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Analysis on energy use by European hotels: online survey and desk research

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ANALYSIS ON ENERGY USE BY EUROPEAN HOTELS: ONLINE SURVEY AND DESK RESEARCH

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ANALYSIS ON ENERGY USE BY EUROPEAN HOTELS: ONLINE SURVEY AND DESK RESEARCH

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1. Introduction

Hotel facilities rank among the top five in terms of energy consumption in the tertiary building sector (minor only to food services and sales, health care and certain types of offices). Although no collective data is available on global energy consumption in the hotel sector, it is estimated that 97,5 TWh of energy was used in hotel facilities worldwide in 2001. Furthermore, the CHOSE project estimated that European hotels – which are reported to provide nearly half of the world total hotel rooms – used a total of 39 TWh (terawatt hours) in 2000, half of which is in the form of electricity.

Most of this energy is derived from fossil sources, and the hotel sector's contribution to global warming and climate change, is estimated to include annual releases between 160 and 200 kg of CO_2 per m^2 of room floor area, depending on the fuel mix used to provide energy. Global hotel-based CO_2 emissions were assumed to be at the level of 55.7 Mt in 2001, while the estimated annual energy consumption for European hotel of 39 TWh, would result in emissions of more than 10 Mt of CO_2 each year.

Although no specific data have been reported for small and medium size hotels, a large proportion of CO_2 emissions can be attributed to them. The hotel accommodation sector in Europe is dominated by small businesses, which provide around 90 per cent of the total number of rooms, and studies show that small independent hotels are less proactive about the environment than large hotel chains. Only 10 per cent of rooms are provided by large hotel chains, and it is these chains which have made most of the energy efficiency improvements in the hotel sector.

Data from research studies into energy use in hotels in Europe has been analysed in detail as part of the Hotel Energy Solutions project[1]. This analysis has revealed that:

- For most hotels, energy use falls in the range 200-400 kWh/m2/yr; a "meta-analysis" (combining data from all the various studies) suggests that average energy use by hotels is in the range 305-330 kWh/m2/yr.

- Variation in energy use levels between hotels within each study sample, is far greater than the differences between the averages for different study samples: there is no evidence that there are any statistically significant differences in levels of energy use intensity (kWh/m2/yr) between hotels or other accommodation with different star ratings

- The main range of energy performance differentiation in published energy benchmarks (eg. set by Accor for its hotel brands; Nordic Swan scheme; LowE project; WWF/IBLF; Thermie programme) is between 200-400 kWh/m2/yr, and some schemes set higher benchmark values for luxury with laundry and full HVAC compared to budget hotels with no laundry and no/partial HVAC.

This report summarises information on the use of energy efficiency and renewable energy technologies in hotels, from a trawl of research documentation. The information was extracted from a selection of studies that report survey data on the use and benefits of specific efficiency and renewable energy technologies in hotels, located through a trawl of the relevant literature and web searches.

[1] Report "Energy use in hotels: Analysis of data from research studies" (Deliverable 2.1)

2. Literature search

An extensive literature search was carried out covering technical reports prepared for IEE projects and academic literature, covering more than 80 reports and papers on hotels and their use of energy efficiency and renewable energy technologies. It was found that while a number of papers examine overall energy use in hotels, far fewer address the use of specific measures that enable performance improvements in energy use, and through this, a reduction in environmental burdens.

Survey data from the following sources is used in this report:

Energy efficiency technologies:

Study of 610 hotels across Europe, carried out in 2002 and 2003 by Bohdanowicz and colleagues at the Royal Institute of Technology, Sweden.

Study of implementation of the EU Environmental Management and Audit Scheme (EMAS) in 115 hotels, carried out in Spain in 2005

Study of Total Quality Management (TQM) in 301 hotels carried out in Spain in 2005-6

Study of 158 hotels in Greece carried out in 1996

Study of 64 hotels carried out in the city of Plymouth in the UK in 1998

Study of 40 hotels in Ankara, Turkey, carried out in 2006-7 (included for comparison)

Study of tourists' attitudes to renewable energy use in four Australian hotels (included as it provides relevant information and is a useful comparison).

Renewable energy technologies:

The HOTRES project – this gathered data on market penetration and hotel attitudes towards renewable energy technologies, and also assessed the economic potential for application of these technologies in specific hotels. The project focused on five renewable energy technologies: solar thermal, solar passive, solar PV, biomass and geothermal energy. Wind and small-scale hydropower were not considered, as these would not have been suitable for the majority of hotel situations covered by the project. The HOTRES project surveyed 200 hotels, and was conducted in the following regions:

East Attica, Greece
Sicily, Italy
Alpes-Maritimes, France
Andalusia, Spain
Madeira, Portugal

The SOLARGE project – this examined market factors affecting uptake of solar thermal systems of more than 30m2 panel area (termed collective solar thermal systems (CSTS)) that are suitable for hotels, apartments and multi-occupancy dwellings in the EU.

The 'Sustainable energy project for the economic development of remote and isolated island communities' – this assessed scenarios for utilizing renewable energy technologies to provide an autonomous power system on Dodecanese islands of Greece (located in the south eastern Aegean).

3. Overview of energy consuming activities in a hotel

The main energy consuming activities in a hotel are:

- ✓ heating rooms,
- ✓ cooling rooms,
- ✓ lighting,
- ✓ hot water use and other energy consuming activities by guests,
- ✓ preparing meals (especially warm ones),
- ✓ swimming pool,
- ✓ others

The relative importance of the different energy end-uses is described as follows:

Space conditioning (heating/cooling, ventilation and air-conditioning) is the largest single end-user of energy in hotels, accounting for approximately half of the total consumption – it is thus widely accepted that outdoor weather conditions and floor areas are among the main factors affecting energy use in hotels. The indoor temperature levels also greatly influence the quantity of energy consumed in a building.

Domestic hot water is commonly the second largest user, accounting for up to 15 per cent of the total energy demand. Lighting can fluctuate between a range of 12-18 per cent and up to 40 per cent of a hotel's total energy consumption, depending on the category of the establishment. Services such as catering and laundry also account for a considerable share of energy consumption, particularly considering that they are commonly the least energy-efficient. Sports and health facilities are typically high energy consumers. Broadly similar results have been reported by studies of Greek hotels: 72-75 per cent of the total energy consumption is used for space conditioning (heating and air conditioning) and for hot water production, 8-9 per cent is used for lighting, 15 per cent is used for catering. No specific data have been found in the literature on the specific energy consumption breakdown of SME hotels.

3.1 Factors influencing hotel energy consumption

Hotel energy consumption is influenced by physical and operational parameters. The physical parameters common to most buildings include size, structure and design of the building (prevailing architectural / construction practices), geographical and climatic location, the age of the facility, the type of energy and water systems installed, the way these systems are operated and maintained, types and amounts of energy and water resources available locally, as well as energy-use regulations and cost.

Operational parameters that influence energy use in hotels include operating schedules for the different functional facilities in the hotel building, the number of facilities (restaurants, kitchens, in-house laundries, swimming pools and sports centres, business centres, etc.), services offered, fluctuation in occupancy levels, variations in customer preference relevant to indoor comfort, on-site energy conservation practices, as well as culture and awareness of resource consumption among personnel and guests.

The energy saving potential of hotels is significant; especially when since a large part of the energy consumption is due to unnecessary loss and wastage. For instance, guests are frequently given full control over thermostat settings and individual air conditioning units, and they adjust these with little or no concern for energy conservation. Often windows and doors are opened simultaneously to the operation of the cooling or the heating system. Also, many rented rooms remain unoccupied for long periods of time – approximately 60 - 65 per cent during the day – while HVAC systems are left running or in stand-by mode. Thus energy within a hotel room is frequently consumed 24-hours-a-day, year-round regardless of whether or not the room is occupied.

Various studies have estimated that hotels have the potential to save at least 10 - 15 per cent of the energy they consume, depending on the age and size of the hotel, as well as type of equipment installed and the maintenance and operating procedures in use. An assessment of potential energy conservation in southern European hotels revealed that there is a potential for 25 - 30 per cent energy savings, especially in hotels with high annual energy consumption. European studies have estimated savings of 15 - 20 per cent for heating, 5 - 30 per cent for cooling, 40 - 70 per cent for hot water and 7 - 60 per cent for lighting.

3.2 Methods for modelling hotel energy consumption

Significant variations in facility types within the hotel sector make it difficult to provide a general model explaining the energy consumption of individual facilities that could be universally applicable to all types of hotels. Nevertheless, a number of attempts have been made to develop such models. The models vary in applicability, number of factors/variables included, data collection and verification procedures, as well as modelling methodology used.

Generally, a linear regression model is used to describe the total energy consumption of a hotel. Analysis of actual energy use and data on hotel facilities is then made using this regression model, and is used to identify the most significant variables that influence energy use. Although many variables may have some influence on total hotel energy use, in practice only a few variables are generally considered depending on data availability. Typically variable investigated with regard to energy consumption are:

- ✓ hotel standard,
- ✓ hotel floor area (or number of guestrooms or beds),
- ✓ heating and cooling degree days,

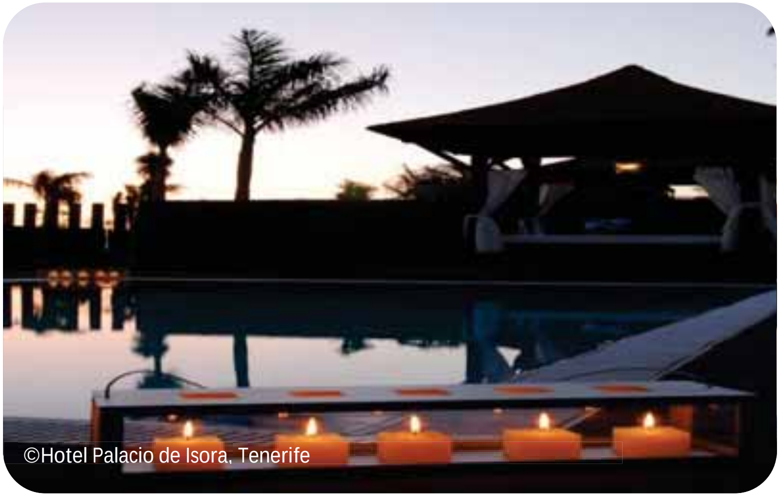
- ✓ guest-nights (occupancy),
- ✓ (warm) food covers sold,
- ✓ presence of heated swimming pool,
- ✓ presence of food preparation facilities,
- ✓ comfort level,
- ✓ chain affiliation,
- ✓ corporate (management and staff) and customer awareness.

Although the structural characteristics of the buildings (wall insulation, etc.) and the equipment used for space conditioning, hot water production, lighting, etc., can have an impact on energy consumption, these are generally not considered in modelling studies due to lack of data. For example it is difficult to evaluate the influence of particular air-conditioning systems on the overall energy consumption, as no system-specific energy consumption data is available in most hotels.

Outdoor temperatures (degree days), hotel floor area and sometimes, guest nights sold, hotel standard and the presence of a heated swimming pool are typically found to be major factors that influence observed variations in specific consumption figures, although this may vary depending on the characteristics of the hotels sample used and the availability of data. These are therefore the major determinants to consider in energy consumption modelling and hotel benchmarking.

Although models for determining the factors that influence hotel energy consumption are based on a limited number of variables, they are able to account for major effects in energy consumption variations in the samples of hotels as indicated by high coefficients of correlation.

It should also be noted that while most studies have focused on larger hotels, some cover hotels of a wide range of sizes, and the findings of key factors influencing energy use in hotels (standard of hotel, floor area, climatic conditions) can be assumed to be applicable to SME hotels.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3.3 Overview of initiatives and tools for improving hotel energy performance

Various initiatives have been established to encourage the tourism industry and hotels in particular, to reduce their environmental impacts. These include Environmental Management Systems (EMSs) and Environmental Management Standards and a variety of eco-labels or eco-certificates, Examples include the International Hotel Environmental Initiative (IHEI), Energy Star for Hospitality set up by the United States Environmental Protection Agency (US EPA), and the Green Globe 21 environmental management standard launched. European projects such as the HOTRES and XENIOS projects have focused on improvement of energy efficiency in hotels and promoting use of renewable energy resources, and the European Eco-Label for Tourist Accommodation Services and campsite services (ELTAS).

Environmental Management Systems (EMSs) and Environmental Management Standards:

An Environmental Management System (EMS) is an organisational approach to environmental management. It provides a structured framework specifically designed to achieve continual improvement. This is achieved through an integrated process of steps that start from elaboration of a company environmental policy, and then move to planning based on this policy, implementation and operation, monitoring and corrective action. The cycle is completed with a management review, after which it begins again, leading to continual improvement as policy and planning learn from experience gained through implementation and monitoring activities. The aim of EMS is to improve the environmental performance of a business or company, particularly through reducing use of energy and water resources, and generation of wastes, and promoting use of renewable energy.

Environmental Management Standards set out specific requirements that need to be fulfilled by an organisation that is implementing an EMS to an externally verified standard. Environmental Management Standards, such as the ISO 14000 series, deal with the process of environmental management, and are not specific to the hotel industry. The Eco-Management Audit System (EMAS), for example, allow business, including hotels, to participate in a voluntary EU standardised environmental management scheme, and adoption of ISO 14001 as the management system element of EMAS allows organisations to progress for ISO 14001 to EMAS without undue duplication of effort. Well designed and implemented environmental and resource management can result in significant improvements, but it is important to note that meeting a standard for the process of environmental management does not imply that better environmental performance is necessarily achieved. It is therefore important to distinguish between environmental management and environmental performance.

Eco-labels and eco-certificates:

There are a wide variety of eco-labels and eco-certificates available for the tourism and hotel sector. Most of them are for the accommodation sector and are based principally on energy, water and resource conservation and waste management. Their main objective is to stimulate environmental concern both from the perspective of the producer as well as the consumer: they aim at helping ecologically-oriented customers to find hotels which offer ecologically friendly services and at creating an incentive for the hotels to improve their environmental performance.

Currently over 100 ecolabels and certification schemes are available for tourism, ecotourism and the hospitality industry worldwide. Europe alone has over 60 labelling schemes. The schemes are of varying quality, based on different criteria and content, and are designed for different sectors and geographical regions. Despite the existing differences, certification schemes have common components, which include voluntary enrolment, required criteria to be fulfilled and which comply or extend beyond regulations, published commitment by a company to comply to a sustainable development, a need of assessment and auditing (preferably by a third party, i.e. accredited organization), as well as membership and fees.

The most important ecolabels and certification schemes include:

- ✓ Eco-Label for Tourist Accommodation Services and campsite services: ELTAS (EU flower)
- ✓ HVS EcoServices Ecotel
- ✓ DEHOGA scheme in Germany
- ✓ Hotel Label in Austria
- ✓ Tourist accommodation eco-label in Luxembourg
- ✓ The Green Key in Denmark, France, and other European countries
- ✓ Nordic Swan Ecolabel for Hotels in Scandinavian countries
- ✓ Catalan Emblem in Catalunya

Two approaches are used in eco-labels schemes to assess hotel performance. The first focuses on the environmental performance of the hotel as measured through a small set of benchmarking values (eg. energy consumption per overnight stay, etc.); the second uses a list of environmental measures of which a certain number have to be undertaken by the hotel in order to get the label. Some schemes use a combination of these two approaches.

The advantage of the first approach is that it provides in theory a small set of environmental indicators, which may be more easily checked than a long list of environmental measures. In practice, however, lack of data makes it difficult to reliably define threshold values, and inherent variation between hotels in different locations, offering different comfort levels and facilities, would also make it difficult to define single threshold values applicable to all hotels.

There is also considerable debate regarding the impact of ecolabels and certificates in the hotel sector, and the extent to which they influence consumer choices, and provide incentives for environmental improvement by hotels. However, there is an upwards trend in environmental concern as a factor in consumer choices, and a growing number of businesses are selecting accommodation for conferences and business travel on the basis of environmental performance, in order to comply with their own policies on the environment and corporate social responsibility. Ecolabels and certificates therefore remain among the tools that have the potential to positively change the market, and encourage improved environmental performance.

4. Energy efficiency technologies:

The literature search revealed that there has been little systematic investigation of management factors that influence use of energy efficiency measures in hotels, and that there is little recent data reported on this. None of the surveys provided very detailed information on the specific characteristics of the hotels that were surveyed, and the data is either broken down by country, or by whether the hotels are chain or affiliated hotels, or independent hotels. No information is available on the sizes of the hotels that were surveyed, although with the large sample sizes of the surveys, they are likely to encompass a reasonable cross-section of properties. However, unfortunately no evidence is available that would allow this to be confirmed.

4.1 Overview of data on use of energy efficiency measures in hotels

Most data is available from surveys carried out by Bohdanowicz in hotels in Sweden and Poland, in chain and affiliated hotels (average size: 133 rooms), and in independent hotels (average size: 57 rooms). Reported in two separate papers, the total number of hotels sampled in these surveys is 610. The results show that around 80 percent of the hotels that responded reported taking some energy conservation measures (Figure 1). Almost as high a proportion also reported that they had undertaken measures for water conservation and responsible waste management. Data for Sweden and Poland (Figure 2), showed that the energy conservation and efficiency measures comprise energy efficient lighting (just over 70 percent of hotels), energy efficient equipment (between 40 – 60 percent of hotels), and providing leaflets to encourage guests to save energy (between 20 – 40 percent of hotels).

