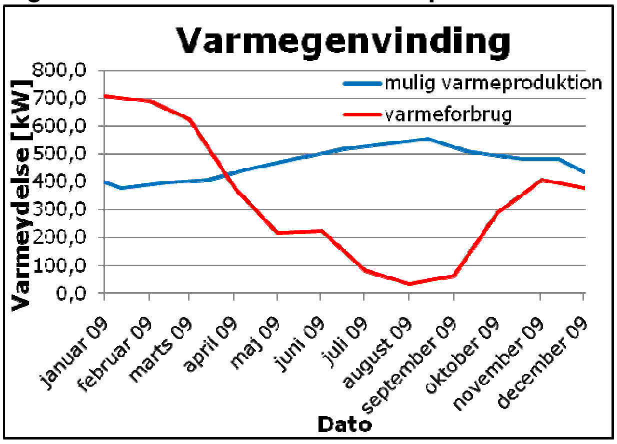
Source: http://www.heatpumpcentre.org/en/aboutheatpumps/heatsources/Sidor/default.aspx

As discussed in the section on heat sources various factors can influence the selection of heat source, including local water extraction permits, access to outdoor space, economic considerations, etc. But based on the temperatures available with the various heat sources and the supply temperatures available through the decision on the distribution system, it is possible to calculate the theoretical COP, which the heat pump will be able to deliver at. Examples of such calculations were provided in the section on the efficiency of the heat pump. To consider thermal, mechanical, and electrical losses the achieved COP can, as a rule of thumb be taken as half of the theoretical COP[82]. This gives a rough figure of the efficiencies achievable with a heat pump and can be estimated for the different heat sources available. Thereby, a rudimentary but fairly certain indication of whether the installation of a heat pump system is applicable is available and, furthermore, a preliminary selection of the preferred heat source is provided.

The heating and cooling demands should be determined in accordance with relevant national standards. For an existing facility it can be taken as the average demands over recent years. The heating and cooling capacity available with the heat source/sink should be determined and an analysis of the concurrency with the heating and cooling demands should be conducted. The analysis of the concurrency should consider yearly and daily variations. The figure below show the actual heat demand in kW (the red line) and the potential heat production from waste process heat in kW (the blue line) over 2009 for a facility in Denmark.

[82] Ochsner 2008: 14

Figure 27. Heat demand and heat production from waste process heat



Source: Grontmij | Carlbro, 2010

As can be seen there may significant variation over the year, but also year-over-year and there may not be concurrency between the load and the capacity. In this example it was estimated that approximately 80% of the heating demand could be satisfied and that a buffer system should be installed.

The analysis of concurrency is also important in relation to the selection of heat source, because depending on the type of heat source there may be opportunity to install a buffer system as in the above example. If the heat source is air it may be difficult to install a buffer system, but if the heat source is water or ground it may be an effective way to ensure that hot water is available beyond the period with heat production. The buffer system makes it possible to balance loads, extend operating cycle length, and/or allow for heating during utility interruption periods[83].

Based on the heating and cooling demand and the heating and cooling capacity of the heat pump, the estimated COP, and the analysis of the concurrency it is possible to estimate the potential savings, which can be achieved by installing the heat pump system. If the payback time is given the sum available for investment can be calculated.

Economics

The economy involved in the installation of a heat pump depends strongly on the specific case which is considered. For a larger building as a hotel the relevant systems would mainly be either based on ground or water-based systems. Air-based systems would generally have too low capacity to heat the entire building and supply the hot water needed – especially during the cold season. As a larger building would generally also require heating, hot water, and cooling, a combined solution may be the preferred option.

Focusing on the heating and hot water application, the calculation needs to consider the other heating options available. In areas where district heating is available, district heating may well be the preferred option. As a rule of thumb the costs of district heating versus heat pumps are comparable with heat pumps being marginally cheaper in operating costs, but with higher investment costs. Compared with district heating the installation of a heat pump therefore has a long payback time. However, because the heat pump is also able to provide cooling it may still be a feasible option.

[83] Ochsner 2008: 80

Significant savings on operational energy costs can be realised when comparing the installation of heat pumps with fossil fuel boilers and with electrical heating options. The input energy required for the heat pumps may reach 25% with the remaining 75% is abstracted from the heat source. As the input energy is also converted to heating the heat pump can deliver the same amount of heating with only a quarter of the energy input. The investment costs are, however, higher for heat pumps compared with other heating options, which may lead to a longer payback time, despite significant savings on energy consumption and CO2 emissions.

The European Union average electricity price for household consumers in 2010 amounted to 0.1223 €/kWh, excluding taxes and based on an annual consumption between 2,500 and 5,000 kWh. For industrial consumers the average European Union electricity price in 2010 was 0.0918 €/kWh, excluding taxes and with annual consumption between 500 and 2,000 MWh. The European Union average natural gas prices for household consumers in 2010 amounted to 11.1203 €/GJ, excluding taxes and based on annual consumption between 20 and 200 GJ. For industrial consumers the average European Union natural gas price in 2010 was 7.7624 €/GJ, excluding taxes and with annual consumption between 10,000 and 100,000 GJ.[84] In kWh these prices correspond to approximately 0.0400 €/kWh for the household consumer category and 0.0279 €/kWh for the industrial consumer category. Consequently, in 2010 prices, the efficiency of the heat pump should be approximately 3.1 or higher for the household consumer category and 3.3 or higher for the industrial consumer category before the heat pump system would achieve lower operational costs than natural gas heating.[85] The installation cost of the heat pump system is higher than gas heating, but as a heat pump system is also able to provide cooling and air conditioning these additional costs might be justified. Potential savings on the operational costs of cooling and air conditioning would have to be included in the calculation as well based on operational efficiencies.

Heat pump efficiency benchmarks – as presented in Table 21 Overview of energy efficiency, environmental impact and economic efficiency benchmarks – are between 2.6 and 5.1 with the air-based systems in the low end and the water-based systems occupying the high end. For the EU eco-label benchmark values provided for cooling efficiencies are between 2.2 and 4.4 depending on the type of system.[86] Looking at the heating part the brine and water-based systems would generally be able to compete with gas boilers on operational costs.

Figures on the **costs of installing heat pump** systems vary significantly with the type of heat pump, the location, and the selected collection and distribution system. For installing a heat pump system for heating, cooling, and hot water the relative price is approximately twice as expensive as conventional systems.[87] The Centre for Alternative Technology, UK provides the approximate figure of £1,000 per installed kW.[88] Consulted HVAC specialists have provided the approximate figures of €150-300 per installed kW for the heat pump and €200 per installed kW for the collection and distribution system.[89] The heating demand in kW can either be calculated from the existing consumption if a retrofit/renovation or determined according to the relevant national standards. The figures for the specific heating demand will depend largely on the building insulation. Values are presented in the table below.

[84] http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables
[85] Note that the COP should be above 3 to reduce CO2 emissions compared with natural gas on the heating part. See the section Achieved environmental benefits for further information.
[86] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2007D0742:20091204:EN:PDF
[87] http://www.econar.com/faq.htm
[88] http://info.cat.org.uk/questions/heatpumps/how-much-will-heat-pump-cost
[89] Discussion with HVAC Specialists, GMCB

Table 27. Specific heating demand for buildings

Building	Specific heating demand in W/m2
Old building with standard (at the time) insulation	75 – 100
New building with good insulation	50
Low energy house, new building	40
Passive house	15

Source: Ochsner 2008: 38

Example: A hotel has a serviced area of 2,000 m2 and a specific heating demand of 50W/m2. The total heating demand can be calculated as the total services area multiplied by the specific heating demand:

2,000 m2 x 50 W/m2 = 100 kW

The installation cost of the heat pump can, assuming the price of the heat pump is 200 €/kW and the price of the collection and distribution system is 200 €/kW, be calculated as:

400 €/kW x 100 kW = 40,000 €

Note: In this case the heat pump is dimensioned following the heating demand. The efficiencies achieved in cooling mode generally are significantly higher than in heating mode, because the temperature differences generally are lower between the cooling source and the collector.[90] In warm climates and for air-based systems this may be different.

Annual running costs - Utilising the benchmark values provided by ITP, 2008 for luxury, fully serviced hotels in the best performing category have a total energy consumption of 285 kWh/m2 of services space if located in a temperate region and 260 kWh/m2 of services space if located in the Mediterranean region.[91] If the hotel is using electric chillers the percentage of total energy used for heating is 50% in the temperate region and 40% in the Mediterranean region.[92] Assuming that the hotel is located in the temperate region and has 2,000 m2 of serviced area the annual heating energy consumption would amount to:

2,000 m2 x 285 kWh/m2 x 50% = 285,000 kWh

Utilising the Eurostat energy prices as listed above the costs of heating with (1) electricity, (2) natural gas at an efficiency of 90%, and a (3) heat pump with an efficiency of 4 would be:

(1) 0.0918 €/kWh x 285,000 kWh = 26,163 €

(2) 0.0279 €/kWh x 285,000 kWh x 1/0.9 = 7,952 €

(3) 0.0918 €/kWh x 285,000 kWh x ¼ = 6,541 €

Assuming that the hotel uses approximately 20% of the annual energy consumption on cooling, the annual cooling energy consumption amounts to:

2,000 m2 x 285 kWh/m2 x 20% = 114,000 kWh

[90] Ochsner 2008: 94
[91] ITP 2008: 38
[92] ITP 2008: 40 – the figure is for a hotel with laundry and pool and calculated based on 3,100 heating degree days.

Assuming that the electric chillers have an efficiency of 2 and utilising the Eurostat energy prices the costs of cooling using electricity in option (1) and (2) and using a heat pump with a cooling efficiency of 6 in option (3) would amount to:

(1), (2) 0.0918 €/kWh x 114,000 kWh = 10,465 €

(3) 0.0918 €/kWh x 114,000 kWh x 2/6 = 3,488 €

Note: The heat pump system is replacing a system, which is operating at an efficiency of 2.

In the following table the calculations are summarised and the annual savings and payback periods are calculated. In calculation A the existing installation (1) is being considered to be replaced with either (2) or (3). In calculation B the existing installation (2) is being considered replaced with (3). The cost of servicing the systems has been abstracted from as it is not considered to vary significantly between the different types of installations.

Table 28. Calculation of annual savings and payback periods

	(1) Electric heating and electric cooling	(2) Natural gas heating and electric cooling	(3) Heat pump for heating and cooling
Energy costs			
Heating	26,163 €	7,952 €	6,541 €
Cooling	10,465 €	10,465 €	3,488 €
Total	36,628 €	18,417 €	10,029 €
Investment costs	(20,000 €)	20,000 €	40,000 €
A	Existing installation	20,000 €	40,000 €
B	-	Existing installation	40,000 €
Annual savings			
A	Existing installation	18,211 €	26,599 €
B		Existing installation	8,388 €
Payback period (simple)			
A	Existing installation	1.1 years	1.5 years
B		Existing installation	4.8 years

Based on these calculations the option of installing a heat pump system for heating and cooling can be recommended in both cases. The expected lifetime of the heat pump system varies with the different components, but can overall be considered as 20+ years.

Online calculation tool - The EU funded project ProHeatPump has developed a basic online calculation tool, which can be used to evaluate and compare the following heating options: Ground Source Heat Pump, Oil Boiler, Gas boiler, Direct electric, Electric boiler, Wood boiler, Pellet boiler, and District heat. Based on information on investments costs, fuel costs, and efficiency the online calculation tool calculate:

- The primary energy demand (the amount of fuel that has to be purchased to meet the heat demand after adjusting for the efficiency)
- The quantity of fuel that has to be purchased annually
- The capital cost per year
- The annual fuel cost

- The total annual cost for providing the heat

The capital cost per year is calculated using an annuity factor of 0.0963, representing a depreciation time of fifteen years and an interest rate of five percent. This annuity factor is the same for all heating options in the calculator. Default values are set as initial values for investments costs, fuel costs, and efficiency, but the user can change these in accordance with the specific values and values provided by a local installer.

The online calculation tool is available at:
http://proheatpump.syneriax.com/calculator.htm?lang=GB

Driving force for implementation

The main driving forces for implementation are energy savings – savings on operational energy costs and reduction of CO2 emissions. The improvements in energy performance, the use of renewable energy, and the reduction in C02 emissions may also be communicated to guests, potential costumers, shareholders, and other stakeholders to market the hotel as a green hotel. The environmental credentials may be communicated to stakeholders, e.g. in the sustainability report.

> Replacement of out-dated air conditioning system with a modern plant

Description

Air conditioning systems have enormous value in providing a high level of guest comfort and in turn contribute significantly to the quality of the guests' experience. At the same time, replacing older systems with more modern plant can bring a range of economic, comfort and environmental benefits.

Achieved environmental benefit

The environmental benefits include:

- reduction in electricity consumption resulting in associated reduction in emissions of greenhouse gases associated with energy production
- reduction in emissions of ozone-depleting CFC substances which were typically used as refrigerants in the past. This is especially relevant for leaky air conditioning systems – examples in Denmark showed that upto 20% of the refrigerant disappeared within one year.

Appropriate environmental indicator

To be added

Cross-media effects

Replacing old air conditioning systems will generate scrap metal which can be sold for recycling. If the old air conditioning system is based on ozone-depleting refrigerants, then these should be disposed of in a responsible manner in cooperation with the competent authorities.

Operational data

To be added

Case studies

Scandic Hotels – Copenhagen, Denmark
In 1997-2000, Scandic Hotels in Copenhagen, invested in the renewal of the hotel's air conditioning (A/C) system. The hotel has 17 floors, area of 31,500 m^2 and 465 rooms, as well as conference rooms and a restaurant. The project included the installation of a new airconditioning system using ammonia. The old system was based on Freon 12 which results in damage of the ozone layer. Analysis of the A/C system had shown that it was badly dimensioned, and not able to service the whole hotel building at the same time, with all facilities being used. The analysis further indicated that a new more advanced A/C system, with 30% more capacity, would result in energy savings of 15,000 kWh per year. The A/C renovation was a part of an overall renovation and redesign of the hotel's cooling system, including also refrigerating and freezing needs, such as minibars and cold rooms. The overall energy savings of the project are calculated as 409 000 kWh/year, at the 2010 European Union average electricity prices of 0.0918 EUR/kWh[93] would lead to annual cost savings of approximately 37,500 EUR and payback time of only 6 years. The CO2 emissions were also reduced by 409 tons CO2/year[94].

AlmaVerde Village & Spa - Portugal
The holiday centre which comprises 130 holiday villas, 28 houses and 30 apartments, has installed a very efficient low energy cooling system as an outstanding ecological alternative to a conventional air-conditioning system. The first year of operation has revealed that this system is able to keep the indoor temperature constantly at roughly 26 °C while the outdoor day-to-night temperature in summer varies between 38 °C and 18 °C at the same time. Combined with a unique 'breathing' adobe brick wall construction, which reduces the internal humidity levels by up to 30 %, the cooling system generates only 810 kg of CO2 a year according to measurement data. In comparison to that, it is estimated that a conventionally run air conditioning system would have generated about 15,200 kg of CO2 a year[95].

Applicability
Replacing the air conditioning system is relevant for those organisations where the existing system is known to be poorly dimensioned. The general condition and dimension of the air conditioning system can be determined via an energy audit.

Economics

Experience shows that the economics and pay back periods vary according to the size of the project but four to six years has been observed (see example below). The economics of the project are helped by the reduced time that needs to be spent on maintenance, especially if the older system was faulty.

Driving force for implementation

[93] http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables
[94] Horesta [2], 2001
[95] ECOTRANS, 2008

There can be a variety of driving forces including the fact that the existing system may be poorly dimensioned, inefficient, unreliable, noisy and does not provide a sufficient level of guest comfort.

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- *http://www.energiforumdanmark.dk/fileadmin/Artikler/blad_4-2010/Energiforum_Danmark_4-2010.pdf*
- The Zetter Hotel, Clerkenwell, London: *http://www.heatpumps.org.uk/CaseStudies.htm#CaseStudy9*

SA3. Alternative energy sources

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

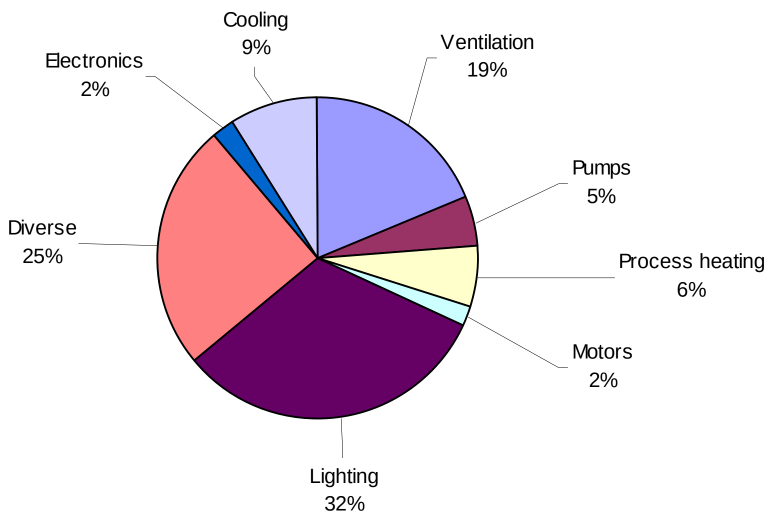
Reference literature

SA4. Efficient Lighting

Description

Lighting makes up a large percentage of the electricity consumption at hotels and significant savings may be realised by managing lighting energy consumption and through the implementation of modern lighting technology. In a hotel lighting typically accounts for 15-25% of the hotel's electricity consumption[96]. In a survey of Danish hotels conducted by HORESTA (see figure below), lighting was found responsible for one third of electricity consumption on average[97].

Figure 28. Electricity consumption in Danish hotels



Source: Miljø 2100, HORESTA (2000)

Depending on the type of lighting technology lighting also emits heat, which may add significantly to the air-conditioning and cooling load[98]. Essentially the heat emission is energy wastage from the lighting production, so a double win may be realised by switching to more energy efficient types of technology.

Two major developments in the lighting sector will lead to significant changes over the coming years:

- The phase-out of incandescent technology in the EU (and a number of countries outside the union)
- The developments in new energy efficient technologies, such as solid-state lighting (SSL) using light emitting diodes (LEDs).

[96] ITP 2008: 54
[97] Miljø 2100, HORESTA (2000)
[98] ITP 2008: 54

As a result a transition from traditional incandescent to fluorescent and SSL technology is currently underway. Fluorescent technology has both a significantly higher efficacy and a significantly longer lifetime compared with incandescent. The energy efficient technology of solid-state lighting using light emitting diodes (LEDs) is developing rapidly with high efficacy and longer lifetime as well as more flexibility in Colour Temperatures (CT) and possibilities for much higher CT than fluorescent lamps and is already providing an economical alternative despite higher initial costs. The promising results from the developments in the SSL technology have led many to expect that the LED technology will replace not only incandescent but also fluorescent technology (Ibid: 54). Currently, the SSL technology is rather costly to install compared with incandescent and fluorescent technologies, yet the potentials savings through reduced energy consumption and due to the lamp life of LEDs are significant.

Lighting management

Efficient lighting management to minimise lighting energy consumption includes a number of techniques besides the choice of energy efficient technology. The following elements are part of the implementation of a lighting management strategy:

- Identification of the specific lighting requirements according to the type of use for the particular space
- Optimisation of the use of daylight and daylight harvesting
- Optimisation of the lighting technology used in the building to more energy efficient types
- Installation of lighting management control systems, including occupancy sensors, timers, etc. to reduce lighting consumption
- Maintenance programme to ensure efficient performance of lighting systems.

In the following sections these individual elements are described in more detail. A description of the various types of electric lighting with their energy consumption, lifecycle, relative costs, lighting quality, and lumens is provided as part of the lighting technology section. In the table below, a brief overview of relevant lighting terms is provided.

Table 29. Lighting terminology

Term	Description
Colour Rendering Index (CRI)	The CRI refers to the colour rendering properties of the light to measure the light source's ability to render the colours the same way sunlight does. The scale is 1-100, where 100 is equal to sunlight. Lamps with a CRI above 80 are considered acceptable for most indoor application. Particularly important where food is prepared and served.
Colour Temperature (CT)	The warmth or coolness of a light source. By convention yellow-red colours are considered warm, where blue-green colours are considered cool. Colour temperatures are measured in Kelvin, where higher Kelvin temperatures (3600-5500 K) are considered cool and lower colour temperatures (2700-3000 K) are considered warm. Cool light produces higher contrasts than warm light. Lamps with a high CT are preferred for visual tasks. Lamps with low CT are used in bathrooms.
Efficacy	The ratio of light produced to energy consumed measured in the lumens divided by the electrical consumption (lumens per watt).
Illuminance	The illuminance (E) indicates how much light - the luminous flux measured in lumens - from a light source falls on a given surface. It does not include reflectance and does therefore not give a precise measure of the brightness of the room.
Lumens	The luminosity provided by a light source.
Luminance	The brightness of a luminous or illuminated surface as perceived by the human

	eye measured in candelas per area.
Lux	The quantity of light incident on a surface, measured in lumens per square meter. Where 1lx = 1 lm/m2
Maintained illuminance	The value below which the average illumination is not allowed to fall. Reduction in the luminous flux will occur due to dust particles and wear.
Reflectance	The reflectance indicates the percentage of luminous flux that is reflected by a surface.
Wattage	The wattage of a lamp indicates the number of electricity units in watts it burns per operating hour, e.g. a 100 watt bulb uses 100 watts per hour of operation.