Data for four different hotel chains (Figure 3) show that a higher proportion of hotels in owned and managed chains were undertaking environmental activities compared to hotels in franchised chains. This reflects the influence of building ownership on the incentive for hotels to invest in environmental improvements. In addition, hotels in the Scandic group in Sweden, which had implemented a major management programme to improve environmental measures, were found to be undertaking significantly more environmental activities compared with the other Swedish hotels that were sampled (Figure 4).

The main motivations for hotels to take these measures were to reduce operating costs, followed by demand from customers, improving the hotel's image, and reducing its environmental impacts (Figure 5). The availability of professional advice was also identified as a factor, although this was only rated about half as important by the respondents as reducing operating costs. This is of interest as problems in accessing suitable technical advice are often cited as one of the barriers to investment in energy efficiency and renewable energy technologies by hotels. Availability of technical advice thus seems to be necessary but not sufficient for hotels to implement EET.

In relation to their customers, hotels rated location, quality of service and price, as the key features that influence customers in their choices of hotels (Figure 6). Respondents only felt that their hotel's concern for the environment was a subsidiary factor, and was only rated about one third as important as location, quality of service and price.

A study on Total Quality Management (TQM), managerial factors and performance in the Spanish hotel industry found that there was a strong link between hotels using the TQM approach, and use of water- and energy-saving measures. This indicates that a commitment to an effective management approach on quality also leads to effective management of resource use in hotels (Figure 7). Another study of 115

EMAS-certified hotels in Spain found that 85 percent reported on their electricity consumption, and 71 percent on consumption of other fuel energy, but that only 24 percent reported their normalised energy consumption (eg. energy per guest-night or energy per square metre per year) (Figure 8). This suggests that there is still some way to go even for environmentally-certified hotels to collect and report on energy use. Encouragingly, the same survey found that 96 percent of the hotels were taking concrete measures to raise environmental awareness of guests.

A separate, smaller study of 64 hotels in one UK city (Plymouth) focused on the benefits and difficulties of implementing sustainable tourism in the accommodation sector. Hotels reported that increased environmental protection, followed by improved customer perception and image, and cost savings were the main benefits (Figure 9). The main difficulties were reported to be a lack of interest, lack of time and energy amongst hotel managers, the costs involved, and lack of information and support for implementation of suitable measures (Figure 10).

Because there is so little information available that looks directly at these aspects, data from a study of 40 hotels in Ankara, Turkey and from a study of tourists' attitudes to renewable energy use in four Australian hotels are also included in this analysis. It was found that only a third of the hotels in the Ankara survey had any environmental policies or assessments (Figure 11), and that the most common energy efficiency measures in use were installation of energy efficient lighting, and use of automatic or key-card controls for lighting in public spaces and guest rooms (Figure 12). Also only 27 percent of the hotels had any customer communications on environmental issues for their guests The study concluded that most hotel managers in Ankara have little concern about environmental issues, and lack knowledge of the existence of energy management system and environmental award programs.

The results from the Australian survey show that nearly 85 percent of tourists think that it is important for tourist accommodation to use renewable energy, that around 75 percent view renewable energy as a reliable power source for hotels, and would be willing to reduce energy consumption in their hotel rooms (Figure 13). 60 percent said that they would even be more tolerant of hotel blackouts (although to what extent is not indicated) if this were a consequence of use of renewable energy by a hotel.

4.2 Performance potential of energy efficiency measures

Energy use in most buildings is known to be highly inefficient, with large heat losses through poorly insulated walls, roofs, windows and heating pipes, poor management of lighting, and design features that necessitate excessive energy use for both heating and cooling. Estimated potential reductions in energy use range from 15 – 20 percent for most applications, and can exceed 45 percent for efficiency improvements in boilers, use of solar thermal panels for hot water production, and use of energy efficient lighting (Figure 14).

An assessment of potential energy conservation in southern European hotels revealed that there is a potential for 25-30 percent energy savings, especially in hotels with high annual energy consumption. European studies have estimated savings of 15-20 percent for heating, 5-30 percent for cooling, 40-70 percent for hot water and 7-60 percent for lighting according to data from the XENIOS project. Energy use by hotels is influenced by their specific operational features. These include operating schedules for the different functional facilities in the hotel building, the number of facilities (restaurants, kitchens, in-house laundries, swimming pools and sports centres, business centres, etc.), services offered, fluctuation in occupancy levels daily and seasonally, variations in customer preference relevant to indoor comfort, on-site energy conservation practices, as well as culture and awareness of resource consumption among personnel and guests. The energy saving potential of hotels is significant since a large part of the energy consumption is due to unnecessary loss and wastage. For instance, guests are frequently given full control over thermostat settings and individual air conditioning units, and they adjust these with little or no concern for energy conservation.

An analysis of Scandic hotels in Scandinavia found that energy efficiency measures – mostly on management, maintenance and staff training – implemented over a seven year period, resulted in energy savings of around 15 percent (Figure 15).

An advantage of many energy efficiency measures is that they can be installed with minimal disruption to the operation of a hotel, for example, by integrating them with regular maintenance, or incorporating them into planned refurbishment programmes. Santamouris et al (1996) point out that cuts in energy consumption can be achieved without sacrificing necessary services and important amenities. This can be done in three main ways:

(i) operation and maintenance

(ii) alterations to the building and building sub-systems

(iii) replacement of obsolete equipment.

They recommend that an energy audit should precede any other action, in order to accurately specify the actual performance of a given building, its problems and priorities, and to plan for retrofitting of the building. The audit provides the information that can then be used to proceed with a preliminary analysis to:

(i) Create an energy profile of the building, by using the available data on monthly electric and fossil fuel use, and breaking down total energy consumption in the major sub-categories for electricity (lights, heating, ventilation and cooling equipment, plug-in equipment, office machines, elevators, escalators, etc.), and fossil fuel use (heating, hot water, process energy).

(ii) Compare design assumptions against actual conditions, particularly to take into account occupancy patterns and levels, to ensure that energy is not being used unnecessarily, for example, during periods of low occupancy.

(iii) Compare existing indoor space conditions with the function of the space, to ensure that conditions correspond to the actual tasks performed in each space, and vary indoor temperature, light levels and ventilation according to different uses (eg. guest rooms, lobbies, restaurant, etc.), for example by creating different energy management zones in the building.

(iv) Identify major areas of energy losses, for example, unprotected entrances, poor thermal performance of external envelope (low U value), overall building construction (poor condition, high infiltration), availability of natural light, type of electrical lighting etc.

(v) Investigate the condition of the facade components, and identify actions that could reduce energy use, for example, sunshades, exterior shading, insulated skin, more or less glazing, or installation of opening windows to enhance natural ventilation.

(vi) List options and make a more in-depth cost/benefit analysis.

Table 1 lists the main areas where energy efficiency savings can be made, from a study of 158 hotels in Greece (140 hotels in Athens, and 18 hotels in other parts of Greece). In a series of scenarios ranging from basic to high-end energy conservation measures, energy savings were estimated to be almost 22 percent against the general building stock for basic energy efficiency measures, while a 43 percent saving could be obtained by using additional measures (Figure 16).

The energy-related criteria of the EU Flower (ELTAS) eco labelling scheme also illustrate the range of measures that hotels are commonly encouraged to take, and report on, in order to improve their energy performance and reduce environmental impacts from their use of energy (Table 2). The criteria, some of which are mandatory, are classified into:

- ✓ type of energy supply
- ✓ equipment efficiency / equipment regulations
- ✓ building characteristics
- ✓ management measures

Table 1: Main sources of energy efficiency savings (Santamouris et al 1996)

Energy conservation from heating
Reduce the overall heat transfer coefficient, by insulating to the level set in the building code
Replace window frames that form a thermal bridge, and/or install double glazed windows, to reduce heat transfer coefficient
Use high efficiency combustion systems obtaining increased efficiency through proper maintenance of the heating system
Energy conservation from cooling
Reduce external loads from incident solar radiation by providing proper shading of the building
Reduce internal loads by using of high efficiency lighting systems
Use natural cooling techniques
Use of indirect evaporative coolers instead of compression refrigeration systems
Use of alternative cooling technologies, such ground cooling with ground-air heat exchangers
Use night ventilation techniques
Use ceiling fans
Energy conservation from artificial lighting
Use improved fluorescent lamps
Use super metal halide fluorescent lamps
Use electronic fluorescent ballasts
Use improved luminaries
Install occupancy sensors
Provide information and warning labels for guests and staff
Use daylight effectively within the building
Energy conservation from equipment and other systems
Use high-efficiency equipment when replacing old equipment throughout the hotels (including in kitchens, offices, laundries, etc.)

Table 2: Review of energy-related criteria of the EU Flower (ELTAS), as set out by European Commission Decision of 9 July 2009.

	Criteria #	Mandatory / Optional	Specific aspect addressed by the criteria
Type of energy used			
	1	M	▪ Electricity from renewable sources (at least 22%)
	2	M	▪ Use of Coal and heavy oils
	30	O	▪ Generation of electricity through renewable energy sources (at least 20%)
	31	O	▪ Energy from renewable energy sources
	34	O	▪ District Heating
	35	O	▪ Combined heat and power
	36	O	▪ Use of heat pump
	48	O	▪ Swimming pool heating with renewable energy sources
Equipment efficiency / Equipment regulations			
	3	M	▪ Efficiency and heat generation
	4	M	▪ Air conditioning (class A)
	7	M	▪ Switching off heating or air conditioning
	8	M	▪ Switching off lights
	9	M	▪ Energy efficient light bulbs
	10	M	▪ Outside heating appliances
	32	O	▪ Boiler energy efficiency
	33	O	▪ Boiler NOx emissions
	37	O	▪ Heat recovery
	38	O	▪ Thermoregulation
	40	O	▪ Air conditioning (15% more efficient than class A)
	41	O	▪ Automatic switch-off air conditioning and heating systems
	43	O	▪ Energy efficient refrigerators, ovens, dishwashers, washing machines, dryers/tumblers and office equipment
	45	O	▪ Refrigerator positioning
	46	O	▪ Automatic switching off lights in guest rooms
	47	O	▪ Sauna timer control
	49	O	▪ Automatic switching off outside lights
Building characteristics			
	5	M	▪ Energy efficiency of buildings
	6	M	▪ Window insulation
	39	O	▪ Energy performance audits for buildings
	42	O	▪ Bioclimatic architecture
Management measures that have an impact on energy use			
	23	M	▪ Maintenance and servicing of boilers and air-conditioning systems
	24	M	▪ Policy setting and environmental program
	25	M	▪ Staff training
	26	M	▪ Information to guests
	27	M	▪ Energy and water consumption data
	29	M	▪ Information appearing on the eco-label
	89	O	▪ Energy and water meters

4.3 Barriers and drivers affecting energy efficiency investment by hotels

A lack of information about energy efficiency systems and best practices on energy efficiency has been found to be a major barrier to investment by hotels (this is also the case with renewable energy systems). According to a report on “Developing a Cleaner Production Programme for the Irish Hotel Industry” prepared for Ireland’s Environmental Protection Agency in 2006, further barriers are a lack of management commitment, unskilled staff who are not properly trained to run existing energy facilities efficiently, confusion in the market place making it difficult for hotels to assess information provided by suppliers on energy efficiency measures and costs, and poor design of existing buildings resulting in energy losses (eg. through poor insulation, draughts, etc.). The drivers that have led to greater use of energy efficiency measures include provision of independent information, advice and training on energy efficiency, better understanding of the costs and benefits of investments in energy efficiency measures, and increasing customer concern and awareness on energy use issues.

A report for the International Energy Agency (IEA) on “Energy efficiency requirements in building codes: Energy efficiency policies for new buildings” in 2008, identifies the following barriers to energy efficiency in new buildings:

- ✓ **Focus on incremental costs** without proper consideration of the running costs of a building, and lack of awareness of decision makers of life-time costing or best practices for energy efficiency.
- ✓ **Lack of awareness of decision makers** of best practices for energy efficiency, and of energy efficiency issues and potential. This barrier is directly addressed by the HES project.
- ✓ **Difficulty in some markets to install** energy efficiency measures that involve special equipment or expertise not readily available everywhere
- ✓ **Split responsibilities and interests in decisions** affecting the energy performance of many buildings, between building owners, who would be required to pay for efficiency investments, and building occupants, who would reap the rewards of lower running costs for energy.
- ✓ **Perception by hotels** that a high energy use is necessary to ensure the comfort of guests.
- ✓ **Confusion through misuse of slogans** such as “energy efficient buildings” or “low energy buildings” to apply to new buildings that only just fulfill the energy minimum standards: when buyers feel satisfied with their building being termed efficient or low energy, they are less likely to take further action to improve efficiency.
- ✓ **Unwillingness to install energy efficiency measures that go beyond the minimum standards set in building codes**, although the efficiency standards in building codes rarely represent the optimum for efficiency, and because builders and designers rarely find an incentive to exceed these efficiency standards which might increase initial costs.
- ✓ **Most barriers to energy efficiency in new buildings work together and strengthen each other**.

Although the report examines barriers to energy efficiency in new buildings, the barriers it identifies are equally applicable to energy efficiency retrofitting. The report also notes that many initiatives for improved energy efficiency in buildings have returned small or limited results because some barriers have been overlooked or insufficiently addressed. For example, a change in legislation and subsequent information campaigns will fail if building constructors and installers do not have access to sufficient funds for efficiency investment. A successful policy, or package of initiatives, will simultaneously have to address all major barriers to buildings' energy efficiency.

A recent report by McKinsey on "Unlocking energy efficiency in the US economy" has identified that energy efficiency barriers in the private sector include an expectation that efficiency investments should pay back in one to four years, and resistance to increasing debt and diverting money from revenue-enhancing projects. Use of subsidised energy audits and public–private partnerships for financing are suggested as ways to overcome these barriers, for example by creating of specific energy efficiency funds by banks or energy service companies, or direct incentives from equipment manufacturers and distributors to promote upgrades using the latest energy efficiency equipment, and to reduce risk to individual businesses. Overall, the report concludes that energy efficiency stands out as the single most attractive and affordable component of the necessary shift in energy consumption.

4.4 Conclusions

Taken together, although the surveys have slightly different focuses and used different questions, they suggest that sound management structures, costs savings and customer demand are important factors that influence hotels in their decisions on investment in energy efficiency technologies, and that there is a large potential to achieve savings through low cost investments, such as ensuring proper maintenance of boilers and other plant, and upgrading to high efficiency equipment in the normal cycle of equipment replacement. However, to achieve this, it is necessary to overcome entrenched perceptions within the hotels sector that work against energy efficiency investments (include a sense that by doing a few small actions such a towel reuse schemes or changing to energy efficient light bulbs, hotels have done all they can on energy efficiency). This requires training and awareness raising, but this must also go hand-in-hand with ensuring that hotels can get reliable advice to plan and implement energy efficiency measures, and are also able to access skilled suppliers and installers of energy efficiency measures. The HES project will contribute to tackling these issues.

5. Renewable energy technologies:

5.1 Overview of data on use of renewable energy technologies in hotels

Little information is available on the use of renewable energy technologies (RETs). A statistical sample of 32 hotels examined by the HOTRES project found that RETs were only used in 11 of the hotels, and that solar active systems (hot water heating; solar cooling) were the most common (Figure 17). The SETCOM project found that use of renewable energy by hotels varies widely between regions (Annex 2), with 40 - 60 percent of hotels surveyed in Spain, Portugal, France and Finland, reporting use of some form of renewable energy, between 20 - 25 percent in Germany, Austria and Slovenia, and only 8 - 10 percent in Italy and Crete. The main sources in use were biomass using wood chips or pellets, and solar energy.

In a survey of managers in 200 hotels, the HOTRES project also found that they placed only low-moderate importance on introducing RETs into the hotel (Figure 18), and that only 28 percent anticipated that RETs would be introduced by them within the following five years (Figure 19). Knowledge of RETs was generally low (Figure 20). The greatest interest was in solar active systems (Figure 21).

A study on the potential to use RETs in the Dodecanese islands of Greece identified wind energy, solar energy, geothermal energy and biomass as the main RETs that would be suitable for electricity production on the islands. It found that wind energy was particularly attractive, since average wind speeds on the islands are high for much of the year. Biomass energy could be developed using wastes from the islands' olive oil processing enterprises. Although suitable, solar photovoltaic (PV) systems were relatively cost intensive, and geothermal energy was not well-perceived on the islands due to some problematic pilot projects in the late 1980s.

Studies in other parts of the world have found that there is a perception in the hotel sector that RETs are not able to provide sufficient power, can be unreliable and are not economically viable, with extensive payback times. A survey reported uptake of RETs by Australian tourist accommodation in only around 10 percent of hotels and identified reluctance by the industry to adopt RETs.

5.2 Performance potential of renewable energy technologies

The HOTRES project used pre-diagnostic assessments to examine the economics of 50 different renewable energy installations in 39 hotels participating in the project. The economics were assessed using actual costs data, along with specific data applicable to each hotel on subsidies, tax relief and other incentives, and detailed audits of hotel energy use. The pre-diagnostic assessments were carried out with standard software tools for assessment of renewable energy installations.

The payback periods calculated for these renewable energy installations are listed in Table 3, while Table 4 provides selected data on energy costs and available subsidies for renewable energy installation by hotels in the five regions covered by the project.

Table 3: Payback periods (years) calculated for sample of 50 pre-diagnostic assessments of options for renewable energy installations (Source: HOTRES project)

	Biomass	Geothermal	Solar photovoltaics (PV)	Solar thermal (SHW)	Solar cooling
Greece					
Min	4.3	3.9	39	1.7	8
Max	4.3	4.7	43	5.1	8
Average	4.3	4.4	41	3.3	8*
No. of hotels assessed	1	4	2	6	1
Andalusia					
Min			6.5	3.4	
Max			9	7.7	
Average			7.7	4.7	
No. of hotels assessed			5	4	
Sicily					
Min			38	3.5	
Max			38	5	
Average			38	4.1	
No. of hotels assessed			5	5	
Madeira					
Min				7	
Max				9	
Average				8	
No. of hotels assessed				10	
France					
Min				10	
Max				19	
Average				14.4	
No. of hotels assessed				7	
TOTAL					
Min	4.3	3.9	6.5	1.7	8
Max	4.3	4.7	43	19	8
Average	4.3	4.4	25.9	7.5	8*
Number of hotels assessed	1	4	12	32	1

* Note: This value is reported to be low for solar cooling installations.

Table 4: Economic parameters influencing RES penetration in the hotel sector

Location	Cost of equipment, including installation. (Taxes free)	Fuel displaced: Type	Fuel displaced: Cost (taxes free) EUR/kWh PCI	Cost of electricity (displaced in cases of cooling, geoth, PV) (taxes free) EUR/kWh	Rate of subsidization for RES in hotels
Greece	Solar thermal 320 EUR/m2 PV grid connection 6.5 EUR/Wp Solar cooling 7337 EUR/RT Geothermal 645 EUR/kW	Diesel	0.065	0.065	Solar thermal 40% PV 45% Solar cooling 50%
Andalucia	Solar thermal 440–620 EUR/m2 PV grid connection 6–8 EUR/Wp	Natural gas Diesel oil LPG	0.026 0.029–0.033 0.042-0.049	0.066–0.096	Solar thermal 30–45% PV 50–60% Plus feed-in tariffs paid for surplus electricity generated with PV panels: 0.22 EUR/kWh (PV Installations > 5 kW) 0.40 EUR/kWh (PV Installations <5 kW)
Sicily	Solar thermal 500 EUR/m2 PV grid connected: 6.5 EUR/Wp	Natural gas	0.054	0.12	40%
		Diesel oil	0.070		40–50%
Madeira	Solar thermal 500 EUR/m2	Propane	0.06	0.104	35–40%
France	Solar thermal 650–800 EUR/m2	Gas Fuel oil	0.04 0.037	0.11	40–50%

The data show that the main technologies of interest for hotels are solar thermal, followed by photovoltaic installations. There is large variation in payback periods for these technologies, range from 6.5 – 43 years for photovoltaics and 1.7 – 19 years for solar thermal systems. This large variation is explained by significant differences in fuel prices (where these are low, there is less benefit from investing in RETs), in the costs of the RETs (for example, solar thermal systems are relatively much more expensive in France compared to Greece), and in incentives (for example, there is a very good feed-in tariff provided in Andalucia for electricity from PV systems). This is why the HES toolkit will not provide payback periods values but will include a Return on Investment calculator.

Other studies have shown similar payback periods for RETs. A feasibility analysis of renewable energy supply options for a grid-connected large hotel in Australia has also investigated the economics of renewable energy installation, using the same simulation software approach as the HOTRES project. In this case, the simulation software used was adapted for Australian conditions, and modeling was performed using hourly load data input from a hotel located in a subtropical coastal area of Queensland. Using the simulation model it was found that, at 2004 prices, the economic costs of a grid/RET hybrid configuration with the RET system providing 73 percent of the hotel's energy needs, was comparable with that of the grid-only supply. This installation had a payback period of 14 years, and gave a 65 percent reduction in greenhouse gas emissions. The modelling also showed that whilst a RET-only configuration could potentially supply all the hotel's energy needs, this was uneconomic with current electricity costs from the grid, although this balance will change if there are relative rises in the price of electricity. The results also indicated that in the Queensland situation, wind energy systems, rather than photovoltaics, were the most economically viable RET for large-scale grid-connected operations.

Other studies have found payback periods of 4.3 years, 5.7 years (for a wind energy / hydro scheme on a Greek island), 5 years (for a wind energy scheme in the US). The is also a tendency for larger systems to have shorter payback periods than small-scale systems, which are more often reported at between 7 – 30 years, and where subsidies and feed-in tariffs have a significant impact on economic performance.

5.3 Barriers and drivers affecting renewable energy investment by hotels

A report to SOLARGE in 2006 on "Barriers to technology diffusion: The case of solar thermal technologies" commissioned from the International Energy Agency (IEA), identified that there is wide discrepancy between market maturities in countries that enjoy essentially similar economic and climatic conditions, which is reflected by widely different per capita contribution from solar thermal: Italy and France, for example, lag behind Austria, Germany and Spain, and Austria has 30 times more solar heat collectors per head than Italy. This results from variation in the barriers to and support for investment in solar thermal technologies between different countries. Among the factors involved are differences in national government policies and incentive measures to support solar thermal technologies, in equipment costs and energy prices, and in (lack of) awareness of solar thermal technology and its potential.

Table 5 summarizes key factors that have a positive or negative effect on the interest of hotels to invest in renewable energy technologies. Amongst the most important factors that encourage investment by hotels in renewable energy systems are technical support, availability of simple and efficient renewable energy technologies, incentives and well-functioning practical examples of renewable energy technologies in similar hotels. Hotels are put off installing renewable energy technologies where there have been past poor experience with renewable energy technology installations, if local authorities have slow and bureaucratic procedures, or if there are problems associated with installing renewable energy technologies because of the age and/or historic features of a building.

Table 5: Factors affecting hotels' interest in renewable energy technologies investments

	Positive	Negative
Greece	Many hoteliers are willing to invest in renovation projects and welcome the idea of introducing renewable energy technology Renewable energy technology confers status and is a strong marketing point Pressure for ecological labeling of hotel units	The majority of the hotel units are SME, family centered enterprises, and have no awareness on energy issues Lack of full-time engineers to plan, install and maintain renewable energy technology at the highest level of operation. Lack of subsidy programmes and Local Authority support
France	Numerous projects are in progress and 38% of hotels are either installing renewable energy technology or have already done pre-diagnostic studies on renewable energy technology installation. Ease of obtaining loans and subsidies for renewable energy technology installation.	Hotel managers in the coastal areas have little interest in renewable energy technology; 23% of hotels have no awareness of renewable energy technology. Concern about reliability due to old examples of poorly-functioning renewable energy technologies (badly designed and/or poorly maintained)
Spain	Great interest in using solar energy systems in hotel establishments. Benefits for renewable energy technologies for saving in fuel consumption, etc., widely recognized Subsidies available for the installation of solar thermal systems for hot water, and photovoltaics (both for stand-alone installations and for those connected to the grid) Relevance to key tourism markets from the more environmentally-awareness countries central and northern Europe which dominate tourism in Andalusia Benefits for rural-type lodgings located in natural spaces away from conventional energy sources Availability of subsidies for installation of solar thermal and PV systems Improvements in feed-in contracts and tariffs to the national grid, enabling hotels to sell surplus electricity generated by renewable energy technologies.	High level of initial investment needed for renewable energy technology installation Procedures for applying for subsidies are slow and involve too many administrative steps Many of the hotel establishments are part of national or international hotel chains, and decisions to invest in renewable energy technology are taken by the head office and not by the individual hotels Problems of installing renewable energy technology on older buildings (particularly in urban areas and on historical buildings) and concerns about adverse visual impact Concern about reliability due to old examples of poorly-functioning renewable energy technologies (badly designed and/or poorly maintained)

Portugal	Increasing awareness of renewable energy technologies and how to plan, install and operate them effectively Benefits for renewable energy technologies for saving in fuel consumption, etc., and as part of environmental management schemes, are well recognized	Concern about reliability due to old examples of poorly-functioning renewable energy technologies (badly designed and/or poorly maintained) Uncertainty amongst investors about the international situation of the tourism market. Reluctance of investors to try new renewable energy technologies Lack of suppliers and technical knowledge for renewable energy technologies. High level of initial investment needed for renewable energy technology installation (further increased on Madeira, by the costs of transportation to the island).
Sicily	Availability of subsidies at regional and national level for installation of solar thermal and PV systems Recognition of good results from installation of solar thermal systems, with very effective cost-benefit returns (relative pay-back time of less than 8 years, without any public support, while the average life of the solar thermal systems is at least 15 years). Enhancement of the 'green' image and social awareness image of the enterprises to the general public and possibility to increase their market value. Promotion of benefits for renewable energy technologies for saving in fuel consumption, etc., and as part of environmental management schemes Availability of subsidies for installation of solar thermal systems for hot sanitary water and photovoltaics, both stand-alone systems as well as connected to the grid (regional subsidies from Structural Funds (Objective 1 Region) and national level 10.000 PV Roofs Programme, Solar Thermal Programme—Ministry of Environment) Relevance to key tourism markets from the more environmentally-awareness countries central and northern Europe which dominate tourism in Andalusia	High level of initial investment needed for renewable energy technology installation Many of the hotel establishments are part of national or international hotel chains, and decisions to invest in renewable energy technology are taken by the head office and not by the individual hotels Problems of installing renewable energy technology on older buildings (particularly in urban areas and on historical buildings) and concerns about adverse visual impact Lack of sufficient effective information campaigns on use of renewable energy technologies. Limited awareness of suitable renewable energy technologies and their potential for hotels Procedures for applying for subsidies are slow and involve too many administrative steps

Barriers:

The HOTRES project found that there was only very limited use of renewable energy technologies in the hotel sector. Data collected from interviews with hotel managers, indicated that a shortage of investment funds, including difficulties in obtaining loans, combined with concerns about the feasibility and viability of renewable energy installations, and the quality of renewable energy products, were significant barriers to hotel investments in renewable energy. However, the most crucial factor was found to be a lack of information and follow-up on systems that would be suitable for a hotel and on how these could be integrated into the hotel buildings and management.

The SOLARGE project reported similar barriers, and in addition identified that a further barrier can be planning restrictions that make it difficult to get permission to install solar panels and other technologies on the outside of buildings. The barriers reported by the SOLARGE project fall into three main groups:

Technical barriers – although solar thermal technologies are now well developed, problems experienced with the performance of installations in the past have affected the confidence of some users about the effectiveness of the technology. This perception is being changed by outreach and training programmes, and by the good performance of the current generation of solar technologies and equipment.

Economic barriers – it can be difficult for hotels to obtain financing for installation of solar thermal equipment, and the relative attractiveness of solar thermal technologies is influenced by the availability of subsidies and other incentive measures, and by local prices for non-renewable energies (which solar thermal systems would displace). Solar thermal systems are economically most attractive where the prices for non-renewable energies are high, and economic incentives are available to offset investment costs. The project also suggested that the benefits of low operating costs, low maintenance requirements, and long life-times of solar thermal installations often go unrecognised by hotel managers.

Other barriers including legal, cultural or behavioural barriers – local or national regulations for ground- or roof-mounted installations, which may often require planning approval and permits present a significant legal barrier to installation of solar thermal systems in some EU member states (although there is large variation in such regulations between different member states, and sometimes between regions within each member state). The need to obtain planning approval and permits can complicate and lengthen the process for installation of a solar thermal system, and can also increase the overall cost. Cultural and behavioural barriers affecting use of solar thermal systems can include lack of awareness of the current status of the technology and its possibilities, concerns of managers regarding systems with which they are unfamiliar and erroneous perceptions that the solar thermal systems may not deliver required comfort levels for hotel guests in relation to space and/or water heating.

In relation to other systems the technologies, such as solar PV systems, are not yet at an efficiency/cost point that makes them attractive for wide application. In the past, these systems have either been used for small-scale, specialist applications, or on subsidised demonstration projects. However, this is changing rapidly as the technologies are improving fast, and costs of installations are coming down as the demand for these systems grows. Some other systems that are highly suitable for use in hotels, such as biomass and geothermal heat pumps, suffer from a lack of promotion or knowledge about their availability amongst technical advisers and installers, as well as hotels.

Solutions:

The HOTRES and SOLARGE projects also considered solutions to support more widespread application of renewable energy technologies in hotels, and proposed the following measures:

Outreach and training to raise awareness of the benefits and availability of renewable energy technologies for hotels, including better provision of information on suitable renewable energy systems, cases studies of applications of renewable energy systems in hotels, and demonstration projects and/or visits to hotels that operate renewable energy systems. The HES project to improved outreach and awareness of these technologies.

Provision of better support, helping hotel decision makers to select suitable renewable energy systems for their hotels for example by performing 'quick audits' and basic design of renewable energy systems that could be installed in their hotels, and/or providing simple decision-making tools (including economic assessments); by improving the training of sales and installation staff regarding renewable energy systems, and by organizing business meetings between the technology suppliers and hoteliers.

Encouraging local market development by using market strategies that involve local engineers and technicians in developing the use and application of renewable energy technologies in hotels **Provision of independent, third party information** (eg. from local/national energy agencies) on suitable RETs, to overcome confusion and lack of trust that is evident in the marketplace for RETs.

Assure effective operation of renewable energy systems suitable for use by hotels, for example, through certification, performance guarantees, and/or energy service contracts (that ensure the financial burden of any poor performance will not fall on the hotel). One example of this example is the work of the European Solar Thermal Industry Federation with the European Committee for Standardisation (CEN) to create the Solar Keymark, as a quality label for Solar Thermal products.

Improving access to financing, subsidies and fiscal incentives (including tax offsets) for use of renewable energy and energy efficiency measures. Most EU members states offer some form of incentives in these areas, but the schemes available are not always easy for hotels to access, and/or may be limited regarding the eligible renewable energy and energy efficiency measures. Some energy service companies may offer third-party financing, and some EU member states have policies that require energy utilities to increase the share of renewables in their energy mix, including by supporting their customers to install renewable energy systems and to increase their energy efficiency. The utilities receive energy saving certificates or "white certificates" for the savings made, and are able to use these to demonstrate their compliance with the relevant national requirements.

Improving 'feed-in' tariffs for surplus energy generated by renewable energy installations on individual buildings, and ensuring these can easily obtain links to the electricity grid. Reducing costs of renewable energy systems and their installation

Revising or introducing regulations and legislation to make it simpler to install renewable energy technologies and energy efficiency measures by removing legal barriers, including by simplifying permitting requirements, and where necessary, modifying building codes (see Box 1). This can be particularly important for systems that need to be installed on the outside of buildings, such as solar thermal or solar photovoltaic (PV) systems. Setting national targets for renewable energy use and for energy savings is also helpful, particularly if accompanied by specific obligations on energy companies to support energy users to install renewable energy systems and to increase their energy efficiency.

Box 1: Municipal ordinances for use of renewable energy in Spanish regions

In 2000 the municipality of Barcelona adopted an ordinance requiring all new buildings or buildings undergoing heavy renovation to install solar collector systems capable of covering at least 60 percent of their domestic hot water needs (with a minimum capacity of 1,860 liters of domestic hot water per day). Within four years, the area of solar collectors had jumped from 1,650 m2 to 20,000 m2. Following this example, twenty municipalities in Catalonia soon adopted similar ordinances, and in 2002, Seville and Pamplona, in 2003 Madrid, followed suit. These experiences were instrumental in the Spanish government's decision in March 2006 to issue the first European law on solar thermal installations, under which new and heavily renovated buildings are required to cover between 30 to 70 percent of their domestic hot water demand with solar thermal energy. This "technical building code" approved by a Royal Decree sets minimum standards, but also allows more stringent requirements to be set in existing or future solar ordinances from municipalities or other sub-national authorities.

5.4 Conclusions

Experience with renewable energy policies around the world is still emerging and more understanding is needed of the impacts of various policies, according to entry on renewable energy policies and barriers in the 2004 Encyclopedia of Energy, which suggest that many policies could still be considered "experimental". The policies which appear to have contributed the most to renewable energy development so far are reported to be:

(i) direct equipment subsidies and rebates, net metering laws, and technical interconnection

(ii) standards in the case of solar photovoltaic (PV) technology;

(iii) investment tax credits, production tax credits, and European electricity feed-in laws;

(iii) grid-access and other policies supporting independent power producers and third party sales.

This is consistent with the barriers and solutions identified by the SOLARGE and HOTRES projects. As with energy efficiency measures, expanding the uptake of renewable energy technologies in the hotel sector requires training and awareness raising amongst decision-makers in hotels, coupled with ensuring that they can easily obtain reliable advice, planning and installation services, along with suitable financing, and a streamline of the permitting process where a renewable energy installation requires prior planning permission. There are already examples of hotels that have made significant investment in renewable energy technologies despite these barriers.