Sources: ITP 2008: 56;
http://www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=11990
http://www.uwex.edu/energy/lighting_terms.html
http://www.licht.de/en/know-how/lighting-quality/

The **identification of the specific lighting requirements** for a given space should consider the use of the specific area and be in accordance with relevant regulations. When zoning the indoor and outdoor areas of the hotel the basic categories for lighting uses include:

Table 30. Basic categories for lighting uses

Category	Description
Ambient or general lighting	Ambient lighting provides general lighting for daily indoor activities and outdoors for safety and security
Task lighting	Task lighting provides the lighting required for particular tasks that require more light than what is needed for general illumination, including in the workspace, table lamps, bathroom mirror lamps, etc.
Accent or decorative lighting	Accent lighting draws attention to specific features and enhances aesthetic qualities of an indoor or outdoor environment.

Source: http://www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=11990

The zoning of the hotel according to lighting uses and the associated specific lighting requirements should be in compliance with relevant regulations. Lighting requirements for indoor and outdoor workplaces, including for restaurants and hotels are specified in the EN 12464 standard. The standard provides lighting requirements according to task or activity in the following categories:

- The maintained illuminance
- The upper limit for direct glare
- The lower limit for the colour rendition index (CRI)

The table below show the specific lighting requirements for indoor areas as per EN 12464.

Table 31. Specific lighting requirements for indoor areas – EN 12464

Type of interior, task or activity	Maintained illuminance, E_m (lux)	Upper glare limit, UGR_L	Lower CRI limit, R_a	Remarks
Entrance halls	100	22	80	
Lounges	200	22	80	
Reception	300	22	80	
Kitchen	500	22	80	There should be a transition zone between kitchen and restaurant.

Restaurant, dining room, function room	-	-	80	The lighting should be designed to create the appropriate atmosphere.
Self-service restaurant	200	22	80	
Buffet	300	22	80	
Conference rooms	500	19	80	Lighting should be controllable.
Corridors	100	25	80	During night-time lower levels are acceptable.

Source: EN 12464

As part of the zoning of the hotel the lighting circuits should be considered so that lighting is controlled according to zone. The zones may be subdivided further so that only the specific part of a room which require lighting is illuminated.

The ITP provides further guidelines for guest rooms on the specific lighting requirements in guest rooms[99]. The BREF on Energy Efficiency contains further guidelines on areas of use and associated lighting requirements. These are listed in the table below.

Table 32. Areas and associated lighting guidelines

Area	Maintained illuminance, E_m (lux)	Comments
Bedroom	50-100	
Bed head	300	
Desk	300	
Bathroom	150	Use lamps with a warm CT
Work environment	800	
Meeting and conference rooms	800	
Corridors	400	

Source: European Commission: Reference Document on Best Available Techniques for Energy Efficiency, Feb. 2009

Optimisation of the use of day lighting - Daylighting refers to the use of windows and skylights to bring sunlight into a building. Utilising sunlight reduces the need for artificial light and, thus, reduces the lighting energy consumption. Because of the properties of daylight with CRI at 100 it will improve the colour rendering and the indoor atmosphere and therefore have a positive impact on the well-being of guests and staff. However, the use of sunlight may impact significantly on heating and cooling loads, but with modern energy-efficient windows the insulation has improved significantly. With improved insulation the heat transfer capacity of windows has reduced significantly and the impact on cooling loads have been reduced accordingly. [100] The incorporation of daylighting in a building will depend on the climatic conditions in the location and the building lay-out and design. Size and locations of windows should consider the cardinal directions. General advice on size and location of windows are, according to cardinal directions, as follows.[101]

[99] ITP 2008: 56
[100] For further information see: EMAS: Draft Pilot Reference Document on Best Environmental Management Practice in the RETAIL TRADE SECTOR, October 2010
[101] http://www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=12290

- South-facing windows are advantageous for daylighting as they allow most winter sunlight into the building and little direct sun during the summer when properly shaded.
- North-facing windows provide relatively even, natural light, produce little glare, and almost no unwanted summer heat gain. They are therefore also advantageous for daylighting.
- East- and West-facing windows cause glare, admit a lot of heat during summer, and contribute little to solar heating during winter.

The lighting energy consumption can be further reduced when the daylighting is combined with daylight harvesting controls. Controls either function through switching or dimming and they can be based on either time/day or photo sensing. The objective of the control is to minimise the utilisation of artificial lighting without dropping below the design levels / lighting requirements for the specific space.

Optimisation of the lighting technology - The choice of lighting technology will have a significant impact on the energy consumption as well as lighting properties, including colour rendering index, colour temperature, and lifetime of installed lighting system. The main types of electric lighting relevant to hotels include the following, which are described in more detail below:

- Incandescent light bulbs
- Gas discharge lamps, including fluorescent lamps
- Light emitting diodes (LEDs)

Incandescent light bulbs are being phased out in the EU and a number of other countries for most uses and gradually being replaced in many applications by fluorescent lights, high intensity discharge lamps, light-emitting diodes (LEDs), and other devices. The advantages of incandescent lamps include that they can be produced for a wide range of voltages and have a high CRI. The disadvantages are their poor luminous efficacy, short lamp life, and electromagnetic emission in the infrared spectrum as heat. In addition incandescent lamps can not reach a CT higher than approximately 2700 K, slightly higher for halogen lamps at approximately 3000 K.

The **gas discharge lamp** includes a range of types, where fluorescent lamps and compact fluorescent lamps (CFL) are the most common. They produce light by sending an electrical discharge through an ionised gas, typically a noble gas (argon, neon, krypton, or xenon) or a mixture of these gases. Most lamps contain additional materials, such as mercury, sodium, and/or metal halides. The common fluorescent lamp is a gas-discharge lamp that excites mercury vapour inside the bulb. Mercury has its major emission in the ultraviolet spectrum. Therefore, a phosphor coating is applied on the inside of the lamp, which absorbs the ultraviolet photon and release a photon with a lower energy level and within the spectrum of the visible light. The difference in energy heats the phosphor coating. The CFLs can replace incandescent lamps directly, where the regular fluorescent lamps are tubes that require specific luminaires. The CFL is typically integrated, which means it contains the ballast and control gear integrated in the lamp casing. For non-integrated CFLs and regular type fluorescent lamps ballast and control gear is installed in the luminaire. The main advantages of fluorescent lamps are their long lifetime and a high luminous efficacy. The main disadvantages are that they more complicated to manufacture than an incandescent lamp, requires electronics to provide the correct current flow through the gas, and emits light in the ultraviolet spectrum.

Light emitting diodes (LEDs) is a semiconductor diode which converts electricity into light. Initially LEDs could only produce white light by grouping red, green, and blue LEDs and controlling the current to each to produce overall white light. Modern LEDs use a coating which creates a wave shift that enables white light from a single diode. This process is much less expensive for the amount of light generated. Significant research and development are being undertaken on the wave-shifting coating and various materials are being tested as the emitting layer. This will have a significant impact on the development in colour temperature and colour rendering properties of LEDs. LEDs are small in size, but can be grouped together for higher intensity applications. Advantages of LEDs include: high energetic efficiency of the illumination system, long lifetime and less maintenance, small in size and therefore possibilities for size reduction of lighting equipment, high flexibility and control of the level of light and colour variation, low power consumption, and lack of ultraviolet and infrared emissions[102]. The main disadvantages of LEDs are related to their status as a developing technology – they are still relatively costly and there still appear to be some variation in the performance of LEDs[103]. They are also a highly directional light source, which is not always desired, e.g. for ambient lighting.

Advantages and disadvantages of lamp technology

The different types of lamp technology have both advantages and disadvantages. The table below summarises these for incandescent, fluorescent, and LED technology.

Table 33. Advantages and disadvantages of lighting solutions

Type	Incandescent	Fluorescent	LED
Advantages	Low production costs High CRI Mature technology Safe to dispose off – no hazardous materials	Energy efficient Long lamp lifetime Mature technology	Energy efficient Very long lamp lifetime Variable CT (typically high) Start instantly Directional – lighting where it is needed and possibility for patterns etc. Dimmable and controllable – new lighting features + power saving options Safe to dispose off – no hazardous materials No heat radiation Low operating temperature
Disadvantages	Short lamp lifetime Poor energy efficiency Heat radiation in the infrared spectrum Only low Colour Temperature - <2700 K for incandescent and <3000 K for halogen	Not appropriate in cold temperatures / cold starting issues Difficult/costly to dim and control Lower CRI versus incandescent Higher production costs than incandescent Most be disposed off safely – hazardous	High production costs Technology is still not mature and under development Lower CRI than incandescent for significant development Directional light is not always appropriate for ambient lighting, but new downlights are being

[102] Zissis 2009: 5, IN: Mottier 2009
[103] Zissis 2009: 21f, IN: Mottier 2009

		materials Moderate heat radiation Ultraviolet light emissions	developed

Sources: various

To provide a clearer picture of the specific properties of the various lamp types the following table can be referred:

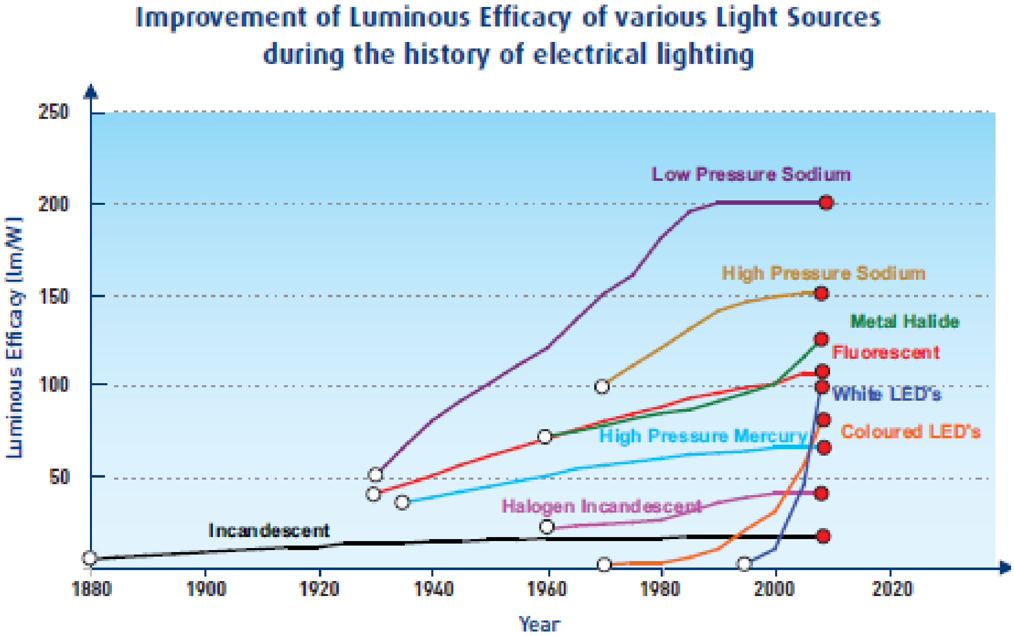
Table 34. Specific properties of various lamp types

Type	Optical spectrum	Nominal efficiency (lm/W)	Lifetime (hours)	Colour temperature (Kelvin)	Colour	CRI
Incandescent	Continuous	12-17	1000-2500	2700	Warm white	100
Halogen	Continuous	16-23	3000-6000	3200	Warm white	100
Fluorescent	Mercury line + phosphor	52-100	8000-20000	2700-5000	White (with a tinge of green)	15-85
Metal halide	Quasi-continuous	50-115	6000-20000	3000-4500	Cold white	65-93
High pressure sodium	Broadband	55-140	10000-40000	1800-2200	Pinkish orange	0-70
Low pressure sodium	Narrow line	100-200	18000-20000	1800	Yellow, virtually no colour rendering	0
Sulphur	Continuous	80-110	15000-20000	6000	Pale green	79
LED (white) (2)		40-100	>35000 - >50000	-	White, warm white	75-94

Source: adopted from European Commission: Reference Document on Best Available Techniques for Energy Efficiency, Feb. 2009. Information on LEDs: http://eartheasy.com/live_led_bulbs_comparison.html (2)

The LED technology is currently developing at a rapid pace. Especially on the efficacy of lamps, but also on the colour rendering properties advances are being made. The figure below shows the developments in the efficacy of various types of lamps as reported by the European lighting industry and demonstrates clearly how LEDs have improving their efficacy in recent years.

Figure 29. Expected developments in the (LED) lighting industry



Originally published: W.J. van den Hoek et al., Lamps, Ullmann's Encyclopedia of Industrial Chemistry, Wiley-VCH, 2001. Updated with recent data. Values for White LED are for commercially available high-power LEDs (90-110 lm/W). Values for low power LEDs may range from 140 160 lm/W.

Source: ELC: Environmental Aspects of Lamps, April 2009

When **retrofitting or installing new lighting** it is important to ensure that adequate lighting properties are ensured. When retrofitting the lighting system to a more energy efficient system it is often a better solution to replace incandescent luminaires with luminaires specifically designed for the more efficient lamp type (fluorescent, LED, etc.) rather than simply changing the lamps within the existing luminaires. Luminaires not designed for specific light sources may result in poor optics and poor thermal conditions and thereby reduce the light output, distort the light distribution, and cause heat to be trapped in the can causing ballast malfunction and reduce lamp lifetime. (Further information on retrofitting required).

Lighting can be controlled by people or by **installing lighting management control systems**. The cost effectiveness of turning off light or dimming light will depend on the type of lamp and the price of electricity. The type of lamp will have an impact because the operating life of a lamp is generally reduced the more times they are turned on or off, with how much will depend on the type of lamp. Lighting control will, however, reduce lighting energy consumption and may also have a significant impact on the sense of comfort as lighting can better be matched to the requirements. People's behaviour can have a great impact on the lighting energy consumption, but will rely on whether sufficient awareness on the matter is present. Another option may be to install lighting management control systems, which automatically regulate lighting. The installation of such control systems can ensure that lighting is automatically turned on and off when needed and that the lighting level is appropriate. This can prevent lighting energy waste and ensure appropriate levels of illumination.

The most common types of lighting controls include:

- Dimmers
- Motion or occupancy sensors

- Photosensors
- Timers

The selection of lighting controls should be made in accordance with the lighting requirements and should therefore be based on the identification of these. Specifically in relation to hotels there are a number of opportunities for significant savings through installation of lighting controls. The lighting controls can be installed in various combinations, which greatly enhance the possibilities.

Dimmers provide variable indoor lighting and reduce the wattage and output of lamps to save energy. They increase the lifetime of incandescent lamps, but reduce the efficacy. Dimming fluorescent lamps requires special dimming ballasts and lamp holders, but in contrast to incandescent lamps it does not influence the efficacy. Fluorescent dimmers are dedicated fixtures and bulbs that provide greater energy savings than a regular fluorescent lamp.

Motion or occupancy sensors automatically turn lighting on when motion is detected and turn them off a while later. Motion sensors usually refer to outdoor application, where occupancy sensors refer to indoor application. Occupancy sensors should be placed to they detect activity occupant activity in all parts of the room. Sensors can also be used for task lighting application.

Photosensors sense the ambient lighting conditions and turn off light when operation is not needed, for example during daylight hours. This can save energy as outdoor light for example is automatically turned off when no longer required. In combination with dimmers they can be utilised for daylight harvesting by controlling the artificial lighting levels to benefit from outdoor light.

Timers can be used to turn lighting on or off at a specific preset time. They do not respond to occupant behaviour, but can be installed in combination with other sensors so that for example outdoor decorative lighting is turned on by a photosensor in the evening and is turned off by a timer at night. Or in combination with a dimmer the lighting in corridors can be dimmed during the night.

Maintenance programme to ensure efficient performance - Illuminance levels decrease over time because of aging lamps and collection of dust on fixtures, lamps, and lenses. This can reduce the total illumination with 50% or more, while power consumption remains the same.[104] This is a significant reduction in efficacy.

The following general advice on maintenance programmes will help to ensure that the lamps are operating at their optimum efficacy[105]:

- Clean fixtures, lamps, and lenses every 6–24 months especially in areas where grease, lint, dust, humidity, and insects can obscure the surface and turn of lamps while cleaning.
- Replace lenses if they appear yellow.
- Replace all the lamps in a lighting system at once. This saves labour, keeps illumination high, and avoids stressing ballasts with dying lamps.

104 http://www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=12270
105 http://www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=12270 & IFC [2], 2007

- Use light colours on walls, ceilings, window frames, and lampshades and clean and repaint frequently to increase the light being reflected.

Achieved environmental benefits

The implementation of a lighting management strategy, which includes the identification of specific lighting requirements for each particular space, daylighting, optimisation of lighting technology and switch to more energy efficient types, implementation of lighting control systems, and the implementation of a maintenance programme, will lead to improvements in the energy performance and thus to reductions in the CO2 emissions. Improved illuminance based on matching the lighting with the specific requirements for the given space, increased use of daylighting, and lighting controls will also influence the well-being of guests and employees. The main environmental benefits can thus be summarised as:

- Reduction in energy consumption and thus reduction in the CO2 emissions
- Improved lighting will lead to improved well-being of guests and staff

In the table below each of the aspects of the lighting management strategy are dealt with in more detail. Risks associated risks with the implementation of the aspect are also included.

Table 35. Lighting management strategy

Aspect of lighting management strategy	Achieved environmental benefit	Risks
Identification of specific lighting requirements	Energy savings by reducing excessive lighting Improved well-being of guests and staff by matching illumination to requirements	-
Daylighting	Energy savings by daylighting rather than artificial light Improved well-being due to the properties of daylight compared with artificial light	Increased heat load from daylight Glare
Optimisation of lighting technology	Energy savings from installation of energy efficient lighting technology Reduction in waste through installation of lamps with longer lifetime Reduction in hazardous waste by installing lamps without hazardous material content	Fluorescent lamps should be disposed off safely Exclusive focus on energy optimisation lead to higher efficacy but lower quality with respect to CRI, CT, glare, and directionality
Lighting management control systems	Energy savings by reducing excessive lighting Improved well-being of guests and staff by controlled matching of illumination to requirements	Excessive switching on/off will reduce lamp lifetime, especially for fluorescent lamps
Maintenance programme	Extending the lifetime of lamps by reducing the depreciation of the level of illuminance will reduce power wastage and lamp waste Improved well-being of guests and staff by maintaining	Lamps are damaged during cleaning etc.

	illuminance according to requirements	

Source: THE EUROPEAN GREENLIGHT PROGRAMME - http://www.eu-greenlight.org/index.htm

Table 36. Energy savings from implementation of lighting management strategy aspects

Hotel	Lighting consumption	Applied technique	Realised savings
		Daylight harvesting	Need information
Hotel Tomo, Riga, Latvia	N/A	Retrofitting with fluorescent lamps	121500 kWh/year
Prague Marriott Hotel, Czech Republic	Reduction of electricity used in the areas covered: 58%	Retrofitting with fluorescent lamps and LEDs	Lighting electricity savings: 404 MWh/year CO2 emission savings: 472 tons/year

Source: THE EUROPEAN GREENLIGHT PROGRAMME - http://www.eu-greenlight.org/index.htm

Lighting pollution - An improved lighting management strategy may also lead to reductions in lighting pollution, including light trespassing, over-illumination, glare, light clutter, and skyglow. These forms of pollution may beyond energy waste have detrimental effects on animal and human health and psychology as well as on ecosystems and may also affect astronomy negatively and increase atmospheric pollution.[106] It is considered beyond the scope of this section to deal with aspects of lighting pollution in detail. Especially when installing outdoor lighting and decorative lighting and for services accommodation located near important biodiversity areas lighting pollution may be a significant issue to consider in a lighting management strategy.

Appropriate environmental indicators

The lighting energy consumption per square meter is an appropriate indicator for the measurement of lighting energy consumption of hotels. However, the occupancy may vary significantly and therefore it may be appropriate to factor in the occupancy. To measure the lighting energy consumption per guest night the appropriate indicator is lighting energy consumption per year per guest night.

Technical performance indicators are also important to consider as they relate to the energy efficiency of the lighting as well as to the use of the illuminated space. The illuminance measured in lux or lm/m2 along with upper glare limit, UGR_L and the colour rendering index limit, R_a are important indicators when analysing whether the installed lighting is appropriate in relation to the use of the given space. The efficacy of the lambs is an important indicator in relation to energy efficiency as it indicates the ratio of light produced to energy consumed measured in lumens per watt (LPW – lm/W).

Cross-media effects

Changing to more energy efficient lighting technologies will reduce energy wastage in the lamps, which almost exclusively is in the form of heat emissions. Therefore, the change in technology will have an impact on the heating load of the heating system, which should be taken into account and coordinated. Especially in incandescent lighting technology the heat emissions may be significant.

[106] http://en.wikipedia.org/wiki/Light_pollution

It is important that retrofitting of lighting to more energy efficient systems not focuses exclusively on efficacy of the systems, but considers other qualitative factors of lighting, such as the colour rendering properties, the colour temperature, glare, and aspects associated with directionality of light. Colour rendering is especially important where food is prepared and served and different types of colour temperatures are preferred for different tasks and situations. Lamps with higher efficacy can produce glare and directional light may not be optimal for ambient lighting.

Use of daylighting should also be considered carefully as it may have a significant impact on cooling and air-conditioning loads if windows and skylights do not have a high insulating capacity. Therefore, solar heat gain and light transmission through windows and skylights should be considered simultaneously. Daylighting should also be careful not to create situations that can cause glare of guests and employees. Especially for windows facing east and west this is a risk.