6. Needs analysis on improving use of energy efficiency and renewable energy technologies in hotels

The analysis of use of energy efficiency and renewable energy measures in hotels indicated that both are limited by low awareness of the technologies and their benefits in hotels, low management capacity and commitment, lack of staff resources, and concerns about financing and performance. These limitations were confirmed in discussions with the members of the Hotel Energy Solutions End-User Advisory Group. It is also evident that these limitations can and are being overcome. For example, the Scandic hotel group implemented basis training and support packages through which their hotels achieved a 15 percent reduction in energy use intensity over a 7 year period, mainly by improvements in management behaviours and staff actions.

It is clear that all hotels, and particularly small- and medium- size hotels, need practical support on this, and to be convinced that there are benefits from EE and RE technologies. Interestingly, EUAG members indicated that during the financial crisis hotels that had made energy investments were less set back financially than those that had not.

A key need is for hotels to be able to access simple information on energy efficiency and renewable energy options, and on their practical business benefits, particularly in terms of cost savings and also improved sales. The EUAG suggested that it would be helpful to provide lists of suitable technologies for each of the different operating areas of the hotel (eg. hallways, restaurants, bedrooms, etc.), so that hotel managers can see which technologies can be integrated into renovation of specific hotel areas

In addition, the EUAG highlighted that ‘leading by example’ is a big factor in hotel investment, and that demonstration projects and visits to existing installations help to promote the technologies amongst the hotel sector. Case studies of successful installations, covering financial as well as technical aspects, are also extremely useful for hotels, and will be included in the HES toolkit.

Financial factors are a critical factor for use of energy efficiency and renewable energy technologies. It is reported that over 90 percent of hotels have difficulty obtaining financing for any types of investments. In addition, small- and medium- size hotels often have poor credit ratings that make loans more costly than for large hotels or chain hotels. As a result, most hotels need easier access to finance at viable interest rates in order to implement energy efficiency and renewable energy technology investments. One possibility is development of innovative financial packages to overcome barriers for investment in energy efficiency and renewable energy by hotels. These packages can include low interest loans and/or performance guarantees. Examples are:

- Philips, which shares the risk of the loan with financial institutions to lower interest rates for hotels, and also offers rental programmes that enable hotels to pay for energy efficiency and renewable energy technologies through rental fees.

- Opportunities for energy supply companies (ESCOs) to play a role in supporting investment in energy efficiency and renewable energy technologies by improving access to finance.

- Relais et Chateaux have a partnership with Primagaz in France to undertake free energy audits and provide advisory services and support on energy efficiency and renewable energy technology investments.

- National and local subsidies are also important, particularly if the application process is simple and easily accessible.

Personal contact with credible technical advisers is particularly important in engaging hotels to invest in energy efficiency and renewable energy technologies. For example, Philips and Rexel which supply energy efficiency technologies both use short audit visits with a simple methodology to show hotels a range of potential options: if a hotel then wishes to proceed, a more detailed survey is conducted by an engineer to check the benefits and plan implementation in detail.

Based on these needs and lessons, the HES toolkit should help hotels by including:

- a mechanism to raise awareness for hotels of the benefits of energy efficiency and renewable energy investments.

- clear definition of the various methods for tracking energy consumption (e.g. kWh per guest-night and energy cost – preferred management measures linked to hotel competitiveness and profitability; kWh per square metre per year – technical measure linked to comparison with energy use across the sector, and planning for energy use improvements).

- strong communications approaches targeted at engaging different groups of staff (from technicians to hospitality specialists to general staff) in energy measures (eg. technical information on energy savings - technical staff; cost and competitiveness improvements – managers; tangible demonstrations of savings and benefits for general staff)

The HES toolkit should also be compatible with existing tools and methodologies used for energy and carbon benchmarking, and for corporate disclosure, and with regard to data collection should provide clear guidance on how to input energy and other data, including how to extract relevant information from hotel invoices and enter it into a spread sheet format. As far as possible, the focus must be on the information that is most easily available in hotels, and to provide a pathway to show hotels how to obtain and enter information into the toolkit.

The overall conclusion is that measures to increase awareness and understanding of the potential and benefits of energy efficiency and renewable energy investments by hotels, need to be integrated with a range of other support measures, including policies and incentives to support investment in these technologies, changes in planning regulations to simplify permitting processes where these apply, and improvements in availability of technical support. There is also scope for the private sector to increase provision of 'turn-key' packages suitable for installation in hotels of all sizes, and which provide combine planning, obtaining necessary permits, financing and performance guarantees, arranged through a single point of contact for hotel managers. Particularly for smaller hotels and guest-houses, this is also a role that municipal authorities and/or energy centres could contribute to, linked to achieving overall improvements in energy use at local and city level.

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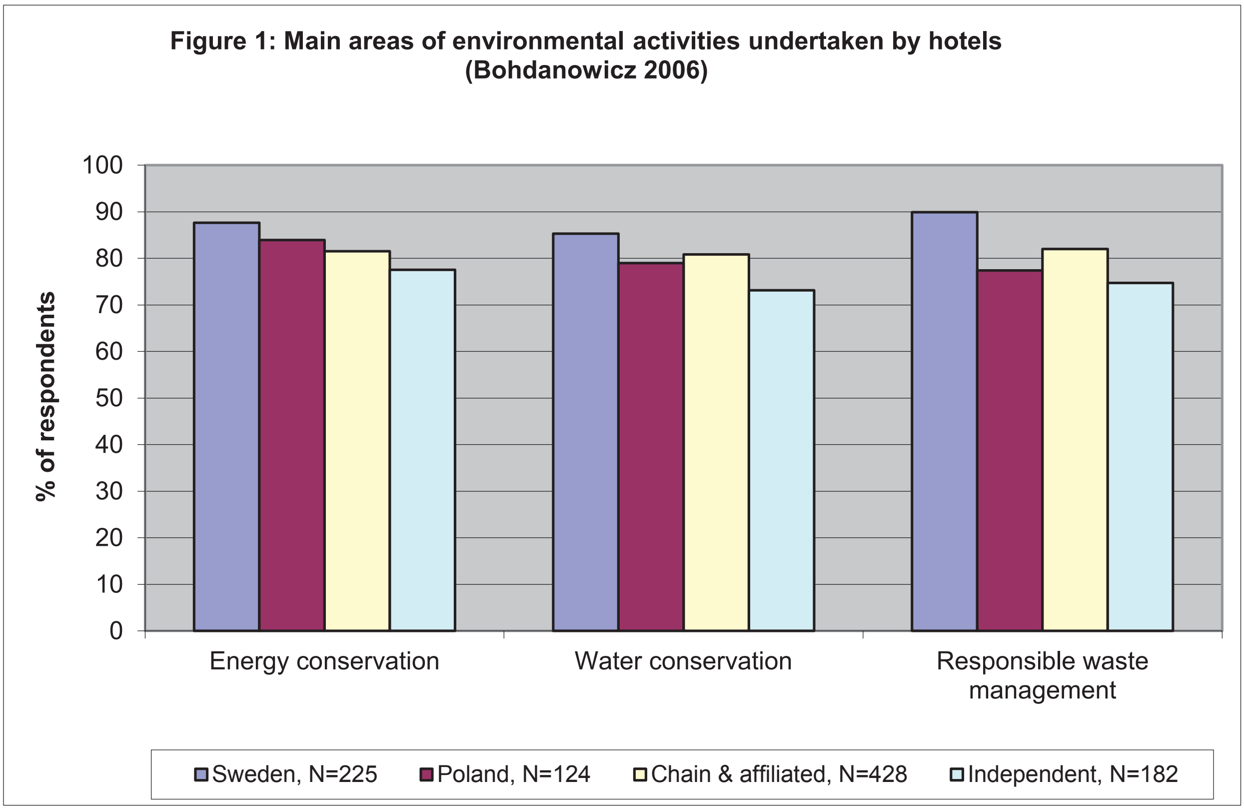
Annex 1: Figures for use of energy efficiency and renewable energy measures in hotels

Energy Efficiency



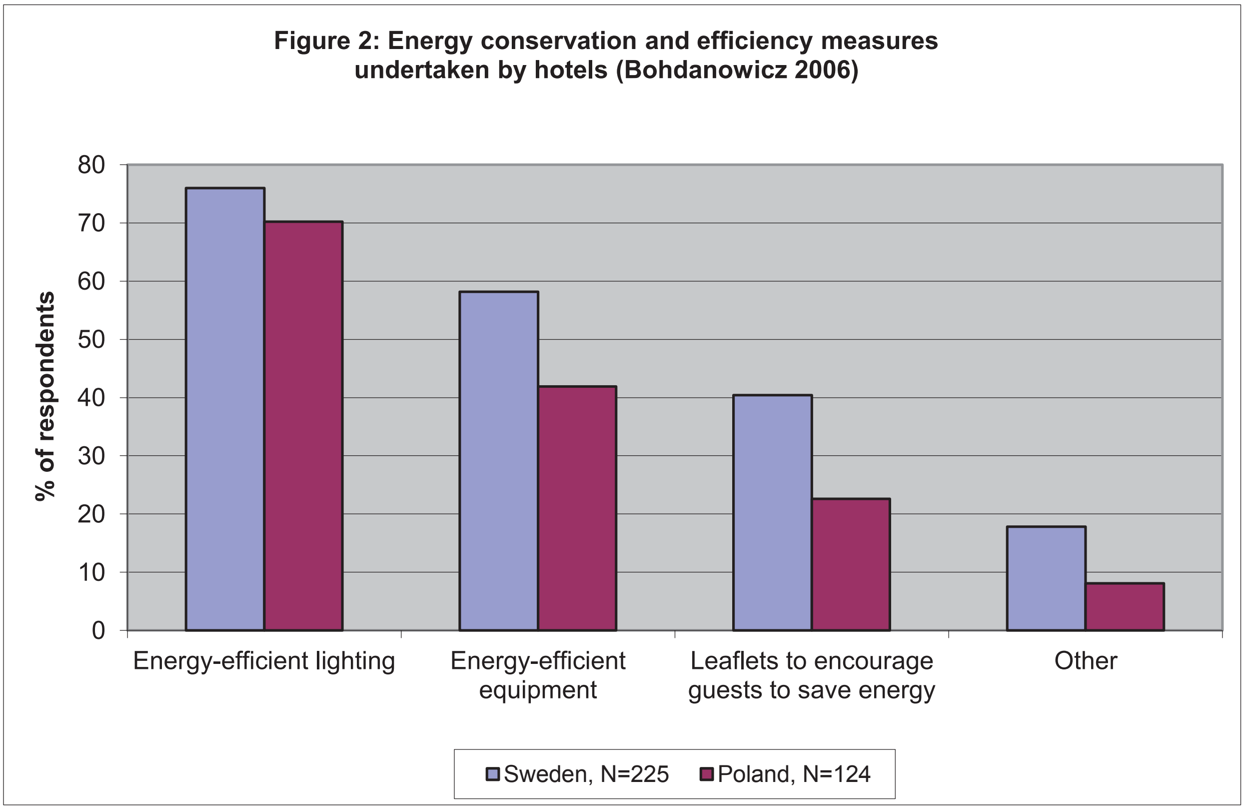


Figure 3: Main areas of environmental activities undertaken by owned and managed, and franchised hotels (Bohdanowicz 2006)

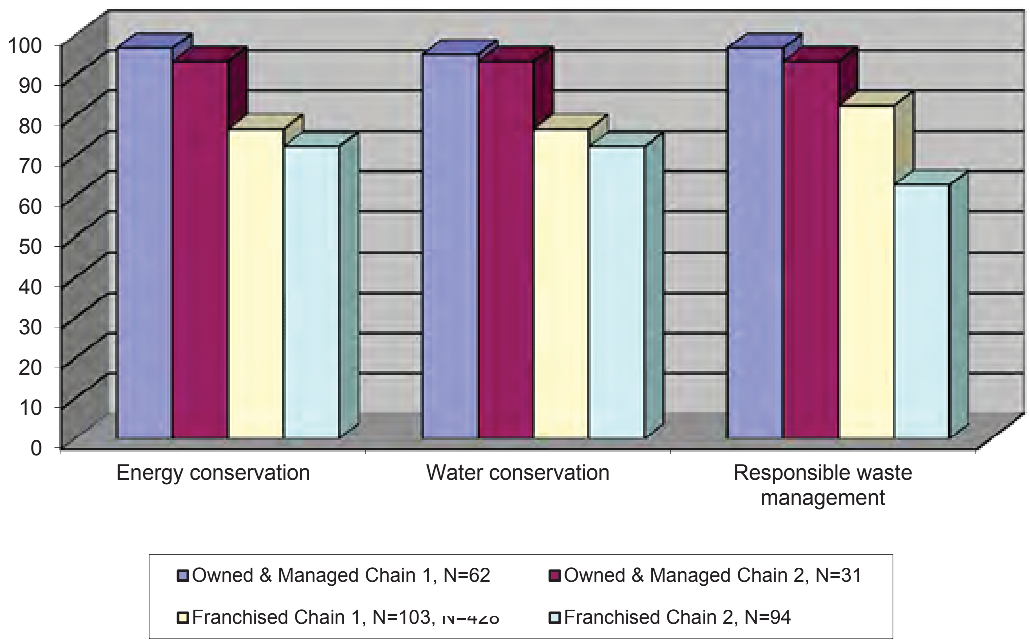


Figure 4: Energy conservation and efficiency measures undertaken by Scandic hotels compared with Swedish hotels (Bohdanowicz 2006)

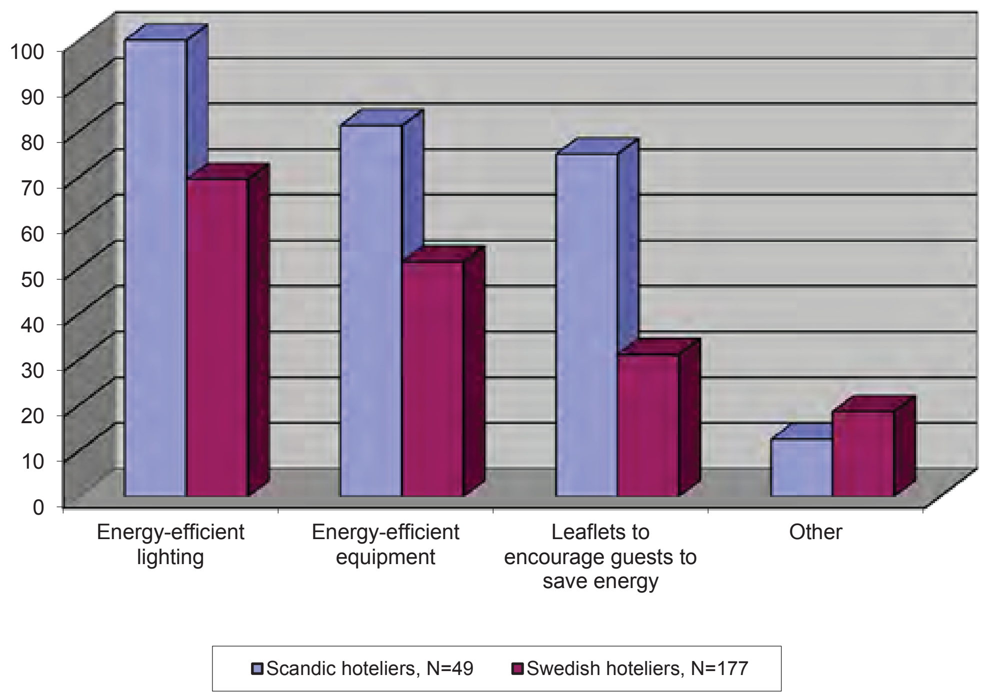


Figure 5: Incentives to introduce more environmentally-friendly initiatives (Averages of 7-point Likert-type scale) (Bohdanowicz 2006)

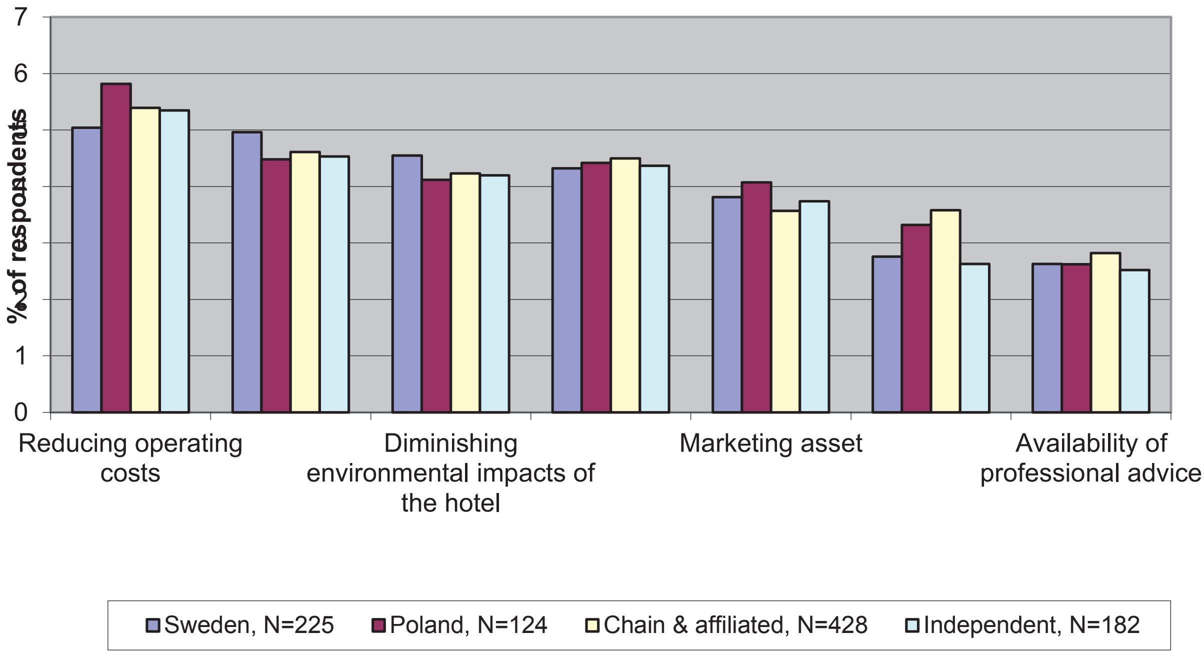
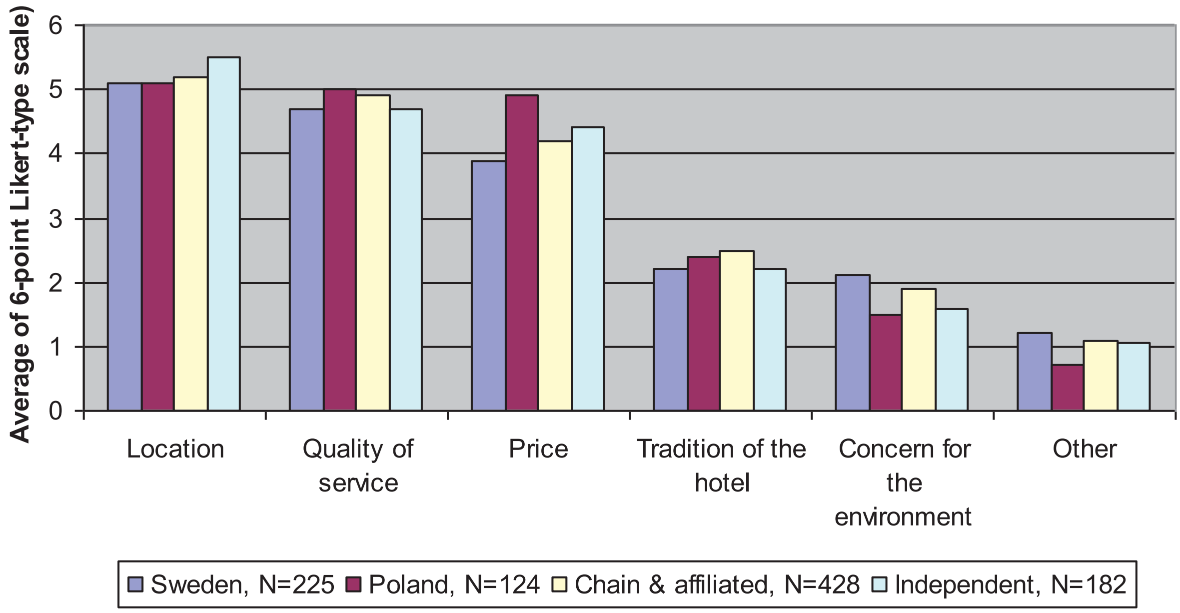


Figure 6: Features advertised and their perceived importance in customer decision making (Averages of 6-point Likert-type scale) (Bohdanowicz 2006)



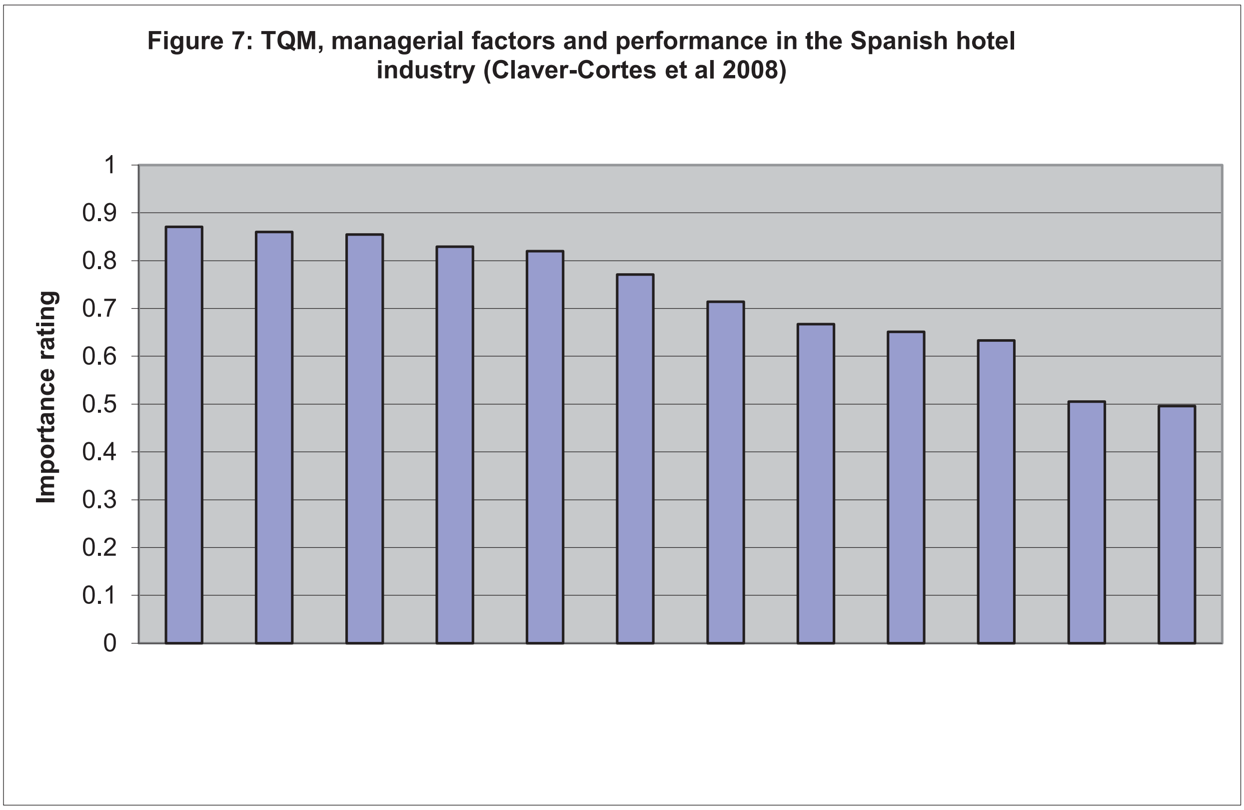


Figure 7: TQM, managerial factors and performance in the Spanish hotel industry (Claver-Cortes et al 2008)
Importance rating
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

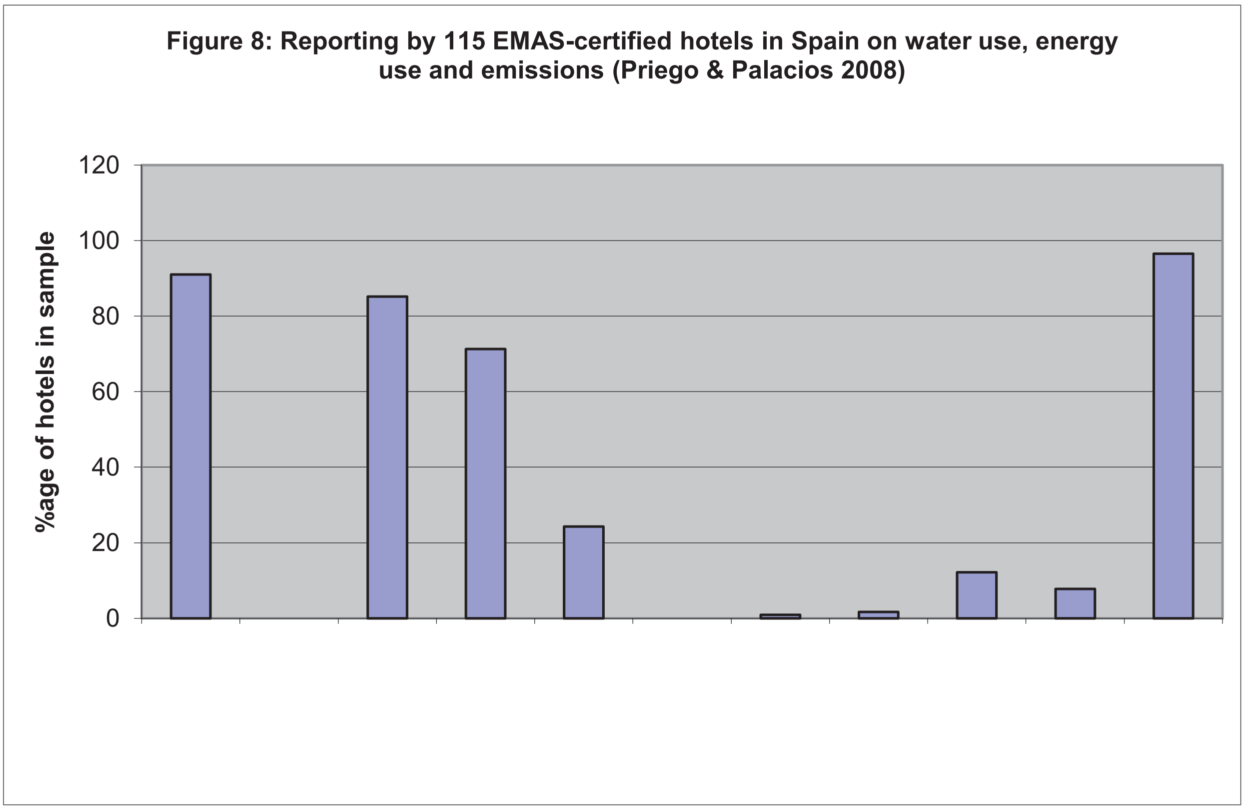


Figure 8: Reporting by 115 EMAS-certified hotels in Spain on water use, energy use and emissions (Priego & Palacios 2008)
%age of hotels in sample
120
100
80
60
40
20
0

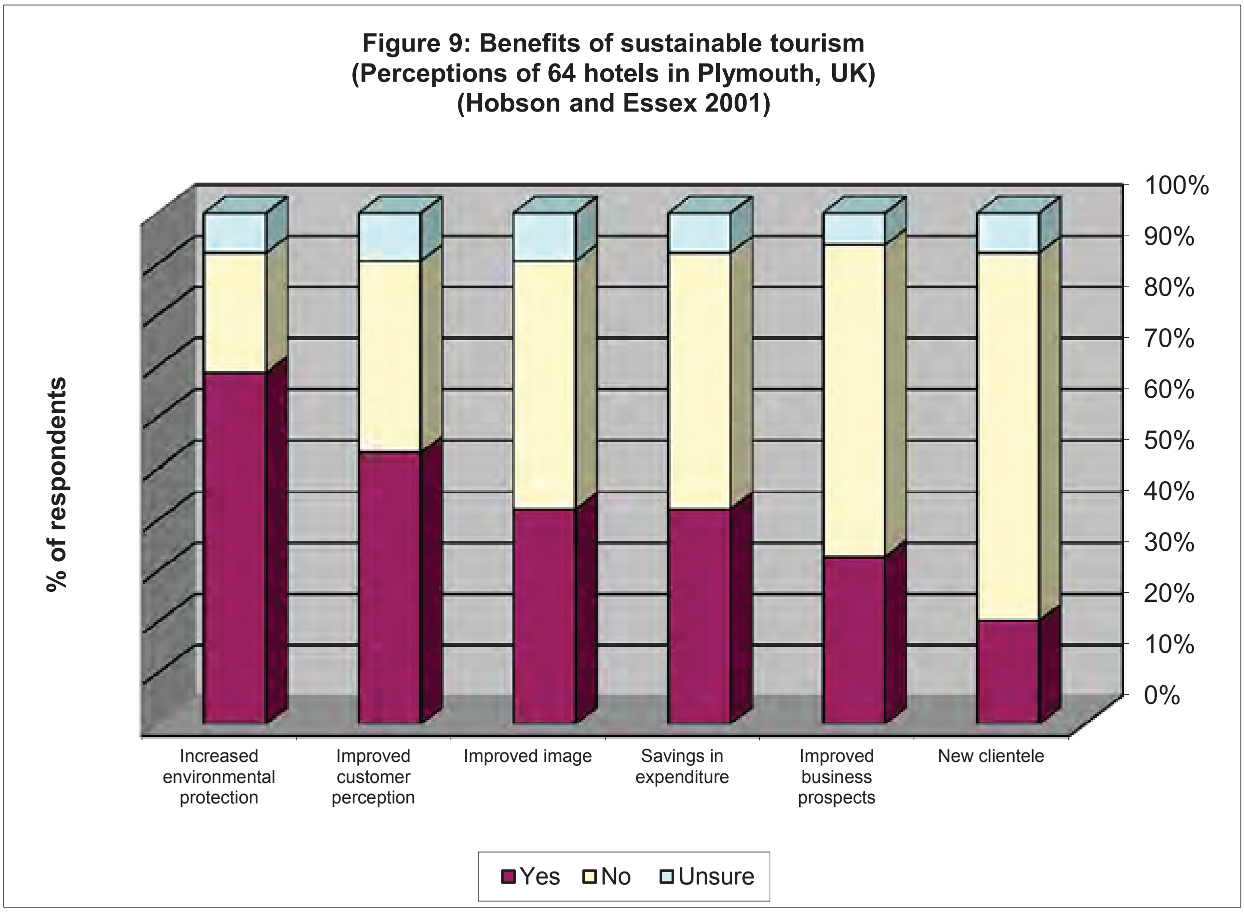


Figure 9: Benefits of sustainable tourism
(Perceptions of 64 hotels in Plymouth, UK)
(Hobson and Essex 2001)
% of respondents
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Increased environmental protection
Improved customer perception
Improved image
Savings in expenditure
Improved business prospects
New clientele
Yes
No
Unsure

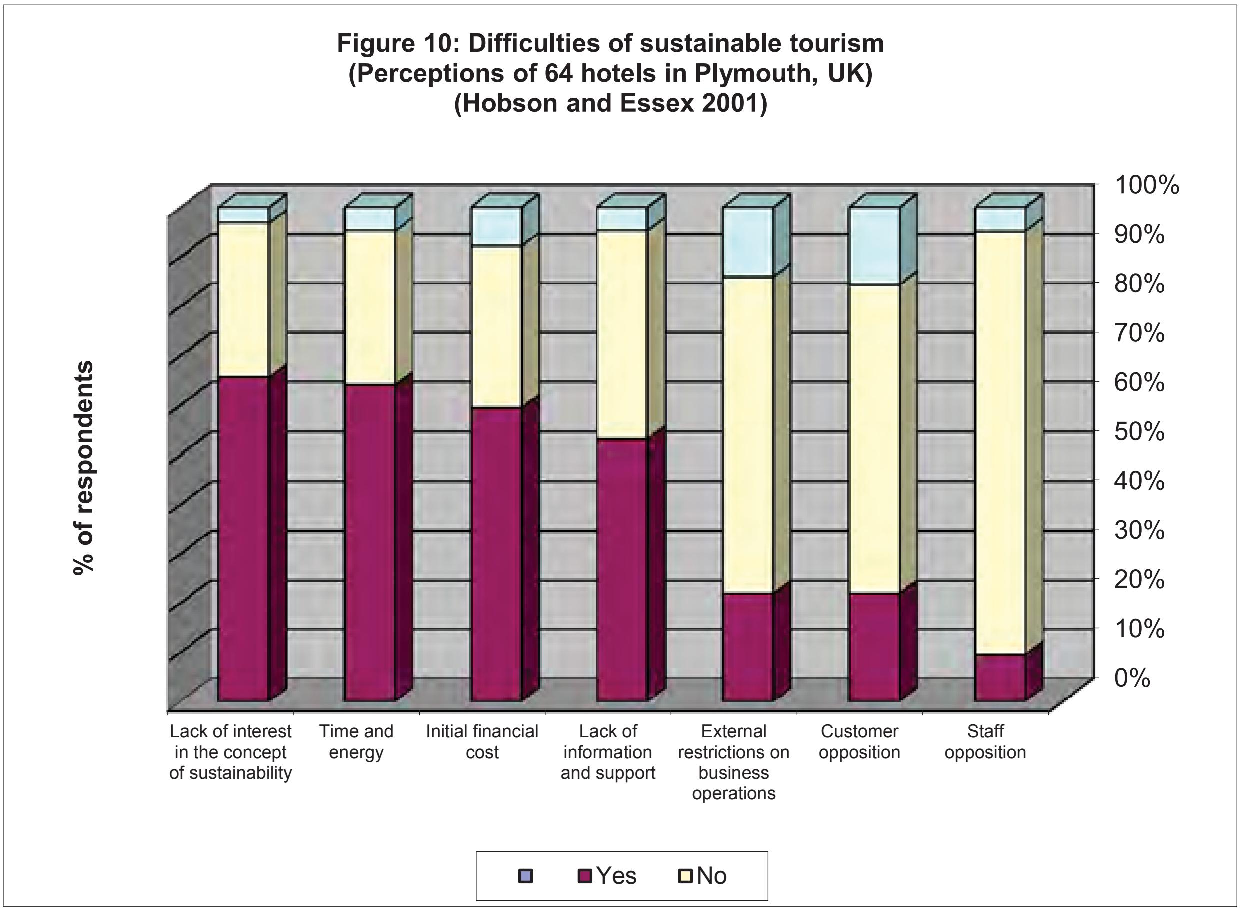


Figure 10: Difficulties of sustainable tourism
(Perceptions of 64 hotels in Plymouth, UK)
(Hobson and Essex 2001)
% of respondents
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Lack of interest in the concept of sustainability
Time and energy
Initial financial cost
Lack of information and support
External restrictions on business operations
Customer opposition
Staff opposition
Yes
No