When installing fluorescent lamps it is important to consider that they contain mercury and should be disposed of safely. However, according to information from the European Lamp Industry's Federation the content of mercury has been greatly reduced over the years and the members have further committed themselves to reduce the mercury content by another 40% by 2012.[107] Coal fired power generation accounts for a significant amount of mercury emissions. Therefore, retrofitting from incandescent to fluorescent lamps may still reduce the net emissions of mercury by reducing the energy consumption. Mercury content in fluorescent lamps may also be collected and reused. As stipulated in the European Waste Electrical and Electronic Equipment (WEEE)[108] Directive fluorescent lamps are collected and recycled.

Operational data

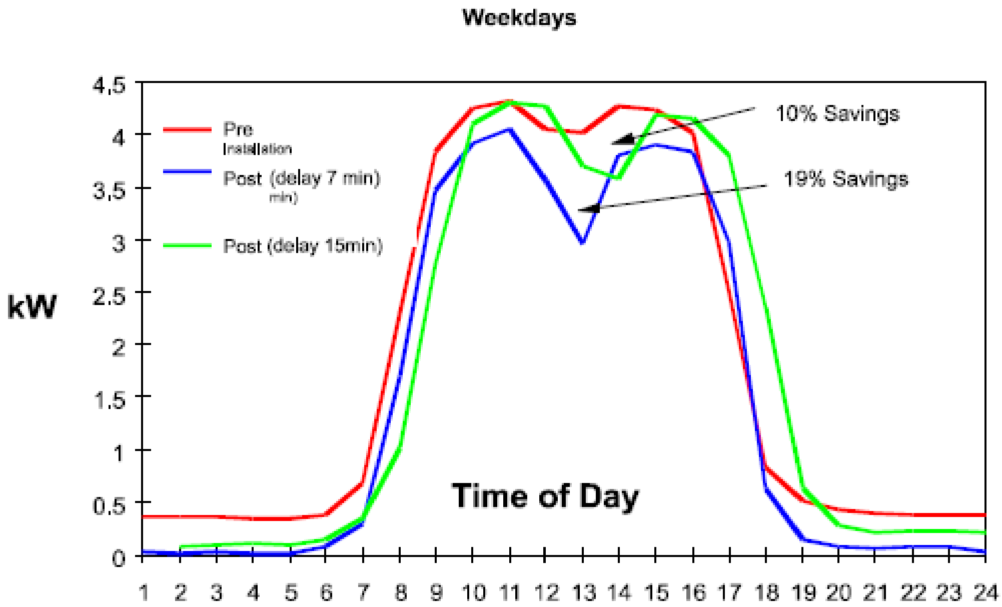
In this section performance data on energy consumption for the following main aspects is presented:

- Daylight harvesting
- Optimisation of lighting technology by retrofitting with fluorescent lamps
- Optimisation of lighting technology by retrofitting with LEDs.

The potential for daylight harvesting can be assessed via lighting use profiles. The figure below shows a lighting use profile for a building, where occupancy sensors have been tested as well.

107 ELC Brochure on Environmental Aspects of Lamps, April 2009
108 http://ec.europa.eu/environment//waste/weee/index_en.htm

Figure 30. Lighting use profile with and without occupancy sensors



Source: *bookstore.ashrae.biz/journal/download.php?file=OfficeBuilding.pdf*

Case Studies

In this section a number of cases, where the lighting management techniques have been used, are presented.

Hotel TOMO, Riga, Latvia

Hotel TOMO is a three star conference hotel in Riga with 170 rooms, 6 conference rooms, internet cafe, restaurant, bar, and club. The total area of the premises is 6911 m^2

The replacement programme is presented in the table below with calculations of savings.

Table 37. The replacement programme and estimated savings

Area	Existing lighting	Replacement	Calculations	Savings	Savings in %
Hallways	156 4-bulbs 112W luminaries with halogen type bulbs, operated 3475 hours per year	Luminaries will be replaced with 156, 26W T5 fluorescent tubes	E: 112W x 3475h x 156 = 60,715kWh R: 26W x 3475h x 156 = 14,094.6kWh	46,621kWh	77%
Corridors	8 luminaries with four 25W incandescent bulbs each	Replaced with 5W CFL	E: 8 x 4 x 25W = 800W R: 8 x 4 x 5W = 160W	540W x no of corridors x operating hours	68%
Rooms	Different types of luminaries and bulbs according to room size and type. 294 luminaries with one 25W incandescent.	Replaced with 294, 11W CFL.	E: 294 x 25W = 7,350W R: 294 x 11W = 3,234W	4,116W x operating hours	56%
Restaurant	Decorative luminaries	Replaced with	E: 4 x 25W = 100W	72W x no	72%

	with each four 25W incandescent bulbs.	four 7W CFLs.	R: 4 x 7W = 28W	of luminaries x operating hours	
Conference rooms and offices	294 luminaries with two-60W incandescent bulb each.	Replaced with 15W CFL.	E: 294 x 2 x 60W = 35,280W R: 294 x 2 x 15 = 8,820	26,460W x operating hours	75%
Outdoor lighting	Seven 350W photo sensor based halogen luminaries	Seven 245W bulbs with reflectors and day light sensitivity and/or sensors.	E: 7 x 350W = 2450W R: 7 x 245W = 1715W	735W x operating hours + lighting control savings	30% + lighting control savings

The total annual energy savings that can be realised by the implementation of all measures have been estimated at: 121,500 kWh/year. At 2010 European Union average electricity prices of 0.0918 €/kWh this amounts to savings of approximately € 11,500 per year.[109]

Information on number of luminaries and operating hours has not been provided for all areas of the hotel where the replacement programme is being undertaken. Therefore, it has not been possible to calculate the savings in kWh for the specific areas except for the hallway. Exact information on the type of lighting control equipment being considered for the outdoor lighting has also not been provided and the potential savings from this equipment can also not be estimated. For indoor lighting the savings rates are between 56 and 77%. The cost of replacing the lamps and luminaries including material costs has also not been provided. Further operation and maintenance costs which should be considered include the considerable reduction in maintenance that the fluorescent lamps have compared with the incandescent lamps due to their significantly longer lifetime – 8,000-20,000 hours compared with 1,000-2500 hours (and 3,000-6,000 for halogen lamps)[110].

Prague Marriott Hotel, Czech Republic

The Prague Marriott Hotel management has decided to make a committed effort to reduce its energy consumption and has selected its interior lighting system as the first step[111]. A hotel building with 293 rooms and a conference facility needs lighting for both the safe orientation of its clients and employees and at the same time to "emphasise" the proper atmosphere of comfort and convenience. The revision of the light sources used for these purposes ensures that these aims are achieved and at the same time significantly lowers operating costs and leads to easier maintenance because all the newly selected light sources have a longer life.

The selected light sources mainly included a wider range of compact fluorescent light bulbs in corridors and rooms (70% more efficient than incandescent lights, 15 times longer life), LED light sources in the corridors (90% more efficient than halogen reflectors, 10 times longer life), and E27 halogen light bulbs in the ceilings of the main halls (30% more efficient than incandescent light bulbs, 2 times longer life).

– Lighting electricity savings: 404 MWh/year
– Reduction of electricity used in the areas covered: 58%
– CO_2 emission savings: 472 tons / year

[109] http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables
[110] THE EUROPEAN GREENLIGHT PROGRAMME - http://www.eu-greenlight.org/index.htm
[111] THE EUROPEAN GREENLIGHT PROGRAMME - http://www.eu-greenlight.org/index.htm

At 2010 European Union average electricity prices of 0.0918 €/kWh this amounts to savings of approximately € 37,000 per year.[112]

Applicability

The elements of an efficient lighting management strategy as described above include:

- Identification of the specific lighting requirements
- Optimisation of the use of daylighting
- Optimisation of the lighting technology
- Installation of lighting management control systems
- Implementation of maintenance programme

These measures are relevant to all serviced accommodation. The scope for the optimisation of the use of daylighting and lighting technology as well as installation of lighting management control systems is obviously broader if a refurbishment, upgrading, or new construction is being undertaken. Regarding each element there may be specific factors to consider when implementing the technique.

The identification of the specific lighting requirements is in itself an analysis of the appropriateness of various types of lighting for the specific interior, task, or activity. It is based on a zoning of the serviced space according to the categories of ambient lighting, task lighting, and decorative lighting and with regards to maintained illuminance as well as glare, colour rendering and other qualitative aspects of lighting according to their appropriateness in the specific situation.

The appropriateness of the optimisation of the use of daylighting will depend on the insulating capacities of the windows and skylights installed and may require optimisation of the insulation to reduce the solar heat gain undertaken at the same time to circumvent undesired heat gains and increased cooling and air-conditioning loads. The implementation of daylighting should also ensure that the increased light transmission does not lead to glaring.

The optimisation of lighting technology relies on multiple variables, including energy efficiency, qualitative aspects of lighting, as well as directionality of light and should incorporate the results from the identification of the specific lighting requirements along with other factors specific to the lighting technologies. Fluorescent technology may not be appropriate where light with high colour rendering properties is required, it may also not be appropriate where lamps are frequently turned on and on because of the resulting increase in power consumption and decrease in lamp lifetime. Fluorescent light may also not be the preferred option in a setting that requires instant light, when switched on.

[112] http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables

LED technology has significant advantages and is used in applications where reliability, colour, visibility, and lamp lifetime are important. They do not have the same issues with cold starts as fluorescent lamps and can therefore be used in locations where it gets very cold and because of the long lamp lifetime they are also preferred in places that are difficult to reach. LED technology is developing rapidly and because of this status as an emergent technology the availability of lamps for specific application may still be limited. In the specific application the efficacy of available lamps may also be below what is available in fluorescent lighting technology.

The applicability of lighting management control systems depend largely on the individual situation. However, the use should be coordinated with the specific type of lighting technology. Dimming incandescent lamps for example increase lamp lifetime, but reduce their efficacy and dimming fluorescent lamps requires special dimming ballasts and lamp holders. When installing controllers it should also be considered that frequent switching on and off of lamps especially fluorescent lamps may reduce their lifetime significantly. At night time outdoor motion sensors may be a source of light pollution as well as disturbance of guests.

Lighting maintenance programmes are generally applicable. However, the installation of LED technology reduces the maintenance requirements due to the long lamp lifetime and lower operating temperatures.

Economics

In this section information on investments and operation and related energy savings will be presented related to the following main aspects:

- Daylight harvesting
- Optimisation of lighting technology by retrofitting with fluorescent lamps
- Optimisation of lighting technology by retrofitting with LEDs.

Information on how to calculate the cost of lighting will also be provided.

Daylight harvesting will reduce the energy use in the serviced accommodation and thereby reduce the operational costs. However, the investment costs of new windows and installation of skylights may be significant, especially because types with low heat transfer capacity will have to be chosen to avoid adding to the cooling and air conditioning load. Installing timers and/or dimmers to harvest daylight may represent relatively limited investments and have short payback time.

Retrofitting the lighting system to high efficacy fluorescent lamps or LEDs will, depending on the lighting concept before and after retrofitting, have short payback times.

Information from the Green Light Programme show that between 30% and 50% of electricity used for lighting can be saved by investing in energy-efficient lighting systems and that these investments are not only profitable but they also maintain or improve lighting quality.[113]

This section requires insertion of energy prices

[113] http://www.eu-greenlight.org/index.htm

Driving force for implementation

The driving forces for implementation of a lighting management strategy, which includes the identification of specific lighting requirements for each particular space, utilisation of daylighting, optimisation of lighting technology and switch to more energy efficient types, implementation of lighting control systems, and the implementation of a maintenance programme, relate to improvements in the energy performance and to reductions in the CO2 emissions. Improved illuminance based on matching the lighting with the specific requirements for the given space, increased use of daylighting, and lighting controls will also influence the well-being of guests and employees. The reductions in energy consumptions can also be explored to improve the environmental credentials and if the change to more energy efficient lighting technologies is carefully managed to ensure that the qualitative aspects of lighting are improved in can be a significant element of the visual branding of the hotel. Thus, the main driving forces can be summarised as:

- Reduction in energy consumption and thus cost savings and reduction in CO2 emissions
- Reduction in maintenance costs by switching to lighting technology with longer lifetime
- Improved lighting will lead to improved well-being of guests and staff
- Improved environmental credentials
- Visual branding

Besides the abovementioned driving forces legislation is a key driver in the implementation of aspects of the lighting management techniques. The phase-out of incandescent lamps for most uses is a powerful driving force behind the change in lighting technology to more energy efficient types as fluorescent and LED lighting technologies. The lighting requirements for indoor and outdoor workplaces, including for restaurants and hotels as specified in the EN 12464 standard are a driving force behind the identification of the specific lighting requirements according to task or activity in the categories of maintained illuminance, the upper limit for direct glare, and the lower limit for the colour rendition index.

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2.2.2 Best Environmental Management Practice for Reducing Process Water Consumption in Serviced Accommodation

SA5. Minimise water consumption in guest areas

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

SA6. Minimise water consumption in guest areas

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

SA7. Minimise laundry water consumption

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

SA8. Water conservation in green areas

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

2.2.3 Best Environmental Management Practice for Minimising Waste in Serviced Accommodation

SA9 Waste Sorting and Recycling

Description

Poor waste management can have implications for health, quality of the environment and public and private economies due to waste management costs. On average, hotels create 1 kg of waste per guest per night[114]. Waste disposal costs are likely to increase steadily in the future due to diminishing landfill space and increasing collection and disposal costs. In general, hotels can put in place a range of activities to address their waste management issues, generating cost savings and reducing the volume of waste that is landfilled each year, including potentially useful resources. Waste management should follow the hierarchy presented below:

○ **Reduce**	Create as little waste as possible by not purchasing it to begin with
○ **Recover**	Set up systems to collect and sort the waste so it can be reused or recycled
○ **Reuse**	Consider where certain items can be reused, sold or donated to others that can use them
○ **Recycle**	Have a system in place for sorting everyday waste items such as bottles, cans, cardboard and paper for reuse and recycling. Consider what else might be recycled, taking into account local disposal possibilities

Hotels face a range of barriers to sorting and recycling their waste. They are to some extent limited by the waste management infrastructure in their locality, which is mostly owned and operated by the local authority, especially if they are not able to find other takers for waste fractions that the local system does not accept. However, experience shows that there are many innovative means of sorting and recycling waste, for example the Hilton Slussen Hotel in Stockholm which sorts its waste into 22 different fractions[115]. There is also the issue of space. In most hotel buildings, as much space as possible on the groundfloor is usually allocated to front-of-house areas such as the reception, lobby, restaurant and banqueting facilities. This leaves minimal space back-of-house for waste to be stored and sorted. There are in addition a range of other factors to take into account, such as health and safety, local and national waste regulations and the noise created by waste compaction and collection which may disturb guests and neighbours[116].

[114] ITP, 2008
[115] ITP, 2008
[116] Claire Baker http://www.waste-management-world.com/index/display/article-display/271254/articles/waste-management-world/volume-7/issue-7/features/a-welcome-sign-hotels-adopt-reuse-and-recycling.html

In order to be able to reduce the amount of waste going to landfill, hotels must sort the waste into as many fractions as possible. Not only are there technical implications regarding how specific waste is to be sorted and disposed of, but there are also implications for the daily routines among the hotel staff. Staff receive clear instructions on what waste types of waste are to be sorted and how. Specific responsibilities need to be assigned, and the waste quantities should be measured and monitored. For these reasons, hotels should ideally seek to integrate waste management into an overall environmental management system (see chapter 2.1 on EMS).

The waste generated by hotels typically includes paper and cardboard items, glass and aluminium products, plastic items, organic waste, building materials and furniture, and used oils and fats. Hazardous wastes may include batteries, solvents, paints, antifouling agents, and some packaging wastes. Tourists may generate up to twice as much solid waste per capita as local residents, resulting in increased stress on local waste management infrastructure[117]. Waste types and quantities at an accommodation facility are highly dependent on whether it provides food and beverage services for guests. The Danish EPA conducted a waste survey of all service sector operations in Denmark in 2000, including accommodation facilities, and conference and course centres. Hotels were generally found to sort into four main waste types: ordinary waste, bottles and other glass jars, organic waste and cardboard packaging[118]. The information obtained in the survey on waste types from serviced accommodation is presented in the table below.

Table 38. Results for serviced accommodation from Danish service sector waste survey

	Hotels with restaurants	**Conference & course**	**Holiday centres**
No. in Denmark	807	120	20
Average number of employees	11	14	18
Main waste types (according to DK classification)	Mixed waste for incineration, batteries, waste with household characteristics, bottles and glass, garden and park waste, iron and metal, organic waste, fluorescent tubes, cardboard waste, paper, plastic packaging, machines, equipment and furnishings, refrigerators, electric and electronic products.	Mixed waste for incineration, batteries, waste with household characteristics, bottles and glass, garden and park waste, iron and metal, organic waste, fluorescent tubes, cardboard waste, paper, plastic packaging, machines, equipment and furnishings, refrigerators, electric and electronic products.	Mixed waste for incineration, batteries, Waste with household characteristics, bottles and glass, garden and park waste, iron and metal, organic waste, fluorescent tubes, cardboard waste, paper, plastic packaging, machines, equipment and furnishings
Breakdown of waste volumes and indicators	Mixed waste for incineration, waste with household characteristics: 46.8t/yr Food waste: 7.7t/yr Cardboard: 2.8t/yr Bone waste: 0.6t/yr (results from one	Cardboard and cartons: 5.5 t/yr Food waste: 2,000 bins/yr Frying oil waste: 3,000 l/yr Mixed waste for incineration, waste with household characteristics: 4 containers per day (results from one	Mixed waste for incineration and waste with household characteristics: 470 tons (t) Paper and cardboard: 12.6 t Bottles: 7.21 t Iron and metal scrap: 17.36 t Food waste: 53.55 t Frying oil waste: 2.44 t

[117] IFC, 2007
[118] Miljøstyrelsen, 2000

	interviewed hotel)	interviewed conference and course centre)	(results from one interviewed holiday centre)

Source: Miljøstyrelsen, 2000

Generally the amount of hazardous waste resulting from hotel operations is not significant. The hazardous waste types identified in the survey were: used batteries, lighting, paints, leftover insecticides and pesticides as well as packaging, leftover chlorine and hydrochloric acid from the swimming pools and de-icing chemicals. Commission Decision 2000/532/EC[119] lists how hazardous waste, including electronic equipment, shall be separated, collected and disposed of. Directives 2002/96/EC and 2002/95/EC of the European Parliament and the Council specify hazardous waste types affected[120].

According to results from a Norwegian survey (Table 39) the two most significant waste fractions in terms of weight from serviced accommodation are paper and cardboard (53.3%) and food waste (22.5%). Plastic is also a significant waste type (10%).

Table 39. Aggregated Waste from Hotels

Aggregated Waste from Hotels	**Percentage weight**
Paper and cardboard	53.3
Plastic	10.0
Food waste	22.5
Nappies	2.3
Other incinerable waste	4.8
Glass	3.3
Iron and metal scrap	1.4
Other non-incinerable waste	0.04
Electric and electronic waste	0.02
Hazardous waste	-
Fine particles (10mm, e.g. ground coffee, dust from vacuum cleaner bags etc)	2.4
In total	**100%**

Source: SFT, 1998

Table 40 presents the results from a more recent analysis of waste management in 36 hotels in the 2 to 4-star categories in Germany and Austria.

Table 40. Waste percentages from Survey among German and Austrian hotels

	Residual	Paper	Glass	Plastic and metal	Organic
Kg	49 %	12 %	6 %	2 %	31 %
Litre	55 %	23 %	5 %	8 %	9 %

Source: ECOTRANS, 2008

In general the largest waste fractions generated by hotels are glass, plastics, cardboard and paper, and organic waste (the lower percentage plastic observed in Germany and Austria may be due to strict national regulations on packaging). Experience shows that, due to its economic value, glass recycling is already well established in hotels with glass being sorted and then picked up on a regular basis by either the municipality or a private enterprise. A similar situation is anticipated for the cardboard and paper fractions.

119 OJ L 226, 6.9.2000 referenced in 2009/578/EC
120 OJ L 37 13.2.2003 and OJ L 37 13.2.2003 referenced in 2009/578/EC

The remainder of this section therefore considers the best environmental management practices and techniques that can be used to sort and recycle plastic and organic waste.

It makes good sense for hotels to sort **plastic waste**, which is collected and distributed to central processing plants for recycling. Sorting plastic helps a hotel to reduce the mixed waste volume, which is often the most expensive in terms of collection prices. In 1998, average prices for collecting plastic were found to vary from €0.08/kg in Denmark to €0.16/kg in Sweden to €1.51/kg in Germany[121]. If there is no municipally organised plastic collection system, the hotel should try and locate another organisation that has an economic interest in collecting the plastics. It may become more attractive for a private business to collect the plastic waste if hotels in the same area network and ensure that there is sufficient capacity to make collection interesting. Plastic can be sorted into soft plastic and hard plastic fractions (see below)[122].