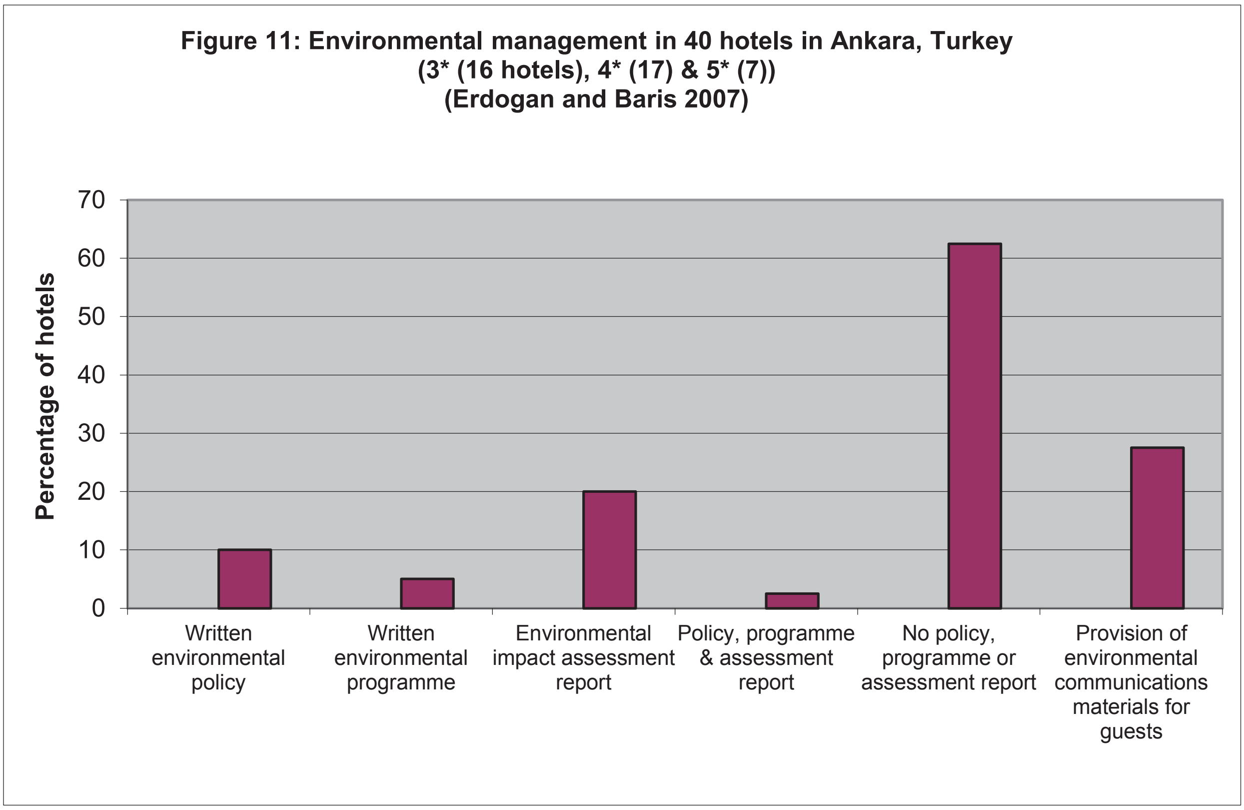


Figure 11: Environmental management in 40 hotels in Ankara, Turkey
(3* (16 hotels), 4* (17) & 5* (7))
(Erdogan and Baris 2007)
Percentage of hotels
70
60
50
40
30
20
10
0
Written environmental policy
Written environmental programme
Environmental impact assessment report
Policy, programme & assessment report
No policy, programme or assessment report
Provision of environmental communications materials for guests

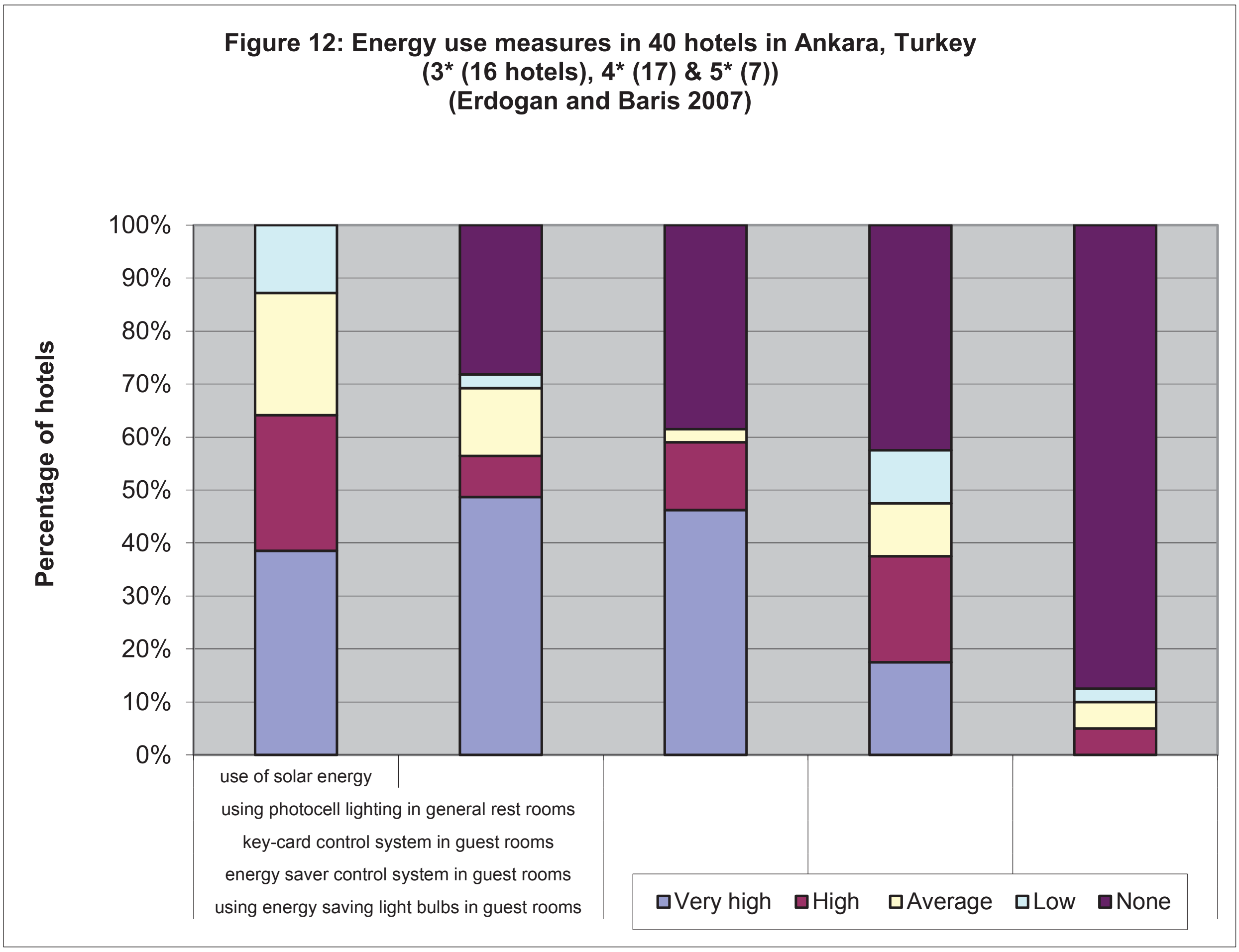


Figure 12: Energy use measures in 40 hotels in Ankara, Turkey
(3* (16 hotels), 4* (17) & 5* (7))
(Erdogan and Baris 2007)
Percentage of hotels
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
use of solar energy
using photocell lighting in general rest rooms
key-card control system in guest rooms
energy saver control system in guest rooms
using energy saving light bulbs in guest rooms
Very high
High
Average
Low
None

Figure 13: Tourists' attitudes towards renewable energy in Australian hotels (Dalton et al 2008)

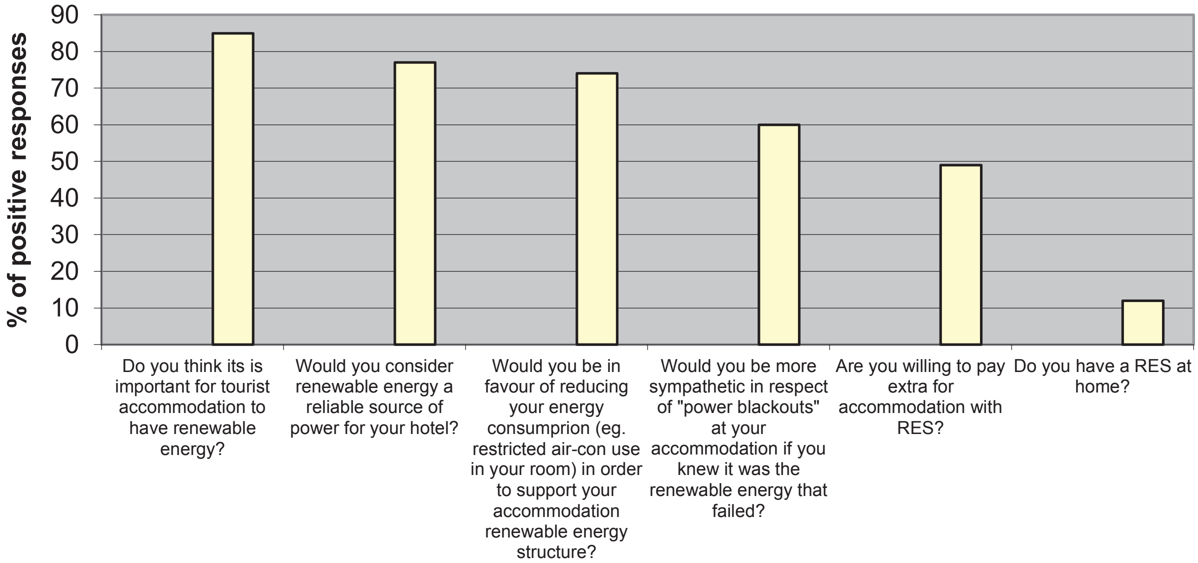


Figure 14: Estimated potential savings from various energy efficiency technologies (Cipiano Marín, INSULA - International Scientific Council for Island Development and UNESCO Centre for the Canary Islands, 2005)

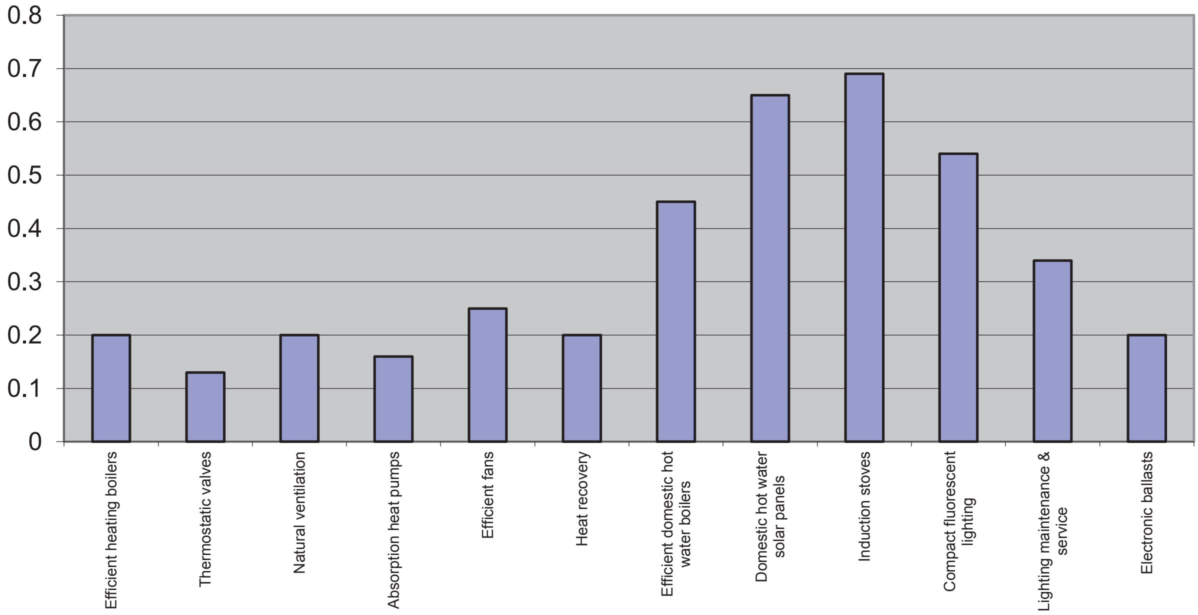


Figure 15: Changes in energy use in Scandic Hotels in Sweden, 1996-2003 (Bohdanowicz 2006)

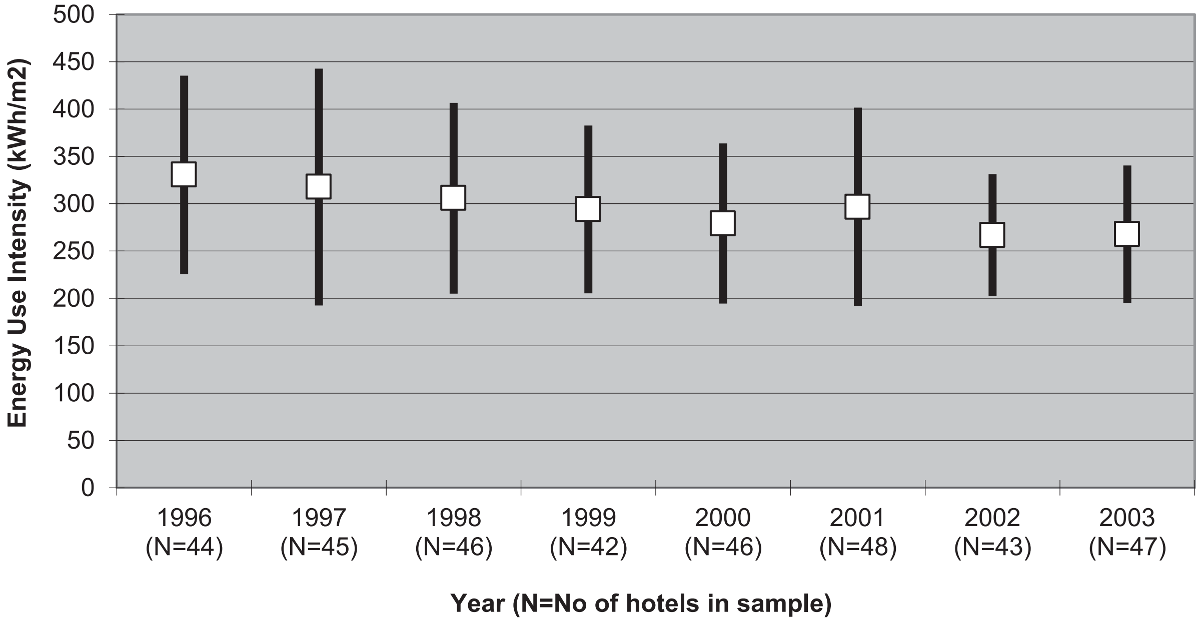
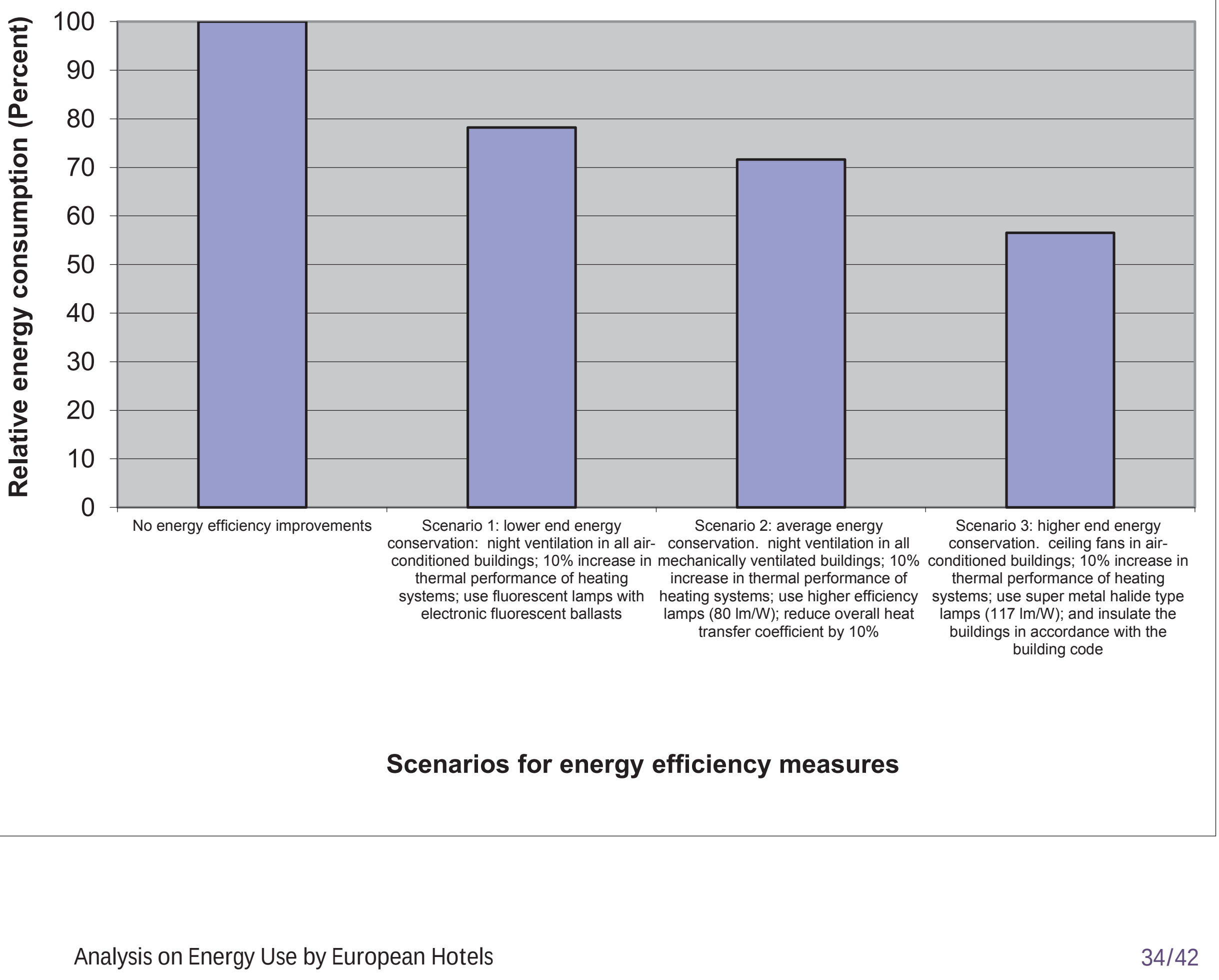