Table 41. Plastic fractions relevant for serviced accommodation

Soft Plastic		**Hard Plastic**	
Soft plastic primarily consists of LDPE (Low Density Polyethylene) which is well suited to recycling. This plastic is more often than not transparent (but can also be coloured) and is used for the packaging of a large variety of goods, as well as for packing goods that are on pallets.		This type of plastic primarily consists of HDPE (Low Density Polyethylene) and PVC. It is most often used in agriculture or gardening centres, for example plastic potting trays and flower pots. Other examples are drink bottles which are made of PET, and drainpipes and plastic windows which are made of hard PVC.	
Stretch wrap: thin and elastic material most often used to pack goods that are on pallets[123].		**HDPE** bottles and containers are used for a variety of liquids including detergents and cosmetics.	
Shrink wrap: denser than stretch wrap and used to pack larger quantities of goods. During packing the wrap is heated up so that it shrinks onto the item(s) being packed[124].		**PET:** this waste fraction mostly consists of 0.5 litre and 1.5 litre drink bottles.	

[121] Grontmij | Carlbro, Indsamling og behandling af emballageaffald i Danmark, Frankrig, Holland Storbritannien, Sverige, og Tyskland, 2001
[122] Marius Pedersen website: www.mariuspedersen.dk (including images unless otherwise noted)
[123] Image from www.northerntool.com
[124] Image from www.boatshrink.com

Sacks: very strong plastic which is welded together at both ends. Used in packaging of building materials, grow bags etc[125].		**PVC:** includes drain pipes and guttering. Mostly associated with the building infrastructure.	

Source: Marius Pedersen, 2011

Since the solutions for plastic recycling are off-site, the remainder of this section focuses on the organic waste fraction which hotels can do on their own premises if there is no municipally organised collection of food wastes.

Hotels with kitchens use significant amounts of **organic products**. The characteristics of **organic waste** mean that it can be recycled into useful materials such as compost or bioenergy when its original value for the kitchen has been lost. As described in the next section on waste minimisation, the organisation should strive to reduce the amount of produce that is thrown out before it is used in food production, i.e. through careful procurement and management of the storage facilities. During food preparation and in the dish wash area, organic waste should be collected separately and used for recycling in order to reduce the quantities of potentially useful resources that are landfilled, and in order to maximise the lifetime of landfills.

Pursuant to the EU regulation on the use of animal by-products, the use of food waste from catering centres and restaurants for animal feed is not allowed. Previously, in certain European countries, there had been specific collection of food waste from large kitchens (in so-called “pig bins”) which was then converted into pig food. In general a hotel and restaurant looking to recycle its organic waste has the following options:

1. Biogas
2. Compost
3. Vermiculture

In general, it will not be feasible for a hotel to construct and operate a **biogas** plant on its own premises. These facilities require large amounts of organic materials, and even if several hotels were to pool their waste and make a common investment, there are both noise and odour issues which are not compatible with the hotel product. For these reasons it is also likely that they require environmental approval by the authorities. There are, however, examples of hotels that enter into agreements with farmers who operate a biogas plant, e.g. Hilton Hotel Slussen in Stockholm which sends its waste to a farmer for treatment (see also Case Studies section). At the same time, authorities across Europe are increasingly collecting organic waste separately and sending it to central biogas plants (see below).

125 Image from www.carterspackaging.com

Local authorities in Europe use **composting** as a sustainable waste management strategy, and encourage both use of centralised and decentralised composting, which may or may not be in conjunction with biogas production. In **centralised composting**, individuals and organisations are encouraged to sort into an organic fraction, for example containing the following[126]:

- Fruit and vegetables
- Bread
- Rice
- Potato peels
- Kitchen roll
- Coffee and tea filters
- Potted plants without the pot
- Meat without the bone
- Fish
- Dairy products
- Egg shells and egg boxes

The organic waste is then collected and taken to a central collection point before being transported to a composting site or a biogas plant. The figure below shows a central composting site in Denmark with the capacity to produce 5,000 tons of compost per year.

Figure 31. Central composting site, Struer

Source: http://dknyt.dk/sider/artikel.php?id=33290

Open-air centralised composting sites use machines to mechanically turn and aerate the waste which is piled into windrows. The intention with traditional composting is to stack waste material in sufficiently large piles so that the heat produced in the intense breakdown of organic matter is retained in the compost pile. This temperature increase stimulates the proliferation of heat loving

[126] Useful organic fractions such as cooking oils, fats and grease should be separated beforehand. The oils can be collected in a secure container and have it collected by a specialised company for cleaning and blending for use in animal feed, soap or cosmetics production or increasingly, to make bio-fuels.

(thermophilic) microorganisms and it is mainly these that are responsible for the decomposition process at temperatures which may exceed 70°C[127]. When combined with biogas production, the organic waste is digested to generate methane giving a residual waste. This is further sorted before being processed to create compost. The compost resulting from centralised processes may be redistributed to gardeners via local waste recycling centres, or used in agriculture as a natural source of phosphor.

In **decentralised composting**, organisations are encouraged to compost their own organic waste on site. Subsidies may be available at the national level or locally, for the purchase of composting equipment.

The Pear Tree country hotel in Purton (UK) is an example of a hotel that has installed a decentralised composting system. The Pear Tree provides accommodation, wedding, business parties and conference facilities. The catering includes a la Carte, breakfasts, conference buffets, weddings, business sandwiches and has around 1000 to 1500 covers per month. They compost their garden and mainly un-cooked kitchen waste (including veg peelings, some shellfish peelings, bread and pastry leftovers) in an in-vessel composting system called a Rocket. They compost around 11 kg of food waste a day. Garden waste is shredded and is also added to the food waste as well as composting just garden waste in bays. The large green areas provide sufficient space on which to use the compost. As a result the hotel no longer needs to buy in soil improver and peat thus realising cost savings[128].

Figure 32. Hotel composting, UK

Source: http://www.crn.org.uk/compostdoctors/casestudies.htm

There are various composting technology solutions for small scale use, ranging from open bays to closed vessels. Open bays are sufficient for gardening waste but food waste should be applied in closed vessels in order to promote hygiene and reduce odour and vermin issues. Closed vessels are also quicker, generating soil within 3-4 weeks[129]. The Case Studies section of this chapter presents the experiences from another hotel that uses a closed composter, and suppliers of composting equipment in Europe are included in the Reference section of this chapter.

127 Vermicomposting Trial at the Worm Research Centre, Jim Frederickson and Steve Ross-Smith
128 Compost Doctors website: http://www.crn.org.uk/compostdoctors/casestudies.htm
129 JORA kompost http://www.joraform.com/homeeng.html

EU member states set their own legislation regarding decentralised composting. There may be requirements for the area where composting takes place, e.g. that it is paved or sealed for soil and groundwater protection, and that a risk assessment needs to be done if the site is within 250 m of a sensitive receptor. In the UK, the maximum size for a home composting unit is 1000m^3 of compost or upto 400 tonnes per year[130]. Due to the Animal Byproducts Regulation, only food waste that does not contain meat may be composted in a decentral manner in the UK. This is because raw meat and other uncooked products of animal origin can spread serious animal diseases such as Foot and Mouth[131]. The UK Environment Agency does, however, provide exceptions to this rule where catering waste is composted on the premises on which it originates, provided that the material produced is used only on that premises, and that livestock are not kept on the premises. This means that hotel owners may compost their own kitchen waste for use on that premises, provided livestock are not present[132].

Vermicomposting[133] is the use of selected species of earthworms to help decompose and transform organic wastes into useful compost. However, as with all composting processes, it is the aerobic microorganisms, such as fungi and bacteria, which mainly decompose the waste; the action of the earthworms merely accelerates this process and also physically improves the characteristics of the final compost.

Vermicompost is the matured, processed material that is egested from earthworms as casts. As earthworms feed on the rich diet of organic matter and micro-organisms in waste, this ingested material is finely ground by the earthworms gut. This helps micro-organisms decompose the organic matter and stimulates mineralisation of complex compounds into simple nutrients, easily utilised by plants. At the same time the organic matter and microbial cells are glued together by the secretions from the earthworms gut forming casts. The amount of time that the waste spends in the earthworm gut is only a few hours and therefore the egested cast material is very microbially active and continues to decompose for some time. Once matured, the casts are known as vermicompost, which can have excellent physical and chemical characteristics. Compared with windrow composts, vermicomposts are likely to contain higher levels of nitrogen because vermicomposting temperatures and nitrogen losses are typically much lower.

While vermicomposting and composting both involve the aerobic decomposition of organic matter by microorganisms, there are important differences in the way the two processes are carried out. The most notable being that vermicomposting is carried out at relatively low temperatures (under 25°C), compared with composting, where pile temperatures can exceed 70°C. With vermicomposting it is vitally important to keep the temperature below 35°C, otherwise the earthworms will be killed. It is the joint action between earthworms and the aerobic microorganisms that thrive in these lower temperatures (mesophilic) that breaks down the waste. Hence it is common with vermicomposting systems to apply waste frequently in thin layers, a few centimetres thick, to beds or boxes containing earthworms in order to prevent overheating and to help keep the waste aerobic. Contrary to traditional composting where the material is aerated mechanically or manually, in vermicomposting it is the earthworms that fragment, mix and help aerate the waste.

[130] Cath Kibbler, Community Composting Network, Regulations and Legislation for On-site Composting
[131] Think Before You Bin, Disposal of waste food by retail premises under the animal by-products regulation, LACORS, DEFRA
[132] Compost Doctors website: http://www.crn.org.uk/compostdoctors/news.htm
[133] Note this entire section is based on information from the Worm Research Centre in the UK

Figure 33. “Humus” vermiculture container (320 litres)

Source: www.humus.dk

Vermiculture may be small scale and decentralised such as in the figure below. It may also be larger and centralised. Automated reactor systems have been installed which allow waste to be fed from a gantry above the reactors while finished vermicompost is collected from the base using breaker bars. Such a vermicomposting system was installed in 1991 at Montelemar, France to process organic matter from the town’s household waste stream. Mixed waste is sorted and then pre-composted for 30 days before being vermicomposted for 60 days by an estimated 1,000 million earthworms. Around 27% of the total waste stream is converted in a number of reactors to good quality vermicompost which is then bagged and sold. Separating the processed waste (vermicompost) from the earthworms at the cessation of processing is often performed manually but for many years earthworm harvesting machines have been commonly available in the USA and other countries.

Achieved environmental benefits

This section has primarily focused on the sorting and recycling of organic waste in the form of food waste from kitchens. The environmental benefits include:

- Reduction in transport and associated energy use and air pollution, since the volume of waste sent to landfill is decreased. For those implementing composting or vermicomposting on premises there is a further reduction in transport since they are not part of a centralised collection system, and they do not have to purchase mulch or sphagnum (which also helps to protect biodiversity in ecosystems where these materials are extracted)
- Reduction in the volume of organic waste that is sent to landfill. Food waste has a value, either for energy purposes or as plant nutrient, and recycling helps reduce the ecological footprint of tourism. Furthermore landfill space is anticipated to become a

much needed resource in the future due to urbanisation and it is therefore necessary to reduce the volumes being landfilled.
- Opportunity to exploit market niche for accommodation providing more sustainable solutions. If carried out on premises, there is an educational effect on guests who are able to learn about composting.

Appropriate environmental indicators

The following indicators are suggested for measuring, monitoring and benchmarking sorting and recycling of waste:

- Volume of total waste generated by hotel (t) per annum
- Volume of each waste fraction that is sorted (kg or t) per annum
- Volume of organic waste that is collected and used for central biogas production and/or composting (kg or t) per annum
- Volume of organic waste composted/vermicomposted on premises (kg or t) per annum
- Volume of nutrient rich soil generated through composting or vermicomposting on premises (kg or t) per annum
- Percentage of total waste that is recycled per annum

These waste fractions can also be related to the number of overnight stays for benchmarking purposes.

Cross-media effects

The cross-media effects from composting and vermicomposting are greenhouse gas emissions and leachate. The greenhouse gas emissions are in the form of methane and nitrous oxide. The leachate is an especially an issue in open-air composting beds where 1mm of rain falling on 1 m^2 of bed will produce approximately 1 litre of leachate[134]. There is some evidence that the leachate is treated on its way through the composting bed. Leachate can be collected separately and used as a fertilizer after dilution for optimal growth.

Vermicomposting does have one serious disadvantage compared to composting, and this relates to the destruction of human and plant pathogens that can be present in some wastes. Destruction of most pathogens is more easily achieved in windrow composting due to the high operating temperatures and the intense microbial reactions taking place. Although the destruction of human pathogens has also been shown to be very effective with vermicomposting, elimination of pathogens requires very effective management of the vermicomposting process. However, since these pathogens are contained in waste types such as sewage sludge, it is not deemed to apply for vermicomposting of food waste from hotel kitchens.

A Danish study carried out in 2004 analysed potential systems for the collection and treatment of food waste, focussing on the advantages and disadvantages regarding technique and handling. LCA screenings were done for the following systems:

- Biogas with central collection and pre-treatment (collection in bins)
- Biogas with decentralised collection and pre-treatment, respectively, with and without collection of waste food in plastic bags.

[134] Vermicomposting Trial at the Worm Research Centre

- Collection together with ordinary mixed waste for incineration
- Composting with decentralised collection and pre-treatment

The project found that biogas production was the best option, followed by waste incineration and composting. The disadvantages related to composting were because it does not generate energy and may cause greenhouse gas emissions (Miljøstyrelsen, 2004).

Operational data

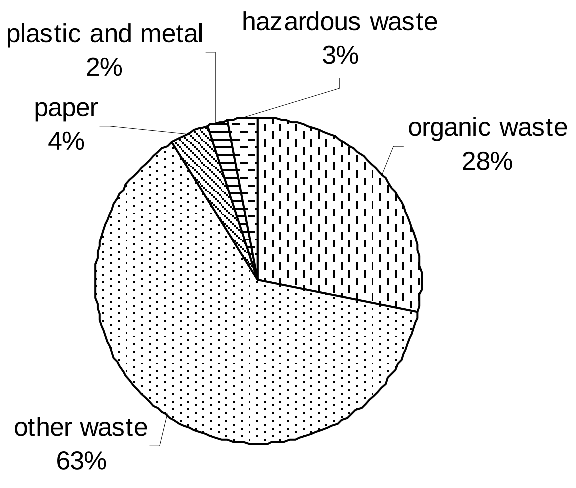
In general, European authorities use increasingly using the waste rates charged to companies to influence them to sort and recycle their waste. Thus the waste charge for collection of mixed waste may be considerably higher than the rates for collection of organic waste. It was not possible to locate a central statistic for waste rates charged across Europe, or an average rate charged for the different quantities. It does seem certain that the prices charged for collection of mixed waste will continue to increase recycling.

A survey of 36 hotels in the 2 – 4 star category in Austria and Germany gave the following average values per overnight stay:

- Weight of waste: 1.98 kg / overnight
- Volume of waste: 6.03 litres / overnight
- Cost of waste: 0.28 € / overnight[135]

The survey further analysed the cost of the different waste fractions, as indicated in Figure 34.

Figure 34. Cost Distribution of Waste



Source: ECOTRANS, 2008

This showed that:

[135] ECOTRANS, 2008

- Residual and organic waste form the major part of the disposal costs. Also, hazardous substances such as fluorescent tubes, paint and varnishes, batteries etc. must be disposed of at the owner‘s expense.
- Paper, plastic and metal can generally be disposed free of charge. However, in cases of large quantities, disposal fees can be charged. The expenditure of time for sorting and storage has not been taken into account.

The survey also calculated the average cost of waste per overnight. It found that the waste costs for one day in a hotel with 43 overnight stays and 58 warm meals amount to € 10.10. The waste cost per overnight was thus: € 0.28.

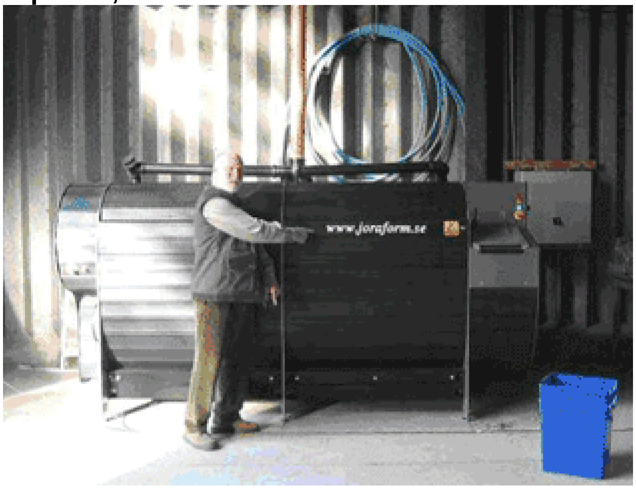
Case Studies

Sorting and recycling of waste: Hilton Stockholm Slussen, Stockholm, Sweden
The hotel sorts waste into 26 different bins and is recognised as leader in Sweden among other hotels and restaurants. Before waste sorting was introduced in 1996, the hotel sent 125 tons of waste a month to landfill. However, following the introduction of sorting and recycling practise, the quantity of waste was reduced in mid-1997 to around 300 grams per guest night (or three tons per month) and has remained at much the same level since then – a reduction of more than 76%. Food waste is separated from other waste and is sent for biogas production. The residue, which includes plant nutrients, is sent to farmers outside Stockholm for use on their fields. Cardboard is sent to recycling and wooden pallets are picked up to heat a house just outside Stockholm. Other combustible materials are sent to generate district heating for apartments in Stockholm. Other initiatives include sorting of candle stumps, which are given to day care centres and to a church where they are made into new candles for sale. Through this work in 2007, 20,000 SEK were raised for orphaned children in India[136].

Composting at Rudstone Walk, Yorkshire, UK
Rudstone Walk is a hotel/ conference facility set in its own 80 acres. It offers bed and breakfast accommodation; self catering cottages; conference and meeting facilities; outside catering afternoon teas/buffet lunches; corporate entertainment, wedding ceremonies and receptions, private dining and celebrations which gives rise to a wide scope of catering wastes. The owners were keen to reduce their waste stream and use it as a publicity tool to educate their customers by having special collection systems in the rooms and cottages with information sheets to explain their commitment to recycling and the environment. They have plenty of land on which to distribute the resultant compost which means it qualified for an UK Environment Agency Exemption.

[136] ITP, 2008

Figure 35. Automatic composter, Rudstone Walk



The method of organic waste recycling currently used at Rudstone Walk employs a Jorakomposter (a Swedish in-vessel machine), which is found to provide an easy to use neat and tidy solution for a busy business. The JK 5100 is a dual-chamber composter. Waste is inserted on a daily basis via the hopper and a carbon source in the form of wood pellets (or sawdust) is added either manually or automatically. Upon closing the hatch the waste is chopped finely and passed into the first, or "processing", chamber, where it is mixed and aerated for approximately two weeks before passing into the second, or "ripening", chamber. Once in the ripening chamber the mixing and aeration continues for a further two weeks (no fresh waste is added to this chamber during this time). The mixing actions in the first and second chambers of the composter are independent of each other, allowing greater control over the composting process. When ripening is complete, after about a further two weeks, the second chamber is emptied mechanically and the waste from the first chamber passed into the second.

The compost produced needs no further processing and is ready for immediate use. The speed of processing makes this an attractive solution, and no further work is needed. It is located in a barn at the back of the hotel within easy reach of the kitchens. The waste is collected in slatted buckets for drainage and then placed with sawdust into the machines chopping element and on into the chamber. According to the Compost Doctor programme waste audit carried out in October 06, Rudstone Walk are producing 151 kg per week of organic waste including garden and kitchen food waste. Scaling this up, annual production is estimated to be 7.852 tonnes of organic waste for use on site.[137]

Four Season Hotel, Philadelphia, USA – Composting and recycling

Since February 2007, Four Seasons Hotel Philadelphia has been sending organic waste to a farmer in the neighbouring county to be made into compost. The landscaper buys back this compost to be used in the flowerbeds and courtyard. Used cooking oil is also sold of to a farmer for use as fuel in diesel tractors and the hotel, in turn, purchase select organic items from the purveyor for use in the kitchens. Other recyclables which are separated at source include: office paper, cardboard, and commingled recyclables.

The implementation of the waste management programme at Four Seasons Hotel Philadelphia included the following measures:

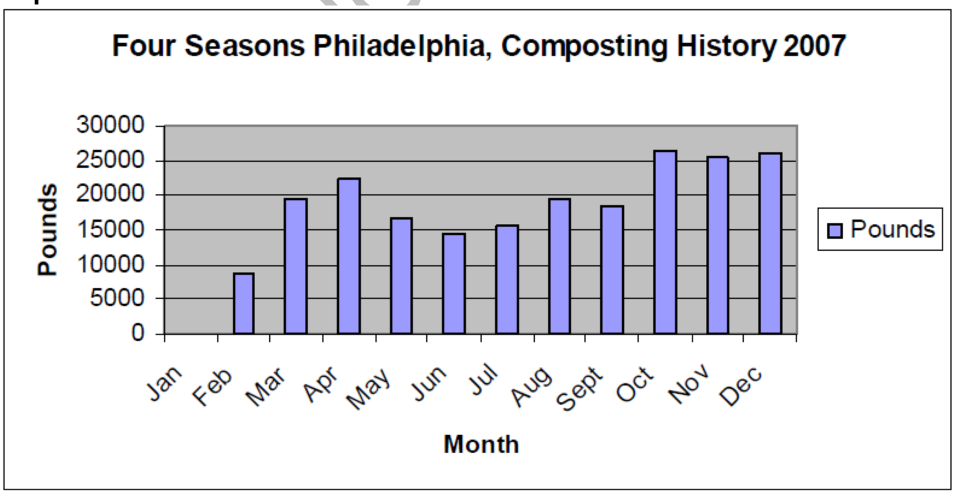
[137] This case study is given on the Worm Research Centre website: http://www.wormresearchcentre.co.uk/projects.htm

- Arrangement of meeting with waste management supplier to determine annual trash tonnage amounts, costs of removal broken down by month, and number of “pulls per week”.
- Assessment of property (including loading dock) to determine in-house challenges or opportunities to simplify the gathering of recyclable materials.
- Quantification of monetary benefits associated with starting and maintaining the recycling programme. Development of plan to track “trash vs. recycling ratio” in order to monitor the progress.
- Research and establishment of contact with food composting facilities in the community – determining of start date and schedule for food waste to be removed.
- Internal meetings in key departments in the hotel (kitchen, stewarding, etc) to introduce composting program and discuss any potential challenges.
- Revamp signage and receptacles within the back of the house, focusing on employee cafeteria, kitchen or any additional high-traffic areas. Use of colour-coded receptacles and signs to differentiate between recyclable/nonrecyclable containers.
- Develop and getting the “green team” on board. Provision of small paper recycling bins for each employee with desk area or works with paper. Encouragement of employees and departments to go “paperless” when possible.
- Join local Commercial Recycling or environmental organizations. Identify with community leaders who can help assist with providing detailed community information regarding current recycling issues, helping to raise awareness and who can offer support for your program.
- Contacts with local officials to pledge commitment and intention to be a community leader for recycling in the commercial sector.

The “Green Team” at Four Seasons Hotel Philadelphia was established in 2005 with an initial focus on commingled and office recycling. In 2006 the hotel was able to reduce the overall trash sent to landfill with 25%.

In 2007, Four Seasons Hotel Philadelphia composted 213,178 pounds of waste, or 106.6 tons. The below figure shows the development in composing of waste in the first year of implementation.

Figure 36. Development in the composting of waste from Four Seasons Hotel in the first year of implementation



Source: http://www.epa.gov/reg3wcmd/SolidWaste/FoodCompostingforHotelsPresentation.pdf

The composting and recycling programme had a significant impact on the amounts of waste generated at Four Seasons Hotel. Compared with 2006 landfill waste was reduced with 23% from 1036.26 tons to 796.88 tons or 239.38 tons. The number of compactor hauls was reduced from 146 to 108. The following tables compare the tonnage and compactor hauls in 2006 and 2007.

Table 42. Waste tonnage and compactor hauls in 2006 and 2008

2006 Tonnage

Month	Compactor Hauls	Total Monthly Tonnage
Jan	13	96.29
Feb	12	90.33
March	14	106.02
April	12	94.07
May	11	105.06
June	7	56.86
July	13	75.69
Aug	14	84.49
Sept	13	85.31
Oct	11	75.02
Nov	13	81.88
Dec	13	85.24
Year End Tonnage	146	1036.26

2007 Tonnage

Month	Compactor Hauls	Total Monthly Tonnage
Jan	13	76.42
Feb	10	59.19
March	9	66.95
April	8	61.29
May	9	71.29
June	9	71.77
July	8	61.52
Aug	9	57.98
Sept	8	56.60
Oct	9	78.03
Nov	8	74.75
Dec	8	61.09
Year End Tonnage	108	796.88

Source: http://www.epa.gov/reg3wcmd/SolidWaste/FoodCompostingforHotelsPresentation.pdf

Using the average figures provided in the ECOTRANS survey[138] of €0.28 per 2 kg of waste the annual savings on the tonnage of waste would amount to € 70,000. However, from this figure should be subtracted the cost of implementing the waste management initiative, the cost of sorting the waste, and the costs associated with the additional waste streams.
Source: http://www.epa.gov/reg3wcmd/SolidWaste/FoodCompostingforHotelsPresentation.pdf

Ireland: Food waste managing and the impact of food waste regulation on hotels
A brown bin collection service has been implemented for sorting and separate collection of food waste. By sorting and using the service food waste businesses have gathered insight into their waste management practices, which in many cases have led to financial savings. Examples include:

- Excessive quantities of food waste may arise due to over ordering, unnecessary meal preparation or due to poor storage;
- A detailed investigation of food purchasing practices may suggest improvements, such as buying pre-prepared vegetables that are associated with less waste and lower preparation costs;
- Better food portion control may cause savings without affecting relations with customers. A pub/restaurant in Tipperary decreased portion sizes and managed to decrease the amount of food waste created by over a third;
- Estimation of the cost of food waste per kg is made possible through the separate collection system.
- Refuse collection contracts are often based on the number of bin lifts carried out, regardless of the weight of waste in each bin. This may not be the most economical mode of collection, with a pay-by-weight approach offering appreciable cost savings;

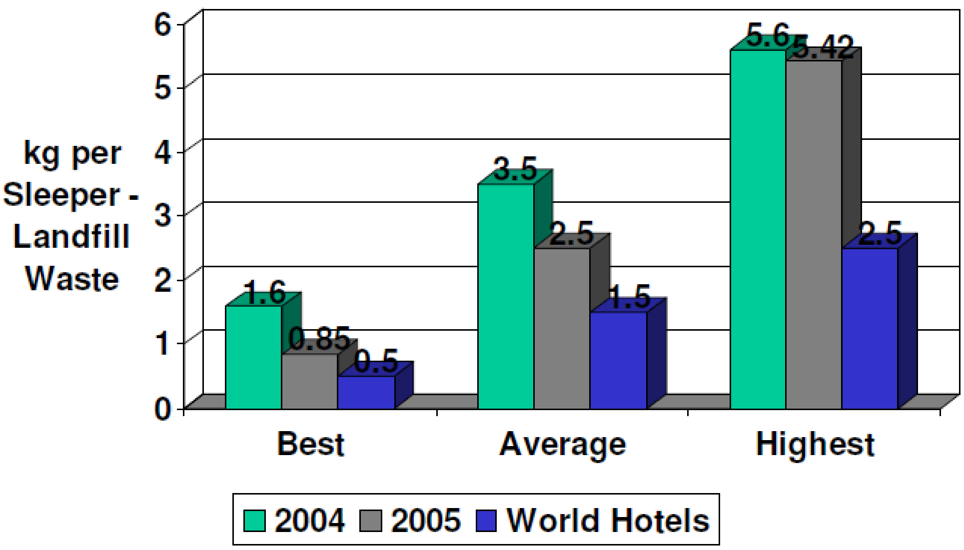
[138] ECOTRANS, 2008

- Decreases in the amount of food waste sent for disposal may create financial savings by the avoidance of landfill levy charges. At present, the landfill levy is €30/tonne. It will rise to €50/tonne in 2011 and then to €75/tonne in 2012. This will have a direct affect on businesses' black bin-related waste charges;
- Other financial savings can be accrued, such as less general waste causing a waste compactor to be used and emptied less often;
- One large hotel, after the introduction of a brown bin service resulted in a 70% reduction of its waste going to landfill and made savings of €21,000 per year. These savings were a combination of factors, such as avoiding the landfill levy and no longer needing to rent a waste compactor for landfilling waste.

The Irish Environmental Protection Agency Environmental Research Technological Development and Innovation (EPA/ERTDI) project "Greening Irish Hotels" involved 56 hotels (3 to 5 star) ranging in size from 30 to 255 beds around the country. Under the project environmental reviews, training, environmental management, best practices and cleaner production plans were developed.

When the project was initiated it was assessed that there was a large scope for reductions in waste going to landfills as the amount measured in kg per sleeper to landfill were significantly higher than world average. The following figure shows the amount of waste going to landfills measured in kg per sleeper for hotels grouped into best, average, and highest and before the project and after implementation compared with global benchmarks for hotels.

Figure 37. The project's impact on waste going to landfill in kg per sleeper compared with world hotel benchmark



Source: http://www.epa.ie/downloads/pubs/other/corporate/oea/research/researchcgpp/maurice%20bergin%20cgpp4ppt.pdf

Quantified actual savings included diversion of 1,113 tonnes of waste from landfill. If extrapolated across the entire sector the benefit would include diversion of an estimated 56,000 tons of waste from landfills. The savings would amount to €14 million per year for the waste component of the project.

The following pages outline case studies of organisations which have made financial savings as a result of the introduction of a brown bin service or composting food waste on site and by introducing food waste prevention measures.

Hotel Sector

The Environmental Protection Agency's (EPA) National Waste Prevention Programme Annual Report 2007/2008[139] contains examples of hotels which have saved money as a result of managing food waste by using a brown bin service or by composting the food waste. The report states: "There are already many examples of hotels that have realised annual recurring cost savings by applying a systematic approach to prevention such as:

- Systematically reducing waste, increasing recycling and composting food waste saved one premises alone €35,000 per annum.
- An in-vessel composting machine installed in one hotel is currently diverting over 150 tonnes of food waste per year and realising them cash savings of €30,000 each year".

Hotel, Wicklow

This hotel in Wicklow, which has 148 guestrooms, two restaurants, a bar and a wide range of meeting and conferences rooms to cater for up to 180 delegates implemented a food waste collection service in 2008. The following information has been compiled by the hotel:

- Before food waste recycling, the average waste costs per month was €4,100;
- The introduction of a food waste recycling service and full segregation of recyclables resulted in a 70% reduction of waste going to landfill;
- Removal of the waste compactor led to savings on transport and compactor rental of €600 per month;
- Average waste costs per month, with full recycling system introduced, is €2,300 giving an average saving of €1,790 per month and €21,480 per year;
- The recycling system has led to a 44% reduction in waste costs.

Hotel, Donegal

This hotel in Donegal has 74 guestrooms, a restaurant, a range of meeting rooms and is used as a wedding venue. It implemented a food waste collection service in 2008. After the introduction of a recycling and brown bin it resulted in the following:

- 127 tonnes of food waste sent for composting;
- 6.5 tonnes of cardboard and paper recycled;
- 17.5 tonnes of glass recycled;
- 0.65 tonnes of plastic recycled; and
- 42 tonnes of waste landfilled.

The amount saved was €2,300 per year. The hotel delivers its own waste to the landfill directly and this has made significant savings by not getting a waste collector to do this[140].

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139 http://www.epa.ie/downloads/pubs/waste/prevention/Final%204th%20NWPP%20Annual%20Report%20to%20Minister%20July%202008%2022.pdf

140 http://www.foodwaste.ie/wp-content/uploads/2010/06/Case-Studies-of-Organisations-Managing-Food-Waste-Properly.pdf

The Ascot Park Hotel, Invercargill, New Zealand

The Ascot Park Hotel has 96 guest rooms, with a further 21 to be built in the near future. The hotel also provides a large conference and function facility, including food and beverage service. Waste management has been a key issue to the hotel. Every month about 6 tonnes of material is now sent to the recycling station, rather than to landfill as was happening previously. At a cost saving of $100 per tonne, diverting waste from landfill currently saves about $600 per month. Some of the initiatives include:

- Fats and oils from the kitchen are collected in a purpose-built drum on-site, before being sent to Bio Diesel New Zealand to be converted into fuel. Office paper is also collected and sent for recycling. Furthermore, all guest bathrooms feature paper towels and toilet paper made from recycled sources, and self-closing taps to reduce water use.
- The Ascot conference website offers a greening option for conferences and the conference website also gives the hotel the advantage of not having to send out the conference pack in the mail and downloading just the selected pages. In the past an estimated 10 conference packs were send to customers every week, each containing some 20 pages of information. This represents a saving of some 10,000 pages of printing annually.
- The IT support company and supplier accepts the E Waste and sends it for recycling.
- The hotel does not accept regularly ordered goods in polystyrene.
- Extensive use of water coolers throughout the hotel. All conference areas and hotel wings have water coolers in them so guests have the option of refilling their personal water bottles with filtered water[141].

The Fairmont Hotel, Vancouver, Canada

The Fairmont Hotel is situated in the heart of the city with 556 rooms and suites, 12 meeting rooms, two restaurants, a health club, pool, spa and retail shops. Both costs and environmental impacts were reduced through the implementation of the Green Partnership Program, an initiative of Fairmont Hotel & Resorts. The initiatives concerning waste reduction and recycling include:

- Delivery of poultry, seafood and bread in reusable food totes led to a reduction of cardboard waste by about 75 per cent.
- Reduction or elimination of individual sugar packages and creamers, condiment containers and disposable cups in food service operations.
- Recycling of all paper, cardboard, cans, glass, plastics, kitchen grease, organic waste, batteries, fluorescent bulbs and coat hangers.
- Composting of food waste. Organic composting has resulted in a 50% reduction in overall material weight. Combined with a lower fee for compost pickup, the result is an annual saving of $5,280.
- Donation of used items including beds, furniture, amenities, linens etc. to charitable organizations. Leftover food is given to local shelters and food banks.
- Blue boxes for collection of recyclable materials placed in all guest rooms.

The hazardous waste management program includes:

141 http://www.qualmark.co.nz/pdfs/Ascot%20Park%20Hotel%20Enviro%20Award%20application%20case%20study.pdf

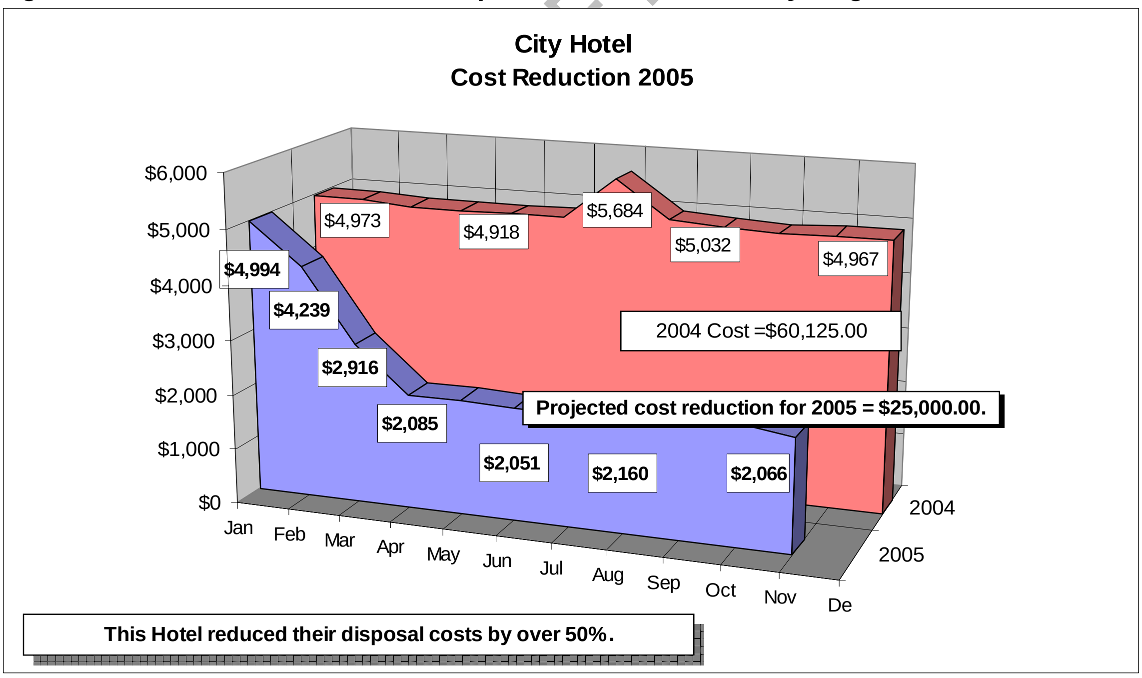
- Phasing out of equipment containing chlorofluorocarbons (CFCs) and polychlorinated biphenyls (PCBs),
- Properly storing and maintaining fuel storage tanks
- Removal of paint sludge by a licensed waste management contractor
- Recycling batteries and fluorescent lamps.

The main savings realised through the initiative related to the reduction in card board waste and to composting. The composting led to a 50% reduction in overall material weight, which led to annual savings of $5,280[142].

Hotel Case Study, Seattle, USA – recycling of food waste, paper, cans, bottles, and plastic film

The hotel is located in downtown Seattle. Before its participation in this program, the Hotel recycled about 32 tons of material each year, mainly glass and cardboard and there was no recycling of food waste, plastic film or compostable paper. The yearly waste disposal amounted to 3,000 cubic yards at an approximately annual cost of $60,000. The two largest categories of waste in the hotel waste stream were organics and paper. Initiatives focused on 1) rooms management, 2) housekeeping and 3) food & beverage and were designed to increase recycling, streamline waste management and reduce disposal costs. The implementation of the initiatives led to a reduction in solid waste by 70% and a diversion of 43 tons of materials from the landfill annually. These include fourteen tons of food waste, and 29 tons of paper, cans, bottles, and plastic film. The cost savings in the first year of implementation amounted to $25,000. The figure below shows the cost reduction between in the year of implementation compared with the year before.

Figure 38. Cost reduction in waste disposal to landfill from recycling



Source: http://www.corprecycling.biz/Case%20Studies.html

[142] http://www.metrovancouver.org/smartsteps/bestpractices/Case%20Studies/CaseStudy-Hotels.pdf

The Savoy Hotel, London, UK – Renewable energy from food waste
As part of refurbishment at the Savoy Hotel a food waste programme is being implemented whereby the food waste will be supplied to a biomass power plant and turned into energy, enough to supply electricity to 10% of the Hotel's rooms. The scheme will reduce the amount of waste going to landfill, but to make a significant improvement to the Savoy's overall carbon footprint by displacing fossil fuels. The methods used include composting and anaerobic digestion[143].

Applicability

The waste recycling options that are open to an accommodation facility are closely related to its location. If the hotel is in an area where the municipality does not have central collection and recycling then it may be difficult for the hotel to pursue waste recycling. The EU ecolabel for accommodation in these circumstances requires that the hotel actively engages in a dialogue with the municipality in question to put recycling on the agenda, and to find alternative solutions. Experience shows that proactive hotels are able to find solutions to waste recycling, for example by networking with other hotels or stakeholders, for example cooperating with farmers to send organic waste to their biogas facilities. In addition, the techniques described here do show that if the hotel has some green areas, composting or vermicomposting is an option to deal with the organic waste which can be upto one third of the company's waste costs.

Economics

The economy involved in sorting and recycling of waste relate to collection rates associated with the different categories of waste and the rates for collecting the various types of waste. Garden waste and green waste from the kitchen can be utilised as compost on site and can therefore significantly reduce the amount of waste being collected. The rate for collection of green waste may also be significantly lower than the rate for unsorted waste. The ECOTRANS survey can be referred with respect to the costs of categories waste. Two examples are provided below – one for installation of composting equipment and an example of the implementation of sorting of green waste for separate supply to a recycling depot.

In the following example the economy involved in installing a composter at the hotel to compost garden waste and green kitchen waste is estimated. The cost of implementing the solution involves the investment costs, the operational costs, and the operational benefits. The composter model selected for the cost and benefit analysis is fully automated and capable of handling large volumes of waste on a daily basis – up to 100 litres or 50 kg of waste per day. It is based on a two-chamber composting system that ensures that the finished compost is taken only when it is ready (after about 1 month).[144] The composter uses 900kWh per year.[145] The operating benefits associated with the reduction in collected waste are calculated using the ECOTRANS values.[146] It has been estimated that the machine can operate at maximum capacity. Additional costs for sorting of green waste have not been considered due to the simple operation of the composter, where buckets of green waste are emptied in the composter.

[143] http://www.ecofoodrecycling.co.uk/news/2010/05/29/top-london-hotel-recycles-food-waste-to-reduce-carbon-footprint/ and http://www.ecofoodrecycling.co.uk/
[144] http://www.smartsoil.co.uk/composter5100.htm
[145] Discussion with supplier of composter.
[146] ECOTRANS, 2008

Table 43. Calculation of annual savings and payback period

	Cost/€
Equipment cost:	22,000
Annual operating costs:	
Equipment repair/replacement at 5%:	1,100
Power supply[147]:	85
Annual operating benefits	
Savings on waste reduction: (at €0.28 / 2 kg x 50 kg / day x 365 days)	2,500
Savings on purchase of plant nutrients (estimate):	500
Net annual benefits:	1,815
Payback time	12 years

The composter will require significant garden or park area to utilise the compost. The payback time for installing the composter is long, but the calculation is based on present day prices for the waste collection. If prices rise further and demands on sorting of waste at source are increased this may reduce the payback time significantly – refer the case study from Ireland where landfill levies will increase from €30/tonne to €75/tonne in 2012.[148]

In the following example a hotel is implementing sorting of green waste, which can be supplied to a nearby recycling depot, which supply the green waste for use either in composting or at a biogas plant. Rates on different categories of waste are taken from Danish recycling depot, which receives waste from the industry.[149] The rates for waste quoted are approximately €130/tonne for unsorted waste and €30/tonne for green waste. The scope for savings is €100/tonne of waste. However, additional equipment (extra container for organic waste), the cost of sorting the waste, and the charges for collection of the additional green waste container have to be considered as well.