Figure 16: Energy efficiency savings potential estimated for hotels in Greece under low, average and high scenarios for energy efficiency measures (Santamouris et al 1996)



Renewable Energy

Figure 17: Use of RETs in a 32-hotel statistical sample in Greece (Source: HOTRES project)

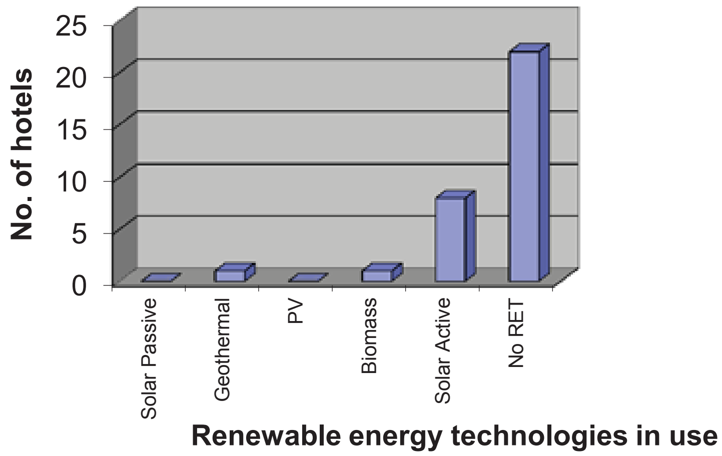


Figure 18: Ranking of importance of RET introduction at a hotel (personnel from 200 hotels in the EU - ranking from 1 (low) to 5 (high)) (Source: HOTRES Project)

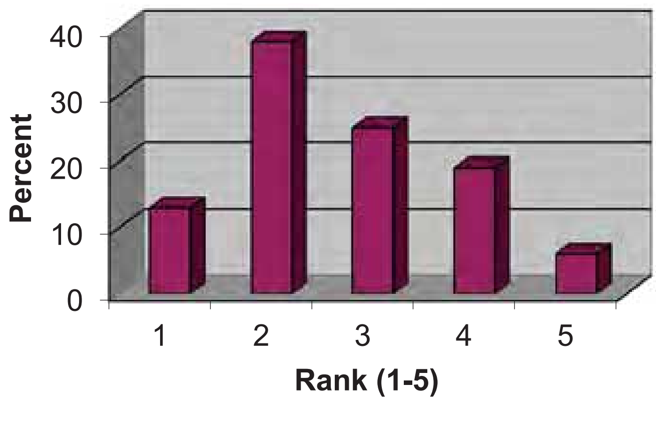


Figure 19: Likelihood of RET being introduced in the hotel in the next 5 years (personnel from 200 hotels in the EU) (Source: HOTRES Project)

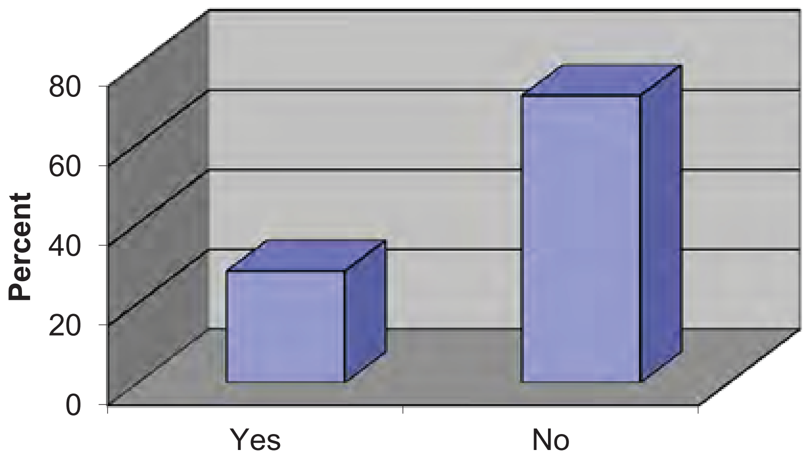


Figure 20: Ranking of level of knowledge about RETs (personnel from 200 hotels in the EU - ranking from 1 (low) to 7 (high)) (Source: HOTRES project)

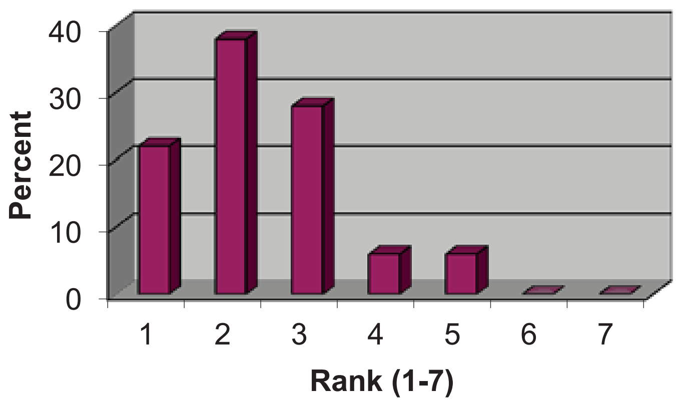
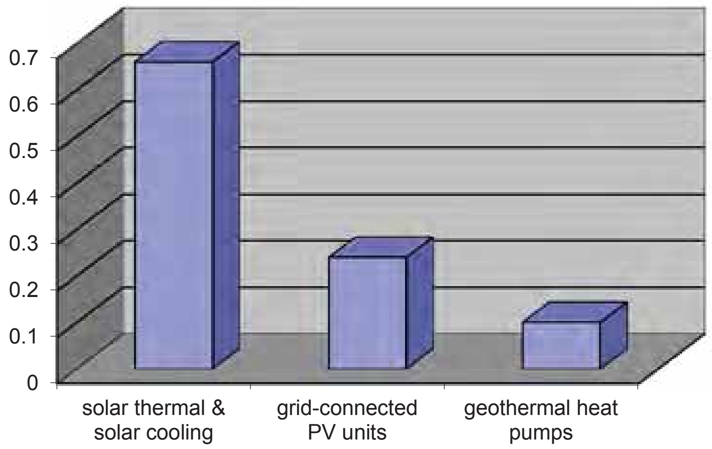
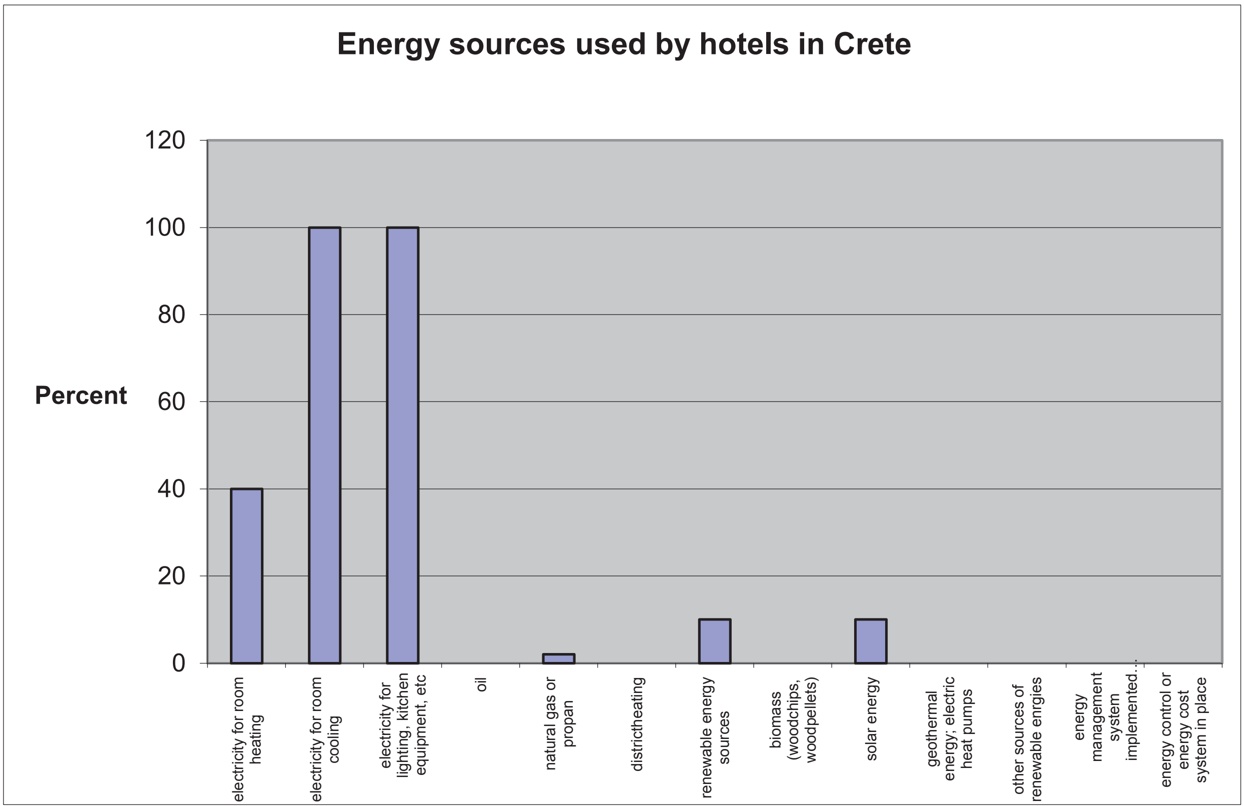
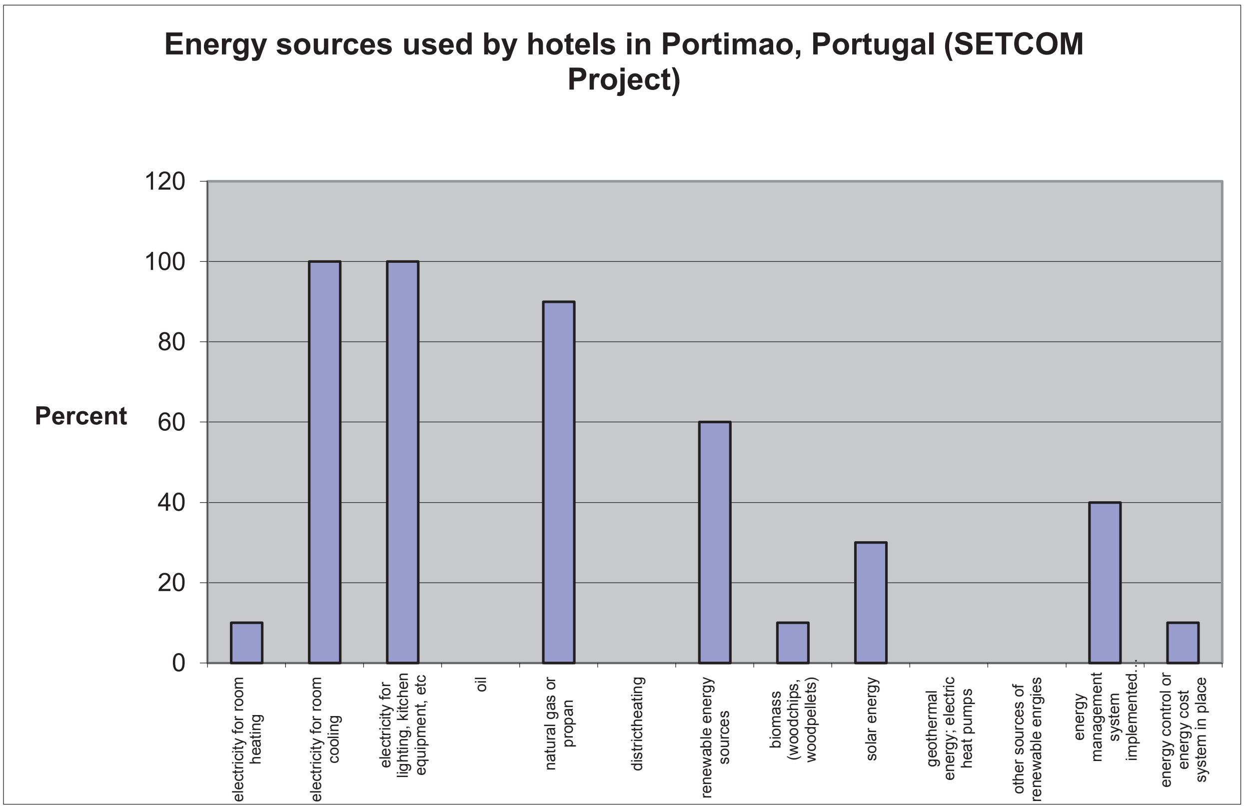


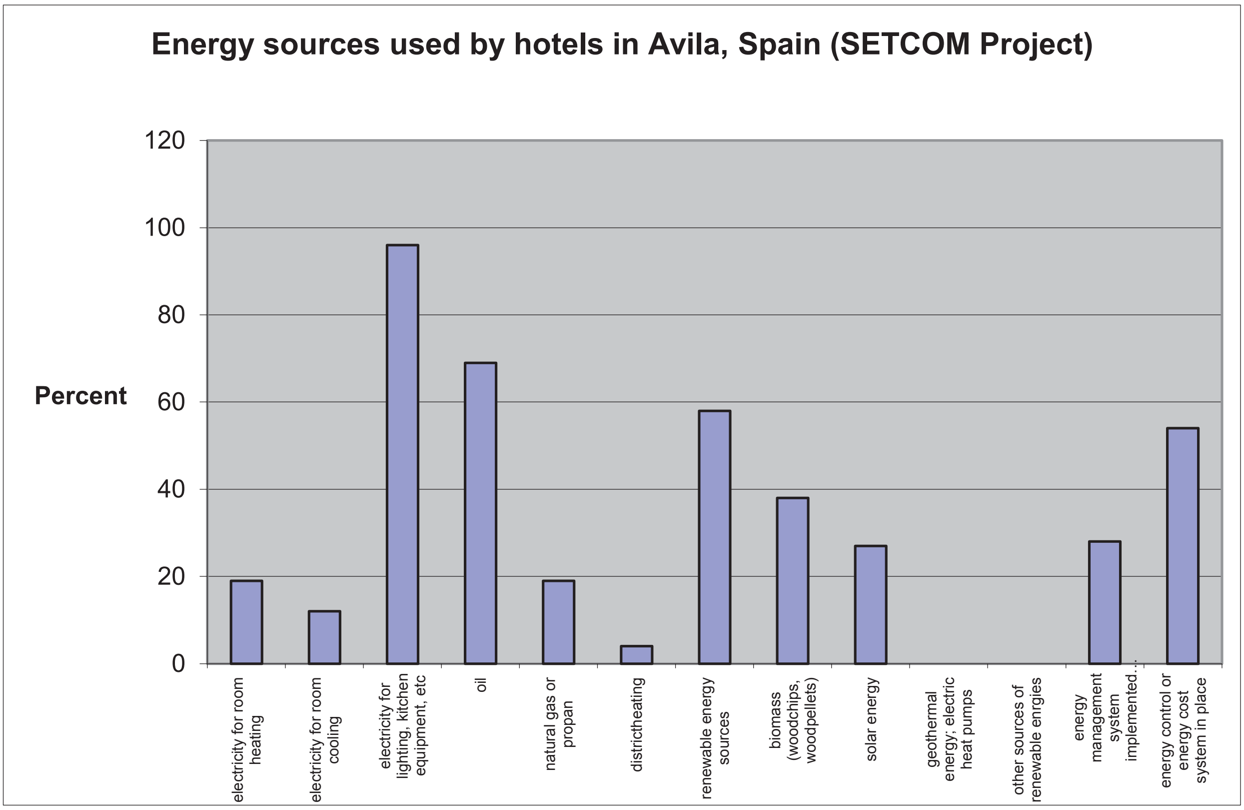
Figure 21: Percentage of hotels expressing interest in various RETs (personnel from 200 hotels in the EU) (Source: HOTRES project)