Driving Force for Implementation

There may be several forces driving implementation of waste sorting and recycling:

- National or local environmental authority requirements
- Cost reduction by reducing waste volumes
- Opportunity to exploit market niche - guests are becoming more environmentally aware and waste management contributes to an overall impression of environmental excellence
- Part of formalised environmental management system or requirements for ecolabel

Reference waste companies

Below is a list of places which sell home wormeries (from Worm Research Centre website):

[147] Based on Eurostat average electricity price in 2010, excluding taxes: 0.0918 €/kWh. http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables

[148] http://www.foodwaste.ie/wp-content/uploads/2010/06/Case-Studies-of-Organisations-Managing-Food-Waste-Properly.pdf

[149] http://www.affaldgenbrug.vejle.dk/page35571.aspx

- www.tallywackerfarm.co.uk – Sell different types of home wormery
- www.wigglywigglers.co.uk – Sell large range of home wormeries and soil improving worms
- www.worms.com – Sell the famous Can-O-Worms wormery
- www.bullnet.co.uk – Sell home worm composters
- www.greengardener.co.uk – Sell large range of wormeries. All come with bedding and instructions for use with worms separate. They sell normal box style as well as worm tower which allows easy access to worms and compost.
- www.recycleworks.co.uk – Sell worms and worm bins for home use
- www.ollierecycles.com – Give information on how to build you own home wormery. Mainly targeted at children
- www.originalorganics.co.uk – Sell worm bins and soil improving worms
- Centre for Alternative Technology – Wales. Sell worm bins in shop and via mail order catalogue
- www.humus.dk – Denmark. Sell worm bins, worms and various waste sorting solutions.
- http://www.joraform.com/homeeng.html - Sweden, sells closed vessel composters

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SA10. Waste avoidance

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

2.3 Non-serviced Accommodation

2.3.1 Best Environmental Management Practice for Encouraging On-site Nature Conservation

<u>NSA1. Measures to increase local biodiversity</u>

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

NSA2. Treatment of wastewater from locations that are not connected to municipal sewerage

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

2.4 Food and Beverage

2.4.1 Best Environmental Management Practice for Electrical Efficiency in Hotel and Restaurant Kitchens

FB1. Efficient equipment

> Replacement of old hood-type dishwashers

Description

Dishwashers are the single largest water consumer in hotel and restaurant kitchens. The capacity of the machine needs to match the demand, and the staff operating the machine need to be given instructions on how to economise on the energy and water consumption. The latter is especially important because almost all the electricity consumption is used for heating the water in the dishwasher[150].

General good practice is as follows:

- Before wash
  - most new dishwashing machines do not need a pre-wash saving both time, water and energy
  - collect the serving ware into large batches
  - fill baskets completely
- During wash:
  - if energy charged on a time tariff basis then washing should be done at the cheaper rate times
  - ensure that the dishwasher settings are optimised in relation to how dirty the serving ware is
- After wash:
  - if there is a long time between wash intervals then the dishwasher can be turned off
  - check the filters and check if there is salt in the machine if there is not a reverse osmosis unit installed
  - in the case of hood type dishwashers, ensure that the hood is closed as much as possible to avoid unnecessary cooling of the water

When **replacing old dishwashers** with energy efficient dishwashers, make sure to include environmental requirements to the supplier. This can be done by requesting an offer from the client that includes the following parameters:

- Lifetime of the equipment
- Electricity consumption
- Water consumption
- Heat energy consumption
- Other resource consumption parameters

150 HORESTA [1], Publication: Kort og godt om: Opvaskemaskiner, Vejviser til en energirigtig opvaskemaskine, HORESTA, Copenhagen, 2000

- Service and maintenance requirements
- Automation that reduces the combined energy use

With regard to industrial dish washing machines, low water consumption is vital for the machine's energy consumption and overall economy. This is because the machine's consumption of electricity and soap/detergent is directly linked to the machine's water consumption.

The following guidelines should be followed in the purchase of a dish washer:

- The dishwasher must be insulated (minimum 20 mm)
- Tunnel dishwashers must not use more than 2½ litres per basket
- Hood type dishwashers must not use more than 3½ litres per basket
- The dishwasher should be connected to the hot water system
- The dishwasher should have heat recovery systems
- The dishwasher should have a double final rinse
- Ensure that the ventilation system operates in conjunction with the dishwasher and that there is an exhaust directly connected to the dishwasher

Making an energy efficient procurement does not necessarily need to take a significant amount of extra time. Many countries in Europe operate energy efficiency information centres that give good advice and support when it comes to energy efficient procurement.

Replacing old dishwashers brings a range of quality, economic and environmental benefits. The quality of the wash is better, and the machines are more reliable and less likely to break down at critical moments. In addition the wash cycles are quicker and they may have greater capacity enabling greater wash capacity at peak serving times. The economic and environmental benefits go hand in hand and include reduced detergent, energy and water consumption. An additional driving force is related to the ergonomics and working environment advantages. Newer dishwashers are often planned better ergonomically and integrated into the prewash and afterwash stages, e.g. featuring metal tables and sinks, to the advantage of the staff.

The older versions of **hood-type dishwashers** typically have wash and rinse tanks and uninsulated hoods. It is often necessary to do a manual pre-wash because these machines are not able to cope with this in a satisfactory manner. Typically the older machines are not connected to water softening systems which means that lime may deposit onto the serving wear and have to be manually dried. The older machines may or may not be connected to the facility's central hot water system.

The newer versions of hood-type dishwashers are typically integrated into additional systems such as ventilation, water treatment, thermostat-controlled pre-wash unit with automatic valve, and drying functions.

Achieved environmental benefit

The following environmental benefits can be achieved in comparison with older versions of hood-type dishwashers:

- Significant reduction in water consumption, which in some cases may be up to 50%

- The electricity consumption is also significantly reduced; depending on the situation this may be up to 50%

The heat energy consumption is related to the hot water consumption as well as the amount of heat that the dishwasher takes in and expels from the room. Heat energy savings

Appropriate environmental indicator

To be completed

Cross-media effects

None.

Operational data

To be completed

Case Studies

Landbogårdens Restaurant, Hjøring – Denmark
Landbogårdens Restaurant installed an energy efficient hood type dishwasher next to the old dishwasher, which had a wash and rinse tank, and an uninsulated hood. 55oC hot water was piped in to the old machine from the gas-fired boiler which supplied the restaurant's hot water and space heating. All pre-washing was done manually because the old machine was not satisfactory. Furthermore, the water used in the old dishwasher was not treated, resulting in lime traces on the serving ware which had to be dried off by hand. The investment consisted of: new dishwasher, new ventilation system, water softener for removal of magnesium and lime, a thermostat-controlled pre-wash unit as well as drying track, tables and sinks. The total investment was approx. 9000 EUR.

The results achieved were a combination of factors:

- The old machine, including the pre-wash unit, used 407,300 litres of water per year. The new machine, including the water softener and pre-wash, used 217,300 litres of water per year. This gave water saving of 190,000 litres per year, and in 2000 prices (18.2 DKK per m3) this gave rise to cost savings of 465 EUR per year.
- The old machine, including the ventilation system, had an electricity consumption of 6,632 kWh/year. The new machine and direct ventilation system had an electricity consumption of 3,270 kWh/year. This gave an annual electricity saving of 3,362 kWh, equivalent to 309 EUR in 2010 European Union average electricity prices of 0.0918 EUR/kWh (http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables)
- The old machine, including the pre-wash and extracted space heating, had a gas consumption of 3,227 m3 gas/year. The new hood-type dishwasher had a gas consumption of 1,346 m3/year, including pre-wash and extracted space heating. The annual gas reduction was 1,881 m3 giving an annual cost saving of 642 EUR in 2010 average European Union natural gas price of 7.7624 EUR/GJ (http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables).
- The detergent consumption was not measured but the theoretical saving is 56 litres per year or 150 EUR.

- The working environment was significantly improved. Reducing the manual labour gave an estimated annual saving of 670 EUR.
- The calculated CO_2 reduction of 7,700 kg per year equivalent to 0.85 kg CO_2 per invested Euro per year.
- The annual cost saving totals at 1,566 EUR including the detergent savings resulting from reduced water consumption in the wash. The payback period was six years. If the labour savings resulting from reduced manual applications are included, the payback period was four years[151].

Applicability

Bearing in mind their capacity, hood-type dishwashers are suitable for small to medium-sized restaurants.

Economics

Studies show that replacing older hood-type dishwashers with new energy efficient versions will lead to substantial reductions in water, electricity and heat consumption. This in turn equates with substantial savings for the restaurant. In addition, the ergonomic benefits may lead to a reduction in the number of injuries and a saving on long term compensation payments.

More information on economics based on a concrete example is provided in the Case Study.

Driving force for implementation

There is a range of driving forces promoting the decision to replace or add on an energy efficient hood-type dishwasher including more reliable operation, lower detergent consumption and lower maintenance costs as well as the associated environmental benefits.

> Replacement of Belt Dishwasher with Tunnel Dishwasher

Description

Tunnel dishwashers may be used to replace older belt dishwashers.

Achieved environmental benefit

Installing a tunnel dishwasher reduces electricity and heat consumption in the kitchen, as well as water and detergent use.

Appropriate environmental indicator

To be completed

Cross-media effects

[151] Horesta [1], 2000.

There are no environmental cross-media effects. There are though typically improvements in working conditions for the kitchen staff related to the installation of new, ergonomic work stations.

Operational data

To be completed

Case Studies

Hotel Munkebjerg, Vejle – Denmark
Hotel Munkebjerg installed a tunnel dishwasher to replace its existing belt dishwasher which was both very large and energy intensive. It had a significant electricity consumption because it needed to heat all water from 10°C to 85°C. The project also included installation of pot washing facilities which were previously located in the basement. In addition to a tunnel dishwasher, the total investment cost of 60,000 EUR included tables, trolleys, reverse osmosis unit, shelving for baskets, plate trolleys etc.

The results were as follows:

- annual water consumption savings of 200m3 giving 147 EUR in cost savings
- the old machine used 142,000 kWh per year while the new machine uses 98,000 kWh giving an annual saving of 44,000 kWh or 4,039 EUR at 2010 European Union average electricity prices of 0.0918 EUR/kWh (http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables)
- detergent savings of 1,442 kg per year or 2,900 EUR
- the old machine used 144 litres of rinse agent but the new dishwasher was fitted with a reverse osmosis system and therefore had no need for reverse osmosis giving a 577 EUR saving
- the total saving of 7,663 EUR per year gave a pay back time of slightly less than eight years[152]

Applicability

Suitable for larger kitchens.

Economics

Tunnel dishwashers are generally a larger investment than hood type dishwashers. Payback periods of around ten years have been noted. More information on economics based on a concrete example is provided in the Case Study.

Driving force for implementation

Driving forces include better all-round performance and reliability.

[152] HORESTA, Kort og godt om: Opvaskemaskiner, Vejviser til en energirigtig opvaskemaskine, Copenhagen, 2000

> Replacement of hot plates with induction ovens

Description

Electrical ovens consume up to 25% of the total electrical energy consumed in hotel and restaurant kitchens[153]. As ovens have a 20 year + lifetime, it is important to make the right decision. There are a range of alternatives, presented below in order of energy effectiveness:

- Gas flame
- Induction cookers
- Ceramic glass cookers
- Hot plates

Gas is the best option if this is accessible, since energy consumption is low and so is the associated CO2 emission. In comparison, electrical ovens need a form of energy which has first been converted to heat, then to electricity and then to heat again. Energy is lost at each stage of this process. The result is that 1kWh electricity emits 1 kg CO2 where as 1 kWh gas emits 0.21 kg CO2.

The combustion of gas may however give rise to nitrogen oxides in the kitchen so it may be necessary to implement extra ventilation in conjunction with gas flame cookers. Minimise waste heat by:

- using a pot size that fits the hob. If the diameter of the pot exceeds the hob by just 1 cm, 25% of the energy is wasted
- ensuring a quick heating-up time and then lowering the temperature
- boiling vegetables, potato and egg in small quantities of water (2 litres to 10 kg)
- using pot lids
- utilising the start-up heat and cooling down heat within the hob
- avoiding stand-by use by turning hob off. Neither gas ovens nor induction ovens need hearing up time in order to reach full effect.
- Taking care to avoid gas flames being exposed to draughts through the kitchen, which may result in the heat being blown away from the objects being heated
- Installing mechanical ventilation directly above the oven

Hot plates are the least most attractive oven seen from an environmental perspective since they take a long time to heat-up and cool down and use relatively large amounts of energy. Induction ovens are on the other hand highly efficient.

Achieved environmental benefit

Replacing hot plates will lead to reductions in greenhouse gas emissions through more efficient utilisation of energy than hot plats.

Appropriate environmental indicator

To be completed

[153] Based on HORESTA, Kort og godt om: Komfurer, Vejviser til en energirigtig komfur, Copenhagen, 2000

Cross-media effects

Induction ovens are generally easier to clean, leading to reduced detergent consumption.

Operational data

To be completed

Case Study

Restaurant Le Premier – Århus, Denmark
Restaurant Le Premier in Århus (Denmark) changed from hotplates to induction cookers. The annual energy consumption with the hotplates was 7 MW and this fell to 0.7 MW when the induction cookers were taken in use. This gave an annual saving of 6,300 kWh or 578 EUR in 2010 European Union average electricity prices of 0.0918 EUR/kWh. This give a pay back period of 8½ years.

Applicability

All kitchens in hotels and restaurants.

Economics

Replacement of hotplates with induction ovens has a medium to long pay back period.

Driving force for implementation

Economic and environmental savings.

References

- European Commission: Eurostat Energy Statistics. Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables - Accessed January 2011.
- HORESTA: Kort og godt om: Opvaskemaskiner, Vejviser til en energirigtig opvaskemaskine, Copenhagen, 2000
- HORESTA: Kort og godt om: Komfurer, Vejviser til en energirigtig komfur, Copenhagen, 2000
- http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables

2.4.2 Best Environmental Management Practice for Water Conservation in Hotel and Restaurant Kitchens

FB2. Efficient equipment

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

2.4.3 Best Environmental Management Practice for Waste Minimisation in Hotel and Restaurant Kitchens

FB3. Recyle organic waste

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

2.4.4 Best Environmental Management Practice for Reducing Environmental Impacts from Foods and Beverages Consumption in Hotel and Restaurant Kitchens

<u>FB4. Green sourcing of food</u>

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

2.5 Travel Agents and Tour Operators

2.5.1 Best Environmental Management Practice for Sensitising Guests to Responsible Behaviour

<u>TO1. Efficient equipment</u>

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

2.5.2 Best Environmental Management Practice for Optimising Environmental Management in the Offer

TO2. Place environmental demands on suppliers

Description

Tour operators develop packages consisting of a variety of different services for their customers. The primary packaged services are accommodation and transport. Over the last decade, there has been an increasing tendency for the larger tour operators to make acquisitions of service providers vertically across the tourism supply chain in order to gain greater control over the supply chain. Tour operators may therefore own and manage accommodation and travel companies themselves, including hotel brands and airlines. In such cases, tour operators have direct control over the environmental management of tourism services, and should refer to techniques for best environmental management practice for particular services elsewhere in this document. This technique specifically describes how tour operators can influence the environmental performance of contracted service providers.

Tour operators function as intermediaries between tourists and tourism service providers. Consequently, they are in a position to exercise leverage over both service providers with respect to environmental performance, and consumers with respect to tourism choices (next technique). Recent developments in Corporate Social Responsibility across Tour Operators have seen increased awareness and reporting on cultural and social aspects of sustainability in their tourism destinations[154] There has been particular emphasis on reducing human rights infringements, improving labour and working conditions, and avoiding sexual exploitation of children. These important issues fall outside the environmental scope of this document, although it is suggested that the mechanisms that can be used by Tour Operators to account for them are similar to those that can be used to account for environmental aspects that are rising up Tour Operators' priority lists[155].

An increasing proportion of travel and accommodation bookings are made online by travellers directly with service providers. Research conducted by IDC Retail Insights showed that travel figured very prominently in online sales with 47% of the 1,500 respondents in the U.K, France, Germany, Italy, Spain and Sweden saying that they had used the internet to make bookings[156]. This corresponds well with the findings of a US-based Travellers Use of the Internet survey. A potential 98-3 million on-line travellers were identified in 2004, with 44% of them booking or making reservations on-line. Furthermore, 70% used on-line travel agency sites such as Microsoft, Expedia, Travelocity or Priceline; 60% used company-owned websites such as those for hotels and airlines; 59% used search engines and 50% used destination websites[157]. It is imperative for future business success that tour operators offer a clear added value to customers. Assured social and environmental standards are not only necessary for CSR, but form an increasingly important aspect of quality for many tourists[158], and present a major opportunity for Tour Operators to add value to their services.

[154] ABTA, TOI and Tearfund International, 2003. Improving tour operator performance: the role of corporate social responsibility and reporting,
[155] For more information on how Tour Operators are working with CSR issues see: UNEP, TOI 2005. A Management Guide for Responsible Tour Operations.
[156] http://travel.daoblogs.com/9402.html Accessed December 2010
[157] Travellers' Use of the Internet 2004 Edition, Tourism Industry Association of America quoted in Tourism Keys Web Enhancement for Tourism Book, December 2005
[158] EC, 2010

In 2000, UNEP, UNWTO and UNESCO launched the Tour Operators Initiative (TOI) to assist and encourage social and environmental responsibility within the sector. In 2010 there were 16 Tour Operator members of the initiative, including some of the largest tour operators in Europe. The TOI website (http://www.toinitiative.org/index.php?id=3) offers a useful framework for tour operators to improve their supply chain management. In particular, the TOI website provides detailed guidance and case studies on best practice. Five key areas of action are listed on the TOI website[159]:

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

Tour Operators can improve the environmental management and performance of their suppliers through both voluntary and mandatory measures, as summarised in Table 1. Best practice for larger Tour Operators is to use their leverage to require mandatory attainment of minimum levels of environmental management and performance. The most rigorous approaches are for Tour Operators to integrate environmental requirements into their business contracts with suppliers through exclusion criteria and environmental certification requirements based on third-party verified environmental performance levels. However, the number of environmentally certified suppliers is limited, and will take time to increase in response to demand by Tour Operators[160]. Therefore, requirements for supplier environmental performance monitoring and reporting, and attainment of minimum environmental standards, can also represent best practice - when associated with a robust auditing and verification system (see operational data).

In addition, pressure can also be put on the Tour Operators themselves to work proactively with environmental issues, **Algemene Nederlandse Vereniging van Reisondernemingen (ANVR)**, the Dutch association of 170 tour operators, requires its tour operator members to have an environmental statement, trained coordinator, and concrete criteria for selecting hotels and other suppliers.

Table 44. A list of examples of voluntary and mandatory measures that can be taken by Tour Operators to improve the environmental management and performance of suppliers

Type	Measure	Examples of approaches
Voluntary	Practical guidelines for implementing various environmental measures	Tour Operators may start campaigns to raise awareness and build capacity in environmental management among suppliers. LTU Touristik launched a campaign to help contracted hotels improve their environmental performance. A 20 page manual "Das umweltfreundliche Ferienhotel" was produced in 6 EU languages giving suggestions for

[159] TOI, 2010
[160] TOI, 2004

Type	Measure	Examples of approaches
		how to implement good environmental practices. Topics addressed include drinking water, energy and communication. The manual was personally distributed to hotel managers when possible and explained by LTU's representatives, which had themselves received environmental training. Hotels were able to contact LTU's 2 man Environmental Department to request advice. The benefits for LTU were an improvement in the environmental performance of, and a better long-term dialogue with, their contracted hotels[161].
	Voluntary questionnaire on environmental management/performance criteria	Tour Operators may use questionnaires to extract environmental information from their suppliers for a range of purposes including benchmarking and marketing. Orizzonti has used a voluntary environmental checklist on suppliers to generate stakeholder interest and stimulate good environmental practices. It contains 33 questions divided into two sections: water and energy saving, and pollution. Most questions require only a yes/no answer. The questionnaire is coordinated by their Environmental Monitoring Office. The questionnaire is distributed on an annual basis and the average return rate is 26%. Information based on the checklist is included in the Orozzonti brochure. Monitoring and evaluation is carried out during representative visits[162].
	Encourage certification or monitored performance improvement through promotion incentives	Tour Operators may recognise environmental achievements and reflect this in prioritised marketing. Since 1996, TUI Travel PLC has given its Environmental Champion award on an annual basis to its 100 most environmentally-friendly supplier hotels worldwide. Holidaymakers are asked to complete questionnaires on a specific hotel which, combined with quantified environmental performance information on the hotel supplied using the Travelife checklist, are analysed in a point system. The winners are awarded the Environmental Champion prize and are publicised on TUI's website. The 10 hotels scoring the highest points also receive Gold distinction and further recognition on the TUI website[163].
Mandatory	Exclude poorly performing suppliers based on exclusion criteria	Premier Tours, a safari tour specialist in Southern and East Africa applies a range of criteria in the selection of the tented camps and lodges that it uses in national parks and private game reserves to ensure that suppliers are committed to sustainability. Brick-and-mortar establishments in environmentally sensitive areas are avoided, as are over-crowded camps. Camps are favoured that: employ full-time ecologists whose job it is to ensure that camps are as environmentally friendly as possible; provide electricity through solar-powered panels or have generators run only while guests are out of camp; do not allow hunting, but support photographic safaris; provide for

[161] TOI, 2003. Sustainable Tourism The Tour Operators Contribution. Note that LTU Touristik is now part of REWETOURISTIK and the manual is available at: http://www.rewe-touristik.com/offen/umwelt-soziales/index.php

[162] TOI, 2003. Sustainable Tourism The Tour Operators Contribution.

[163] TUI, 2010: http://www.tui-deutschland.de/td/de/qualitaet_umwelt/umwelt/umweltchampion/verfahren.html

Type	Measure	Examples of approaches
		a direct or indirect spin-off to local communities and/or conservation projects; have lined tanks for safe sewage processing; have garbage removed to appropriate places for safe disposal[164].
	Require environmental award	The organisations behind the planning of COP15 in Copenhagen in December 2009 wanted to ensure that as many guests as possible stayed at hotels with an environmental management profile. In order to get preference in the procurement process, it was required that a hotel must be certified by the Green Key. A project was started, lead by WOCO, to encourage hotels to apply for the Green Key. This was a major contributor to the number of hotels with Green Key increasing by 78% whilst the number of rooms that are Green Key increased by 154%[165].
	Require certified EMS	In Costa Rica, a group of inbound tour operators will require that all accommodations they use must be certified[166]. TUI Nordic/Star Tours is also working towards ISO 14001 certification of all the hotels included in its Blue Village programme, any most of them have already achieved this[167].
	Require compliance with minimum environmental criteria (e.g. set out in contract)	Aurinkomatkat, a Finnish outbound tour operator, introduced minimum environmental criteria into its partner hotel contracts in 2003 (see case study 2)[168].
	Require environmental reporting and continuous improvement	Aurinkomatkat monitors the progress of its suppliers within the minimum environmental requirements specified in contracts through checklists. Here the focus is on areas of non-compliance identified either through guest complaints or representative on-site checks. If sufficient progress is not made in these areas, then contracts may not be renewed[169].

Best practice for supplier management by Tour Operators can be presented as a hierarchy of actions, based first on the prerequisite of integrating environmental awareness into management and operations (see Chapter 2.1 in this document), and followed by a systematic approach implemented across suppliers, as indicated in Fig. 45:

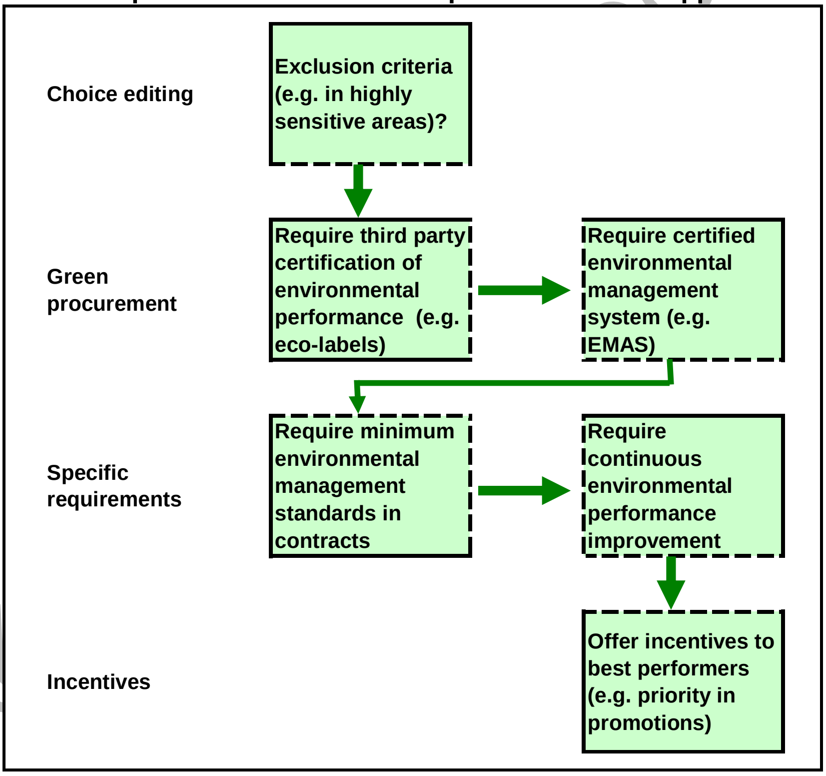
- The establishment of a person or team (environmental management team: see Chapter 2.1) responsible for supplier environmental performance, that identifies environmental hotspots for specific types of supplier.

- The environmental management team should screen suppliers both beforehand and during contractual relations for obvious environmental problems, including well-defined and serious incidents that may be used as exclusion criteria (e.g. poor customer feedback on environmental issues, environmental damage and related areas such as poor food hygiene)

[164] 164 TOI, 2003. Sustainable Tourism The Tour Operators Contribution.
[165] CLIMATE, Årgang 1, Nr. 2, juli 2009.
[166] CESD, 2008. Practical Steps for Marketing Tourism Certification.
[167] TUI, 2008. Sustainable Development Report.
[168] TOI, 2003. Sustainable Tourism: The Tour Operators contribution.
[169] ibidem

- The environmental management team should identify relevant third party certified environmental standards (eco labels) that can be used to verify improved environmental performance, and ascertain to what proportion of holiday packages offered such standards could be applied.
- The environmental management team should either establish procurement requirements for suppliers to have a certified environmental management system, or design a monitoring system and associated database to initiate monitoring of supplier performance (e.g. environmental management criteria in a questionnaire, periodically audited)
- Minimum performance requirements based on specific environmental criteria, or a requirement for continuous improvement, should be integrated into contracts issued by the procurement department.

Figure 39. A schematic of best practice actions, in order of priority (highest at top) that tour operators can implement to improve the environmental performance of suppliers



Achieved environmental benefits

Tour Operators have relatively insignificant *direct* environmental impacts related to the operations of their corporate and sales offices, but significant indirect environmental impacts through the accommodation and transport services provided by their suppliers. By placing environmental requirements on their suppliers, Tour Operators can therefore contribute to lower environmental pressure across a wide range of impacts, particularly: resource depletion, air pollution, global warming, water depletion and water pollution. Table 2 displays some of the criteria required by third-party certified environmental standards, and associated environmental benefits. These will be realised when tour operators require suppliers to be certified according to such standards, or to comply with equivalent criteria in contracts.

Table 45. Some examples of the main environmental criteria and associated benefits required by ecolabels for accommodation

Standard	Main mandatory criteria	Environmental benefits
EU Ecolabel for Tourist Accommodations	Energy. Requires at least 50% renewable electricity (where applicable), low-sulphur oil and efficient heating boilers, efficient (at least Class A) new air conditioning units and lighting, and appropriate window insulation.	Reduced rate of resource depletion Reduced global warming impact Reduced air pollution
	Water. Requires tap and shower water flow < 9 L per minute, avoidance of continuous flushing of urinals, green area watering evening or morning, waste water treatment, adherence to local wastewater plan.	Reduced water extraction Reduced water pollution
	General management. Requires good maintenance, environmental statement and action programme, staff training for environmental measures, data collection for consumption of energy, water and chemicals and generation of waste.	Contributes to all of the benefits stated above and below
	Waste reduction. Requires management to facilitate waste separation by guests, sort waste, avoid disposable products and single-dose food packaging (except where required by law).	Reduced rate of resource depletion Reduced landfill and incineration (water pollution, air pollution)
	Information to guests. Requires management to inform guests: of environmental policy; to switch off air conditioning, heating and lights when appropriate; to use waste bins as appropriate; of public transport options	Reduced rate of resource depletion Reduced global warming impact Reduced air pollution
	A selection (20 points) of additional measures must be implemented from optional criteria.	Range of environmental benefits
Other standards???	Put in Travelife Bronze, Silver, Gold – if the criteria can be provided	Not able to locate

Appropriate environmental indicator

For accommodation and food service providers, the most relevant indicators for supplier environmental performance are listed in relevant sections of this document. They include:

- Energy use, expressed as kWh / guest-night and kWh/m^2/yr functional area
- Water use, expressed as m3/ guest-night
- Waste generation expressed as kg / guest-night
- Percentage use of environment-certified cleaning products
- Percentage use of environment-certified food products

Package holidays (travel and accommodation) may be assessed in their totality by indicators such as:
- kg CO_2 eq. / guest-week

Tour operator performance may be assessed by:
- Number of suppliers or packages excluded because of environmental criteria
- Percentage of eco-labelled packages sold (by value)

- Percentage of packages with environmental management system sold (by value)
- Percentage of packages sold involving suppliers with specific environmental requirements
- Percentage of supplier contracts that contain environmental requirements
- Percentage of suppliers that have been visited and subjected to an environmental audit by a consultant or representative trained in environment
- Percentage of suppliers where complaints have been received from consumers on ecological considerations

Cross-media effects

The main cross-media effect associated with this technique is related to the impact of transport necessary for visits to the service providers, to operationalise and check on environmental performance across destinations – in particular air emissions from air and road transport contributing to global warming and air pollution. Efficient scheduling and offsetting can be used to minimise the net impact, including the training and use of representatives in destinations to perform basic compliance audits.

Using a certification or award requirement can help to counter the amount of travel needed by tour operators in conjunction with their supplier management. Experience shows that many tour operators Europe, as well as a few in North America, are implementing "sustainability policies." While their choice of products to include in their catalogues depends on their own direct inspection of properties to ensure quality and sustainability, an increasing number of tour operators see certification as a way of pre-selecting the businesses they will consider using for their itineraries[170].

Cross-media effects arising from actions to tackle particular environmental hotspots can be minimised through consideration of lifecycle impacts when planning priority actions.

Operational data

Environmental management and performance checks can be integrated into health and safety checks. Questionnaires and checklists are an effective means of obtaining information from new and existing suppliers, in order to:

- assess whether the supplier fulfils environmental requirements stipulated by the Tour Operator in its criteria
- determine a baseline for the environmental performance of new suppliers
- track continuous improvement in environmental performance

Questionnaires should establish the level of environmental management that is in place based on existing environmental policies or statements, and third party awards (e.g. ecolabels, EMAS, ISO 14001). In addition, environmental performance should be ascertained by specific questions in relation to at least the following categories:

- Energy saving measures
- Renewable energy sources
- Water saving and monitoring measures
- Wastewater treatment system
- Waste management system

[170] CESD, 2008. Practical Steps for Marketing Tourism Certification

- Green procurement (chemicals and food)

Additionally, questions can be asked on what the facility does to engage in the wellbeing of the local community as well as encourage nature conservation. The following examples are from the Travelife Supplier Sustainability Checklist used by TUI Travel PLC in its Environmental Champion award programme:

- Nature Conservation and Biodiversity
  - Does the business actively contribute to the upkeep of the natural environment by:
    - Corporate donation (e.g. by donating money per lobster meal sold)
    - Donations (e.g. through a weekly guest raffle or staff pay roll giving schemes)
    - In kind support through activity (e.g. by organising a beach clean up using staff volunteers)
    - Other (please specify)
- Nurturing Understanding
  - Does the business provide customers guidance on environmental protection in the destination (e.g. protecting turtle nesting sites, the importance of barbequing only in dedicated areas, etc)

Tour Operators may use simple "yes/no" checklists to check whether pre-defined environmental criteria are fulfilled. The example below is from the Italian Tour Operator Orizzonti[171].

Box 1: The Orizzonti Environmental Checklist for Suppliers

Water and Energy Saving

The facility:
1. uses low-energy light bulbs.
2. uses a separate electrical circuit on each floor.
3. switches off the electrical system at night.
4. uses solar energy for the production of hot water.
5. can modify light intensity.
6. has a central vacuum system for cleaning the environment.
7. has an air conditioning system with variable capacity.
8. regularly maintains and cleans air conditioning filters.
9. has air changing systems.
10. allows clients to change the room or apartment temperature.
11. uses aerators in sink and/or shower taps.
12. has toilets with a flushing capacity of less than 12 litres.
13. collects and re-uses rain water.
14. waters green areas during the night.
15. waters green areas with grey water.
16. checks light and water consumption periodically.

Pollution

The facility:
1. has used non-toxic paints in internal decoration.
2. has sound-proof rooms.
3. is sound proof throughout.
4. has given preference to wooden furniture.
5. changes sheets and towels on request.
6. uses low environmental impact products.
7. analyses wastewater quality.
8. has a separate green area for the clients.
9. has analysed internal air quality.
10. collects solid waste separately.
11. collects glass separately.
12. collects plastic separately.
13. collects aluminium separately.
14. collects paper and cardboard separately.
15. has built the facility using mostly local inputs.
16. raises client awareness by written notes.
17. has separate smoking areas.

More detailed questionnaires to document actual environmental performance of suppliers may be asked. These examples are taken from the Travelife Training Programme:

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[171] TOI, 2003

- Energy efficient lighting: At least 75% of energy efficient lighting is installed in the organisation
- Sustainable energy: At least 50% of total energy consumption is ‘sustainable’ energy.
- Water: Flow restrictors are installed in min. 75 % of the taps.
- Water: Percussion taps are installed in min. 75 % of all taps.

Finally, Tour Operators may request actual environmental performance data from their suppliers to assess whether defined environmental performance criteria are being met. TUI’s Sustainable Development Report provides the following target and information on its suppliers:

- Key performance indicator: Reduce carbon emissions in all Blue Villages (TUI Nordic’s flagship hotel properties) from 1.5 kg/guest night to 1.35 kg/guest night by 2010/2011[172]
- First Choice Holiday Village Cyprus uses an average of 178 litres per guest per night and 17.2 kWh of energy[173]

The advantage is that with a central system in place for collecting data, it is possible to monitor individual supplier environmental performance over time, and benchmark between suppliers. The disadvantage is that this may be a time consuming process to establish and implement.

It is essential for Tour Operators to implement a system of auditing and verification to cross-check the accuracy of self-declared environmental performance. This could include requirements for submission of verifying data (e.g. energy consumption data from annually submitted electricity and fuel bills), and onsite audits. Some of this work could be outsourced. Tour Operator staff from specialised environmental departments may perform full audits of suppliers, whilst onsite representatives may perform basic compliance checks. It is particularly important that specialist environmentally-trained staff perform audits on prospective suppliers to identify environmental problems. Non-compliance should first be addressed through dialogue to seek improvement, and finally by sanctions to maintain credibility.

It is important to build capacity among suppliers and Tour Operator staff with respect to environmental performance monitoring, reporting, and auditing. Tour Operators should provide staff training, information packs, and seminars for hotel managers and environmental staff from municipalities.

Most Tour Operators automatically invite their consumers to complete a guest feedback form, which may include opinion on how the establishment managed its environmental impacts. Some Tour Operators even interview their guests to assess the overall quality of their experience in relation to expectations. Such surveys and interviews could provide useful supplementary information on day-to-day environmental management.

Case study

Aurinkomatkat environmental requirements for accommodation providers
Aurinkomatkat, a Finnish outbound tour operator, introduced minimum environmental criteria into its partner hotel contracts (many of whom are family owned enterprises) in 2003. The programme was rolled out over three year period in order to introduce suppliers to the concepts before becoming mandatory[174].

[172] TUI, 2008
[173] TUI, 2009
[174] TOI, 2003

Suppliers have received information in their own language about how the system works. Aurinkomatkat's Manager of Sustainable Tourism visits and arranges meetings for hotel owners in some destinations. Most of the monitoring is done by the Manager of Sustainable Tourism together with staff and agents at the destinations. The initial monitoring takes place through a checklist completed by the supplier, which is then checked by Aurinkomatkat personnel at the destinations. This is then verified annually in conjunction with the regular hotel check performed by Aurinkomatkat staff in the destination. Feedback from customers is also collected. Any areas of poor performance may result in non-renewal of contracts unless improvements are shown.

All Aurinkomatkat staff receive sustainable tourism training, which is critical for the success of compliance monitoring. The programme is based on a 100 point scale. There are plans to communicate points scored to consumers. A minimum score of 30 is needed for inclusion in the programme, and this is achievable through implementation of basic criteria including being connected to a waste water treatment system, and various water and energy saving measures.

Table 46. Environmental management criteria used by Aurinkomatkat to score accommodation service providers

Points are awarded for	No. of points:
Independent and locally owned accommodation	5
Environmental/sustainability policy, certificates, awards	5
Wastewater treatment system	15
Waste management system	1
Water saving and monitoring measures	5
Energy saving measures	10
Renewable energy sources	10
Sustainable purchasing policy	2
Community relations programmes	5
Hotels are classified at four levels:	
Mimimum level of acceptance	30-39
1 star	40-59
2 star	60-79
3 star	80-100

Applicability

This section is applicable to those Tour Operators that have not bought into the supply chain and therefore do not have direct control of accommodation and transport service providers. Green procurement based on environmental certification can be implemented by any size of Tour Operator. Inserting environmental criteria into contract requirements will only be feasible for larger Tour Operators with significant market power.

Economics

The assessment of the economic costs associated with this best environmental management practice is complicated since there is no technological solution; rather it is a human resource based solution. Many Tour Operators have established environmental management units in order to ensure that there is an effective management of environmental issues within their business activities. The creation of a specialised environmental unit is likely to be more effective than incorporating environment related tasks into existing job profiles or outsourcing to consultants.

This economics assessment is therefore based on the human resource costs associated with one medium sized tour operator, working with up to 100 accommodation providers in each of ten countries, and a range of transport service providers (table 3).

It is proposed that a central approach to managing environmental issues requires one senior environmental manager and two junior staff. Based on the calculations below, it is proposed that an environmental unit within a large, national tour operator will need a budget of approximately 240,500 Euros per year in order to be able to function.

Table 47. Indicative costs for an environmental management team responsible for supplier procurement and auditing

Amount	Title	Units		Subtotal
1 x	Senior manager	Working day	350 EUR	350
2 x	Junior officers	Working day	150 EUR	300
	Working days in a year	Working day	250	= 650 EUR * 250 = 162,500 EUR
		Travel	200 EUR	
		Accommodation	100 EUR	
		Per diems	50 EUR	
		Trips	40	
		Travel days	120	= (3 x 40 x 200) + (3 x 120 x 100) + (3 x 50 x 120) = 78,000 EUR
Total budget				**240,500 EUR**

There may be some significant economic benefits for tour operators following implementation of environmental requirements for service providers, but these are difficult to quantify. When assessing costs, tour operators should consider potential economic benefits, including those associated with:

- A higher sales share of more profitable value-added packages
- Greater sales arising from enhanced image and reputation among consumers
- Improved long-term business viability (i.e. risk management)

TUI Travel PLC provides an example of the size of the environmental team at a Tour Operator related to the size of the company. TUI Travel PLC operates in over 180 countries with over 30 million customers and has a staff of 49,000. TUI operates over 200 products and brands, 146 aircraft, and 3,500 retail shops in Europe. In the 2009 financial year, TUI Travel had a revenue of £13.8 billion and an underlying profit before tax of £366 million. In 2009, the company employed 40 full time employees working on sustainable development related activities[175].

[175] TUI, 2010.

Driving force for implementation

Environmental awareness is steadily growing among European citizens who expect to experience the same level of environmental consciousness on holiday as at home. Research from 2001-2002 showed that 87% of British tourists think that its important that their holiday does not damage the environment and 70% consider that the reputation of their holiday company on environmental issues is either very or fairly important[176]. The same level of environmental awareness was, however, not registered in a more recent Gallup Survey conducted for the European Commission DG Enterprise and Industry[177]. This showed that ecological concerns or considerations did not have a major impact on most interviewed EU citizens' holiday plans; with ecological considerations influencing the decisions of about a third of those interviewed (31% of all respondents, or 35% if those who said they never go on holiday are ignored), and an additional 11% said that such considerations would play a role in the future. On the whole providing assurance on the environmental performance of suppliers makes good business sense, and can be an integral component of the added value offered by Tour Operators.

A clean and safe environment, locally and globally, and efficient resource use, are critical to the continued success of the tourism industry. Tour Operators have a strong long-term business interest, and unique position of influence, to preserve environmental quality in tourist destinations.

Improved environmental management and value-added holiday packages improve business relationships between local communities and tourism providers, tourism providers and Tour Operators, and Tour Operators and customers, creating a more robust and sustainable business model.

Effective self regulation by the tourism industry may avoid the authorities to impose less flexible mandatory regulation.

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TO3. Develop and promote eco-tours

Description

Achieved environmental benefit

Appropriate environmental indicator

Cross-media effects

Operational data

Case studies

Applicability

Economics

Driving force for implementation

Reference companies

Reference literature

3 EMERGING TECHNIQUES/APPROACHES

To be completed

4 CONCLUSIONS

4.1 Environmental Performance Evaluation

Monitoring environmental performance is a fundamental part of environmental management. Unless performance is measured, then there is no baseline to benchmark against and assess whether performance is getting better or worse. Consequently management measures to improve performance are likely to be unfocused and ineffective.

This section gives an overview of Environmental Performance Indicators (EPIs) that can be used for evaluating environmental performance of companies in the tourism sector.

4.2 Environmental Performance Indicators

Various sources of EPIs have been reviewed and analysed, and relevant EPIs selected for inclusion in this reference document. Indicators are presented for each of the environmental aspects discussed in chapter 5.

Guided by ISO standard 14031 on Environmental Performance Evaluation, the following types of Environmental Performance Indicators are presented for each of the environmental aspects:

Environmental Condition Indicators (ECIs)
Management Performance Indicators (MPIs)
Operational Performance Indicators (OPIs)
- Suggested core OPIs
- Examples of other OPIs

For the suggested core OPIs, the tables also include examples of benchmark values, where they have been identified.

Note that development and application of ECIs is usually the function of local, regional, national or international government agencies, non-governmental organisations and scientific and research institutions rather than a function of individual organisations. Nevertheless, some examples[178] are given here as ECI information, when available, reflect the state of the environment in a given area, and can thus be used when prioritising environmental aspects and initiatives among other.

4.3 Aspect: Energy Use

Within the field of energy use, indicators are presented relating to both *Energy efficiency* and *use of renewable energy*, covering both *electricity consumption* and *heat consumption* as well as fuel for transportation.

[178] ECI examples are mostly sourced from the ISO standard 14031 on Environmental Performance Evaluation

Environmental Condition Indicators (ECIs) - examples
None identified.

Management Performance Indicators (MPIs)
• An energy audit has been carried out to assess energy consumption (electricity and heat) in the operations. Based on the audit results, an action plan with measurable, scheduled targets has been prepared to reduce energy consumption and increase the share of renewable energy used. Management has assigned resources, appointed responsibility and provided training to ensure implementation of the action plan. Guests have been informed about environmental initiatives and how they are contributing to reducing their energy consumption.

Core Operational Performance Indicators (OPIs)	Examples of benchmarks							
	Swan - hotels	**Swan - restaurants**	**EU flower - hotels**	**EU flower - camping**	**SUTOUR**	**IFC EHS - tourism** Luxury serviced hotels	**IFC EHS - tourism** Mid-range serviced hotels	**IFC EHS - tourism** Small serviced hotels
Energy consumption/efficiency								
• Overall energy use (kWh/year/guest-night)	ClassA: 50-72.2 ClassB: 55-77.5 ClassC: 55-77.5				Camping: 3.4 B&B: 15.8 Hotels: 30.6			
• Overall energy use (kWh//year/m2)	ClassA: 295-475 ClassB: 265-445 ClassC: 250-430				B&B: 49.8 Hotels: 165.5	Temperate climate: <285 Mediterranean: <260 Tropical: <270	All climate zones: 260-280	All climate zones: 240-270
• Electricity use per year and guest-night (kWh/year/guest-night)								
• Electricity use per year and square metre (kWh/year/m2)						Temperate climate: <135 Mediterranean: <140 Tropical: <190	All climate zones: 70-80	All climate zones: 60-70
• Heat use per year and guest night (kWh/year/guest-night)								
• Heat use per year and square metre (kWh/year/m2)						Temperate climate: <150 Mediterranean: <120 Tropical: <80	All climate zones: 190-200	All climate zones: 180-200
Renewable energy								
• Proportion of overall energy consumption that comes from renewable sources (%)	>90%	>50%						
• Proportion of electricity which comes from renewable energy sources (%)	>90%							
• Proportion of heat which comes from renewable energy sources or industrial waste heat/heat pumps (%)	>90%		>70%					
Transport								
• Proportion of own vehicles that are powered by renewable fuel (e.g. ethanol, biogas) or electricity		50%						
• Fuel efficiency / total consumption of fossil fuels for transport purposes (l/100 km)								

Examples of other OPIs
• Cost of energy consumption (Euro/guest-night)
• Proportion of the light sources in the establishment that are low-energy lamps (%)

- Proportion of the spotlights in the establishment that are LEDs or similar products (%)
- Proportion of office machines (computers, faxes, copiers, etc.) that are operated with the standby function activated (%)
- Proportion of the lighting in the guest rooms that is presence-controlled (%)
- Proportion of television sets that have a passive standby setting of maximum 1 W, and if applicable, an active standby setting of maximum 9 W (%)
- Proportion of minibars that consume at most 0.8 kWh/day (%)
- Proportion of ventilation that is connected to heat recovery system (%)
- Proportion of ventilation system that is demand-controlled in rooms that are ventilated (%)
- Proportion of ventilation system that is timer-controlled in rooms that are ventilated (%)
- Proportion of ventilation system that is natural draft only (%)
- Proportion of interior lighting that is presence-controlled in non-guest rooms (%)
- Proportion of interior lighting that is presence-controlled in non-guest rooms (%)

Transport

- Proportion of own vehicles that meet the Euronorm IV standard
- Distance driven in vehicles that meet the Euronorm standard (km/year)
- Proportion of all drivers that have taken an eco-driving course
- Significant environmental impacts of transporting products and other goods and materials used for the organization's operations, and transporting members of the workforce (GRI-EN29)

4.4 Aspect: Water Use

Tourist water use is generally higher than water use by residents. A tourist consumes around 300 litres per day; European household consumption is around 150-200 litres[179]. In addition, recreational activities such as swimming pools, golf, and aquatic sports contribute to put pressure on water resources.

Environmental Condition Indicators (ECIs) - examples

- Concentration of a specific contaminant in groundwater or surface water
- Dissolved oxygen in receiving water
- Change in groundwater level
- Number of coliform bacteria per litre of water
- Water temperature in surface water body adjacent to the organisation's facility
- Change in groundwater levels – balancing water withdrawal and recharge

Management Performance Indicators (MPIs)

- An audit has been carried out to assess water consumption in the operations. Based on the audit results, an action plan with measurable, scheduled targets has been prepared to reduce water consumption. Management has assigned resources, appointed responsibility and provided training to ensure implementation of the action plan. Guests have been informed about environmental initiatives and how they are contributing to reducing their water consumption.

Core Operational Performance Indicators (OPIs) — **Examples of benchmarks**

Core Operational Performance Indicators (OPIs)	Swan - hotels	Swan - restaurants	EU flower - hotels	EU flower - camping	SUTOUR	IFC EHS - tourism Luxury serviced hotels	IFC EHS - tourism Mid-range serviced hotels	IFC EHS - tourism Small serviced hotels
• Water consumption (m3/guest per night)						Temperate climate: <0.50 Mediterranean: <0.60 Tropical: <0.90	Temperate climate: <0.35 Mediterranean: <0.45 Tropical: <0.70	Temperate climate: <0.20 Mediterranean: <0.22 Tropical: <0.29
• Consumption of all fresh water within the establishment (litres/guest-night)	ClassA: 300 ClassB: 250 ClassC: 200				Camping: 96 B&B: 133 Hotels: 213			

Examples of other OPIs

- Cost of water consumption (Euro/guest-night)
- Overall water consumption (litres/m2 of indoor area)
- Proportion of WCs that use a maximum of 6 litres of water per flush (%)
- Proportion of WCs that provide 2 flush options (%)
- Proportion of shower heads that are of the water-saving type, with a flow rate of at most 10 litres/minute (%)
- Proportion of mixer taps for washbasins that are of the water-saving type, with a maximum flow rate of 8 litres/minute (%)
- Proportion of the mixer taps that are single lever mixer taps alternatively sensor controlled (%)
- Dishwasher's consumption of final rinse water (litres/basket)
- Average flow of the taps and shower heads, excluding kitchen and bath tub taps (litres/minute)
- Toilets' consumption of water (litres/flush)

179 http://www.grid.unep.ch/product/publication/freshwater_europe/consumption.php

4.5 Aspect: Material Use, Purchasing and Supply Chains

Environmental Condition Indicators (ECIs) - examples

None identified.

Management Performance Indicators (MPIs)

- An audit has been carried out to list and assess the use of consumables, chemicals and hazardous materials, in the operations. Based on the audit results, an action plan with measurable, scheduled targets has been prepared to reduce material and chemical consumption and to integrate environmental considerations into purchasing procedures. Management has assigned resources, appointed responsibility and provided training to ensure implementation of the action plan.

  A written list of all chemical products is kept and updated on regular basis (at least yearly). The establishment has readily accessible, clear and easily understood instructions for the staff regarding the dosage and handling of chemical products. Safety data sheets are available for all chemicals used, in language that employees understand.

Core Operational Performance Indicators (OPIs)	Examples of benchmarks					
	Swan - hotels	Swan - restaurants	EU flower - hotels	EU flower - camping	SUTOUR	IFC EHS - tourism
• Use of all chemical products for cleaning and dishwashing (excluding washing detergents, special cleaners and pool chemicals) (grams/guest-night)	ClassA: 35 ClassB: 30 ClassC: 25					
• Proportion of the amount of chemical products used for regular/general cleaning that are ecolabelled (%)	>80%	>70%	>80%	>80%		
• Proportion of different consumables (purchase volume) that are eco-labelled; such as photocopy paper, napkins, batteries, micro fibre cloths, floor care agents, rinsing agents, soaking agents etc. (%)	50-90% (depending on product category)	90% of kitchen rolls, paper towels and toilet paper	>80 % of toilet/tissue paper and/or office paper and/or printed paper	>80 % of toilet/tissue paper and/or office paper and/or printed paper		
• Proportion of indoor and/or outdoor painting of structures and rental accommodation that are eco-labelled			>50%	>50%		

Examples of other OPIs

- Cost of different consumables (Euro/guest-night)
- Proportion of the amount of dishwasher detergent and drying agents (calculated as active substances) that are ecolabelled?
- Proportion of chemical products for dishwashing and cleaning (estimated active substances in dishwashing detergents, drying agents, general-purpose cleaners and sanitary cleaners) that are eco-labelled (%)
- Proportion of the amount of chemical laundry (textile laundry detergent) products that are ecolabelled (%)
- Proportion of the refrigerants in refrigerator and freezer units are hydrocarbons (methane, propane, butane, etc.), ammoniac (NH3) or carbon dioxide (CO2)
- Proportion of the volume of purchased tissue products, i.e. kitchen rolls, paper towels and toilet paper, that are ecolabelled (%)
- Proportion of different services that are eco-labelled; such as alternative dry cleaning, cleaning, carwash or other (%)
- Proportion of bathrooms/toilets that use ecolabelled soap and shampoo (%)
- Proportion of bathrooms/toilets with soap and shampoo dispensers (%)
- Proportion of the hotel's total volume of beer, soft drinks and mineral water that are delivered in recyclable containers, for example bottles, barrels or tanks (%)
- Proportion of main food ingredients with known country of origin (%)
- Proportion of the annual purchase volume of foodstuffs/beverages served that are organic (%)
- Number of products served that are organic
- Proportion off foodstuffs/beverages of purchase volume, that are regional (%)
- Proportion of products served that are fair-trade (%)
- Proportion of food with documented sustainable origin (e.g. tiger prawns)
- Proportion of food containing GMOs

4.6 Aspect: Land Use, Landscaping and Biodiversity

Environmental Condition Indicators (ECIs) - examples

- Concentration of a specific contaminant in surface soils at selected locations surrounding the organisations facilities
- Area rehabilitated in a defined local area
- Area dedicated to landfill, tourism or wetlands in a defined local area
- Protected areas in a defined local area
- Measure of soil erosion from a defined local area
- Population of certain species (flora or fauna) in a defined area
- Special Protection Areas and Sites of Community Importance
- Measure of the condition of sensitive structures

Management Performance Indicators (MPIs)

- Potential impacts due to land use and landscaping on humans and biodiversity (plants and animals) have been assessed. This may include proximity to areas of high conservation value and/or biodiversity impacted due to other environmental aspects. Commensurate to the potential impacts an action plans has been established, to reduced negative biodiversity impacts and enhance positive biodiversity effects, containing measurable and scheduled targets. Management has assigned resources, appointed responsibility and provided training to ensure implementation of the action plan. Guests have been informed about environmental initiatives and how they can or are contributing to reducing impacts on biodiversity.

Core Operational Performance Indicators (OPIs)	Examples of benchmarks					
	Swan - hotels	Swan - restaurants	EU flower - hotels	EU flower - camping	SUTOUR	IFC EHS - General General
None identified so far.						

Examples of other OPIs

Land use

- Area of land used by category (directly or indirectly); e.g. urban or Greenfield, natural habitats, green area, paved area etc.
- Location and size of land owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas. (GRI - **EN11)**

Biodiversity

% of planted vegetation (trees, bushes and hedges) on the site consisting of local species and varieties (Green key – Attractions)

- Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas. (GRI- **EN12)**
- Habitats protected or restored. (GRI- **EN13)**
- Strategies, current actions, and future plans for managing impacts on biodiversity. (GRI- **EN14)**
- Number of IUCN Red List species and national conservation list species with habitats in areas affected by operations, by level of extinction risk. (GRI-**EN15)**

4.7 Aspect: Air Emissions (including from transport)

Environmental Condition Indicators (ECIs) - examples

- Concentration of a specific contaminant in ambient air at selected monitoring locations
- Frequency of photochemical smog events in a defined local area
- Number of hospital admissions for asthma during smog season

Management Performance Indicators (MPIs)

- Air emissions have been assessed (types and quantity) and an action plan established to reduce air emissions, such as related to energy generation/use related to facilities and transport. Based on the assessment results an action plan has been established, containing measurable and scheduled targets. Transport requirements have been assessed and an action plan established to reduce transport requirements and transport related impacts (e.g. course in eco-driving or biofuel vehicles), related to own workforce and customers to the degree possible. Management has assigned resources, appointed responsibility and provided training to ensure implementation of the action plan. Guests have been informed about environmental initiatives and how they are contributing to reducing emissions to air.

Core Operational Performance Indicators (OPIs)	Examples of benchmarks					
	Swan - hotels	Swan - restaurants	EU flower - hotels	EU flower - camping	SUTOUR	IFC EHS - tourism
Emissions from facility operations						
• Boiler NOX emissions (mg/kWh)			Gas condensing boilers: <60 Non condensing gas boilers up to nominal output of 120 kW: <70			
• Total direct and indirect greenhouse gas emissions in CO2 equivalents (kg/guest-night)						
Transport emissions						
• Direct and indirect greenhouse gas emissions, related to transportation, by weight (GRI-EN16)						

Examples of other OPIs

Emissions from facility operations

- Total direct and indirect greenhouse gas emissions by weight (GRI-EN16)
- NO, SO, and other significant air emissions by type and weight (GRI-EN20)
- Initiatives to reduce greenhouse gas emissions and reductions achieved (GRI)
- Emissions of ozone-depleting substances by weight (GRI-EN19)

Transport emissions

- Proportion of five-seat passenger vehicles with a carbon dioxide emission rating lower than 120 g/km or seven-seat passenger vehicles (or larger) with a carbon dioxide emission rating lower than 125 g/km
- Percentage of visitors using carbon offsets (e.g. measured via visitor surveying)

4.8 Aspect: Effluent Discharge

Environmental Condition Indicators (ECIs) - examples

- See examples of ECIs for water use

Management Performance Indicators (MPIs)

- Effluents have been assessed (types and quantity as well as type of receiver) and an action plan established to reduce amount of effluents, containing measurable and scheduled targets. Management has assigned resources, appointed responsibility and provided training to ensure implementation of the action plan. Guests have been informed about environmental initiatives and how they can or are contributing to reducing effluent pollution.

Core Operational Performance Indicators (OPIs)	Examples of benchmarks					
	Swan - hotels	Swan - restaurants	EU flower - hotels	EU flower - camping	SUTOUR	IFC EHS - tourism
• None identified so far						

Examples of other OPIs

- Total water discharge by quality and destination (GRI - EN21)
- Total number and volume of significant spills (GRI-EN23)
- Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the reporting organization's discharges of water and runoff (GRI-EN25)
- Effluent values for treated sanitary sewage discharges (IFC EHS guidelines)

4.9 Aspect: Waste Generation

Environmental Condition Indicators (ECIs)

- Area dedicated to landfill in a defined local area
- Amount of waste to landfill vs. recycled in a defined local area

Management Performance Indicators (MPIs)

- Waste generation has been assessed (types and quantity of waste) and an action plan established to reduce amount of waste generated, containing measurable and scheduled targets. Management has assigned resources, appointed responsibility and provided training to ensure implementation of the action plan. Guests have been informed about environmental initiatives and how they can or are contributing to reducing waste generation.

Core Operational Performance Indicators (OPIs)	Examples of benchmarks							
	Swan - hotels	**Swan - restaurants**	**EU flower - hotels**	**EU flower - camping**	**SUTOUR**	**IFC EHS - tourism** Luxury serviced hotels	**IFC EHS - tourism** Mid-range serviced hotels	**IFC EHS - tourism** Small serviced hotels
• Weight of all unsorted waste that arises from daily operations (kg/guest-night)	ClassA: 1.35 ClassB: 0.9 ClassC: 0.45							
• Waste generation (kg/guest per night)						<0.60	<0.40	<0.60
• Weight of all hazardous waste per type (e.g. paints and solvents, oils, batteries, light bulbs containing heavy metals, electronic waste) (kg/guest-night)								

Examples of other OPIs

- Weight of all waste (sorted and unsorted) from daily operations (kg/guest-night)
- Weight of all waste per type and disposal method (kg/year)
- Amount of all sorted waste per category from daily operations (kg/guest-night)
- Amount of hazardous waste and special waste produced (kg/guest-night)
- Proportion of organic waste that is composted, organically rotted or used for biogas production (%)
- Cost of waste disposal (Euro/guest-night)
- Proportion of rooms equipped with a waste paper bin (%)

4.10 Aspects: Noise and Odour Generation

Environmental Condition Indicators (ECIs)

- Weighted average noise levels at the perimeter of the organisations facility
- Odour measured at a specific distance from the organisations facility

Management Performance Indicators (MPIs)

- Potential impacts on the local community have been assessed, such as regarding noise and odour pollution from operations. Commensurate to the potential impacts, an action plan has been established to reduce amount of waste generated, containing measurable and scheduled targets. Management has assigned resources, appointed responsibility and provided training to ensure implementation of the action plan. Guests have been informed about environmental initiatives and how they can or are contributing to reducing pollution.

Core Operational Performance Indicators (OPIs)	Examples of benchmarks					
	Swan - hotels	**Swan - restaurants**	**EU flower - hotels**	**EU flower - camping**	**SUTOUR**	**IFC EHS - General** General
Noise						
• Level of noise at nearest receptor location off site						**Residential; institutional; educational** Daytime (07-22): 55 dB(A) Night time (22-07): 45 dB(A) **Industrial; commercial** Daytime and night time: 70 dB(A)

Examples of other OPIs

Noise

- Number of complaints due to noise pollution from operations

Odour

- Number of complaints due to odour pollution from operations

References

The indicators presented in this chapter are to a large extent based on the sources listed in the following table. The listed documents are also sources of further information related to environmental performance evaluation, best practise and relevant benchmarks.

- Nordic Ecolabelling of Hotels and Youth Hostels. Version 3.2, 14 June 2007 – 30 June 2012.
- Nordic Ecolabelling of Restaurants. Version 1.1, 13 December 2006 – 31 December 2011
- Commission Decision of 9 July 2009 establishing the ecological criteria for the award of the Community eco-label for tourist accommodation service
- Commission Decision of 9 July 2009 establishing the ecological criteria for the award of the Community eco-label for campsite service
- SUTOUR; Environmental Initiatives by European tourism business Instruments, indicators and practical examples. December 2006.
- IFC General EHS Guidelines
- IFC EHS guidelines for Tourism and Hospitality Development
- The Green Key website: www.green-key.org accessed November 2010
- Commission Recommendation of 10 July 2003 on guidance for the implementation of Regulation (EC) No 761/2001 of the European Parliament and of the council allowing voluntary participation by organisations in a Community eco-management and audit scheme (EMAS) concerning the selection and use of environmental performance indicators.
- ISO 14031: Environmental management - Environmental Performance evaluation - Guidelines (ISO 14031:1999)
- Tourism Queensland - Tourism Environmental Indicators Fact Sheet; http://www.tq.com.au/fms/tq_corporate/industrydevelopment/Tourism%20Environmental%20Indicators%20Fact%20Sheet.PDF
- Global Reporting Initiative (GRI) G3 guidelines

GLOSSARY OF TERMS AND ABBREVIATIONS

Best environmental management practice	:	The most effective way to implement the environmental management system by organisations in a relevant sector and that can result in best environmental performance under given economic and technical conditions
CDD	:	Cooling Degree Day
COP	:	Coefficient of performance
Direct environmental aspect	:	An environmental aspect associated with activities, products and services of the organisation itself over which it has direct management control. Examples of direct environmental aspects cited in EMAS: (i) legal requirements and permit limits;(ii) emissions to air;(iii) releases to water;(iv) production, recycling, reuse, transportation and disposal of solid and other wastes, particularly hazardous wastes;(v) use and contamination of land;(vi) use of natural resources and raw materials (including energy);(vii) use of additives and auxiliaries as well as semi-manufactured goods;(viii) local issues (noise, vibration, odour, dust, visual appearance, etc.);(ix) transport issues (both for goods and services);(x) risks of environmental accidents and impacts arising, or likely to arise, as consequences of incidents, accidents and potential emergency situations;(xi) effects on biodiversity.
EC	:	European Commission
ECI	:	Environmental Condition Indicator
EEA	:	European Economic Area
EMAS	:	Community Eco-Management and Audit Scheme
EMS	:	Environmental Management System
Environmental aspect	:	An element of an organisation's activities, products or services that has or can have an impact on the environment
Environmental performance	:	The measurable results of an organisation's management of its environmental aspects
EPI	:	Environmental Performance Indicator. An EPI is a specific expression that allows measurement of an organisation's environmental performance
EU	:	European Union
HDD	:	Heating Degree Day
HSPF	:	Heating Seasonal Performance Factor
Indirect environmental aspect	:	An environmental aspect which can result from the interaction of an organisation with third parties and which can to a reasonable degree be influenced by an organization. Examples of indirect environmental aspects cited in EMAS:
IPTS	:	Institute for Prospective Technological Studies
ISO	:	International Organisation for Standardisation
JRC	:	Joint Research Centre
LED	:	Light Emitting Diode
MPI	:	Management Performance Indicator
Non-financial business economy	:	NACE Rev. 1.1 Sections C to I and K
OPI	:	Operational Performance Indicator
SEER	:	Seasonal Energy Efficiency Ratio
SSL	:	Solid State Lighting
SRD	:	Sectoral Reference Document

Tourism	:	Activities of persons who travel to and stay in places which are distinct from normal abode for less than 12 m for leisure, business
Value added	:	(at factor cost) calculated from turnover plus capitalised production plus other operating income, plus or minus the change in stocks, minus the purchase of goods and services, minus other taxes on products which are linked to turnover but not deductible, minus the duties and taxes linked to production
Verifier	:	An accredited individual or company that reviews and validates the company's policy statement, the programme, the management system and audit cycles

APPENDICES