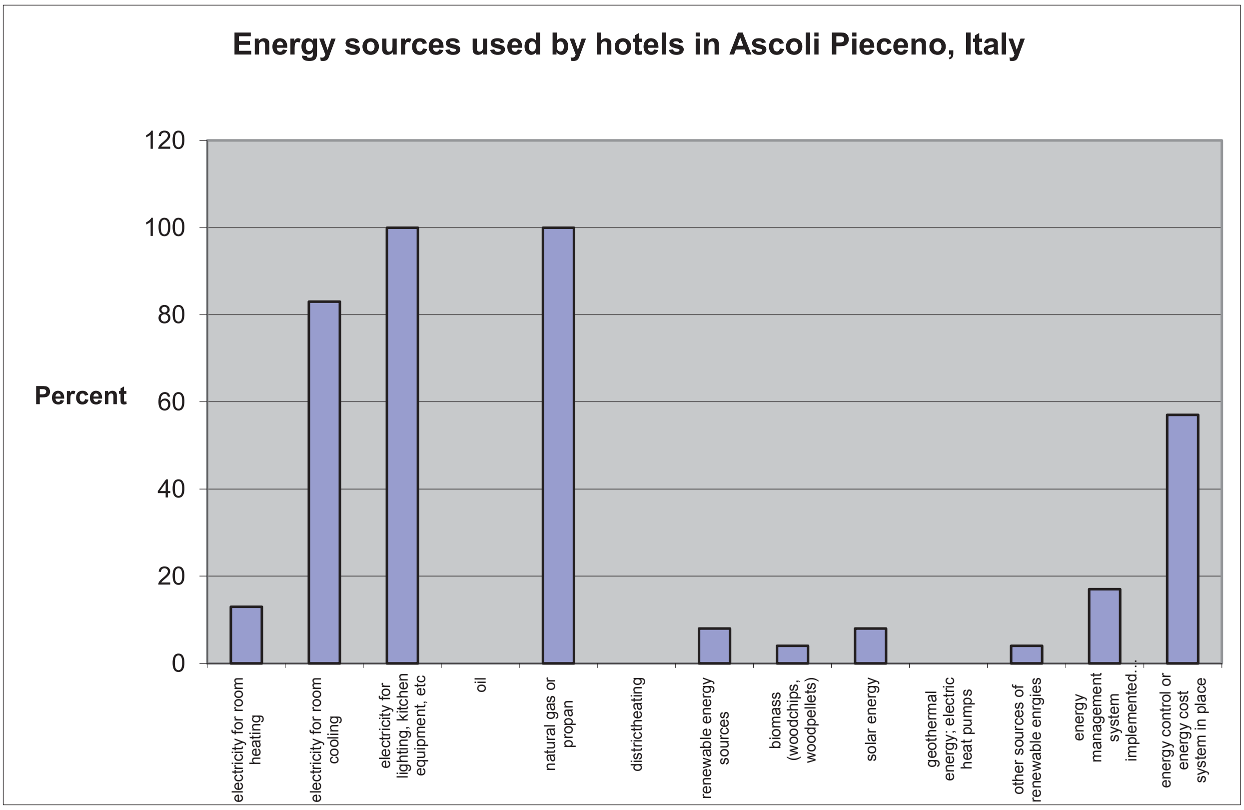


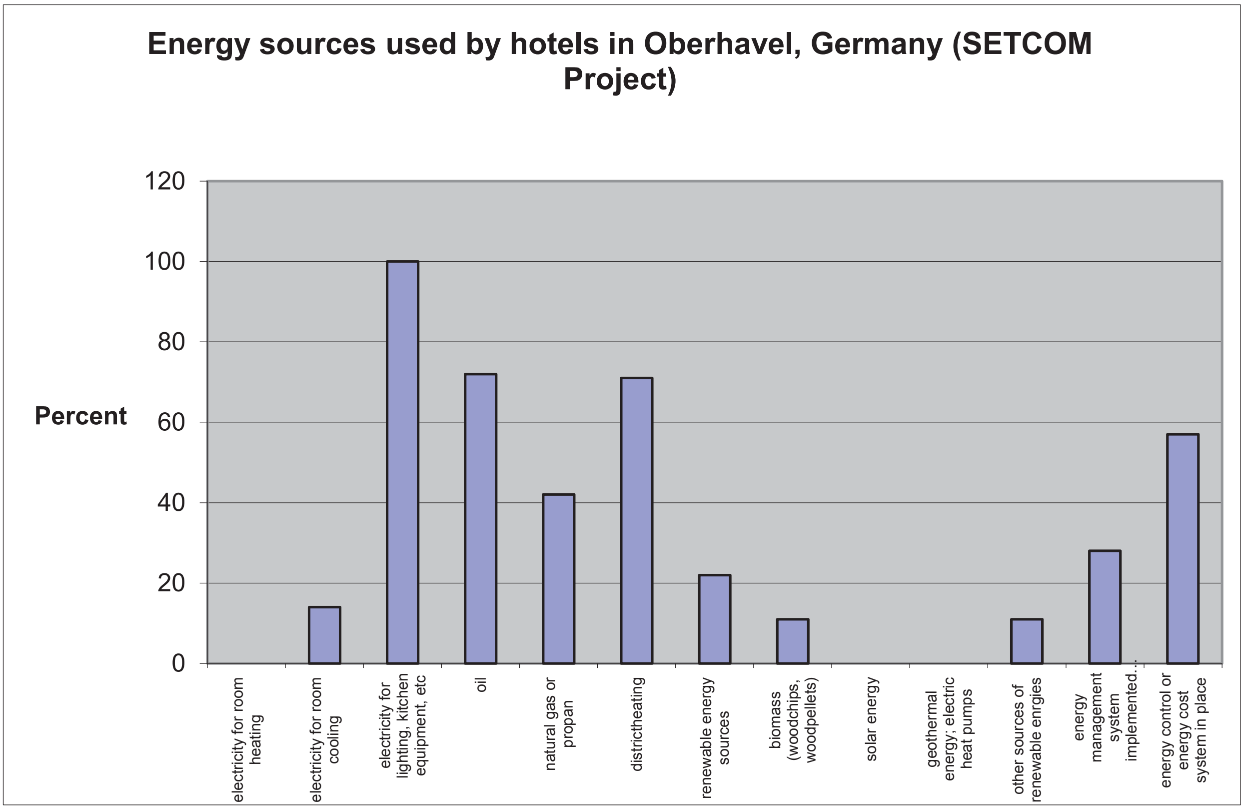
Annex 2: Data from the SETCOM Project on energy sources used by hotels in various European Regions

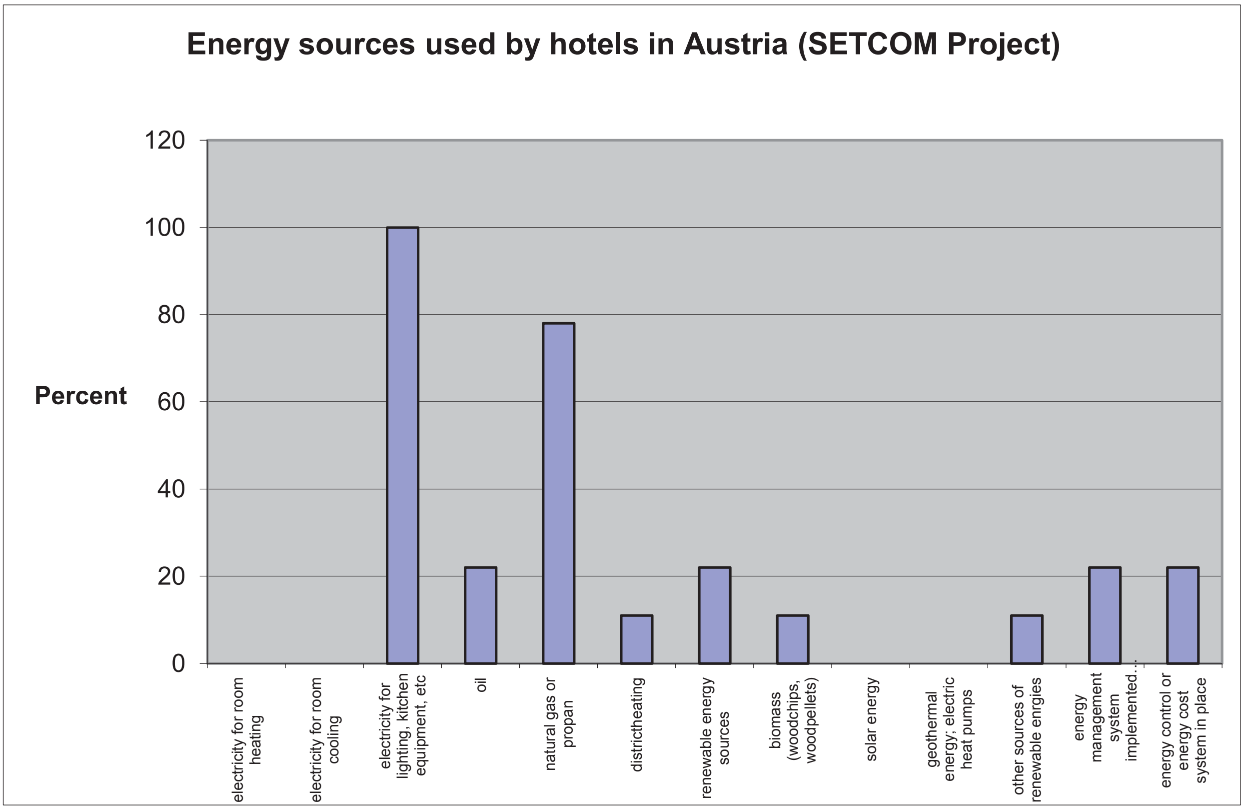


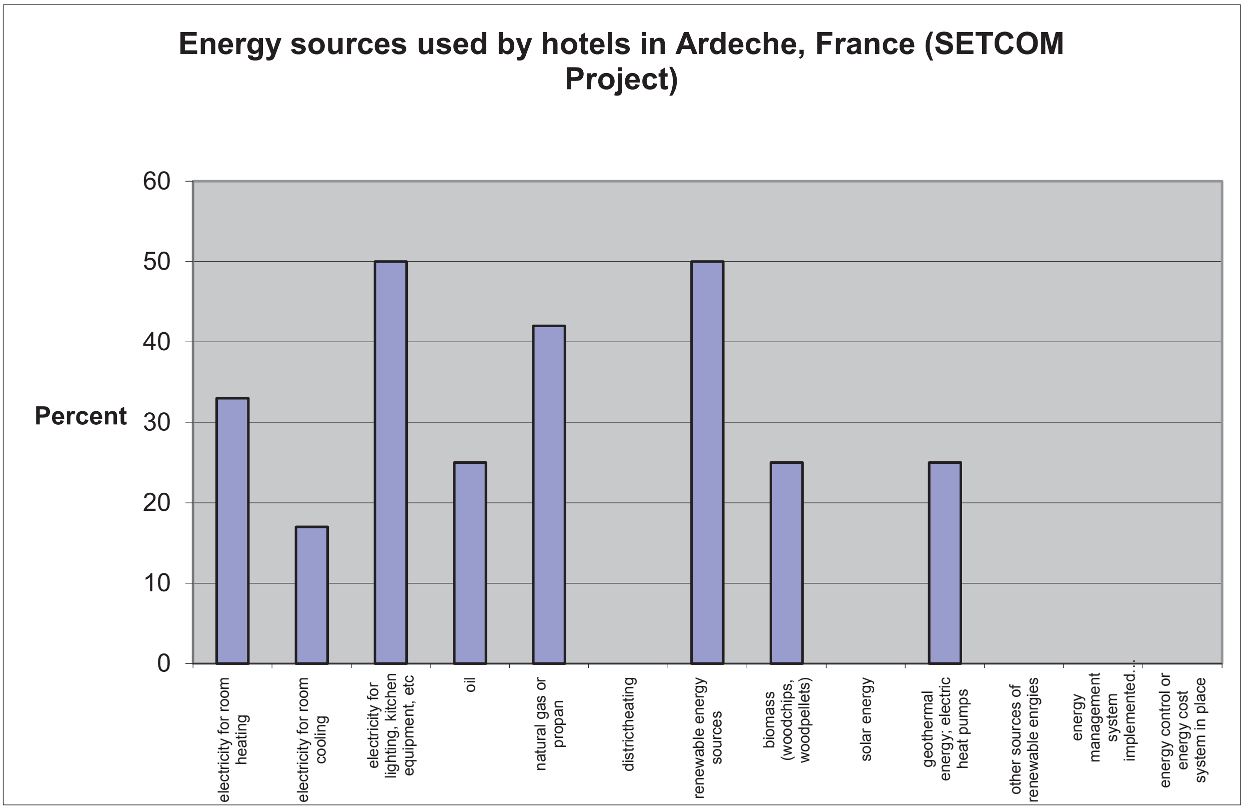


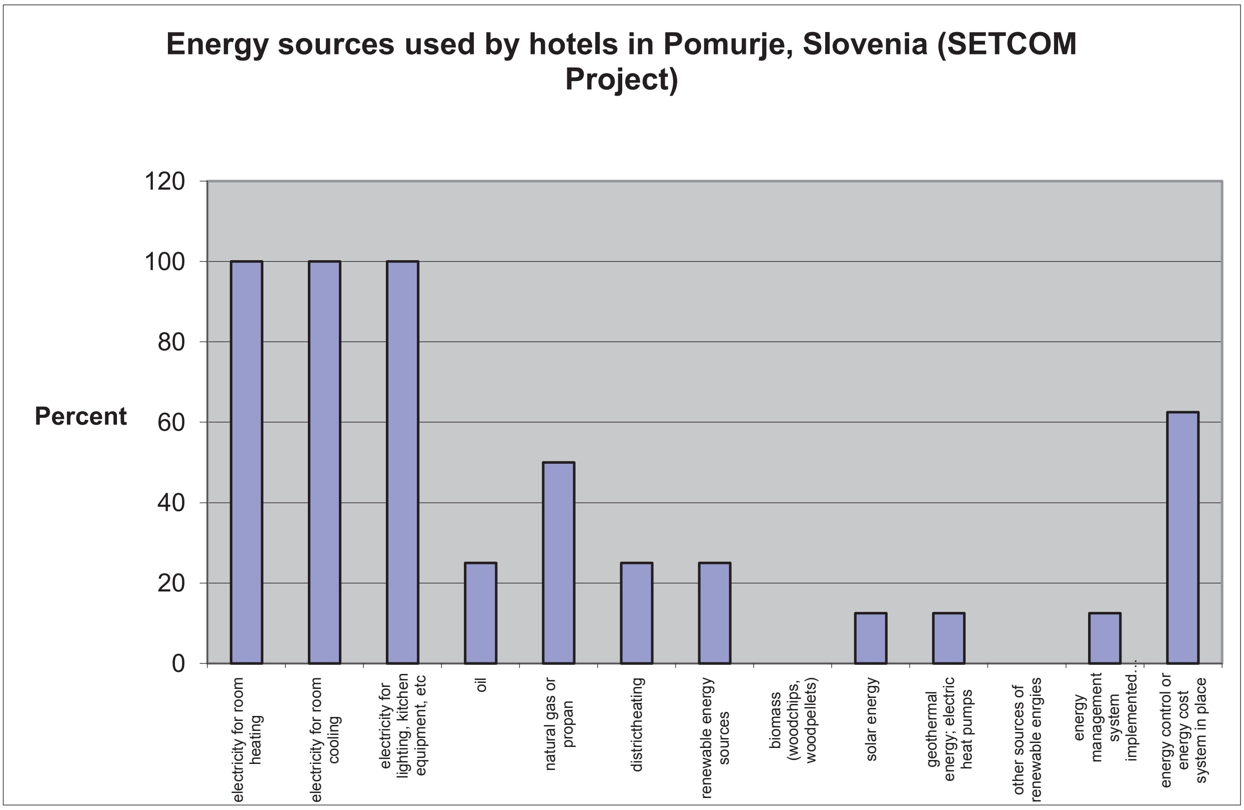

Energy sources used by hotels in Avila, Spain (SETCOM Project)
Percent
120
100
80
60
40
20
0
electricity for room heating
electricity for room cooling
electricity for lighting, kitchen equipment, etc
oil
natural gas or propan
districtheating
renewable energy sources
biomass (woodchips, woodpellets)
solar energy
geothermal energy; electric heat pumps
other sources of renewable enrgies
energy management system implemented...
energy control or energy cost system in place

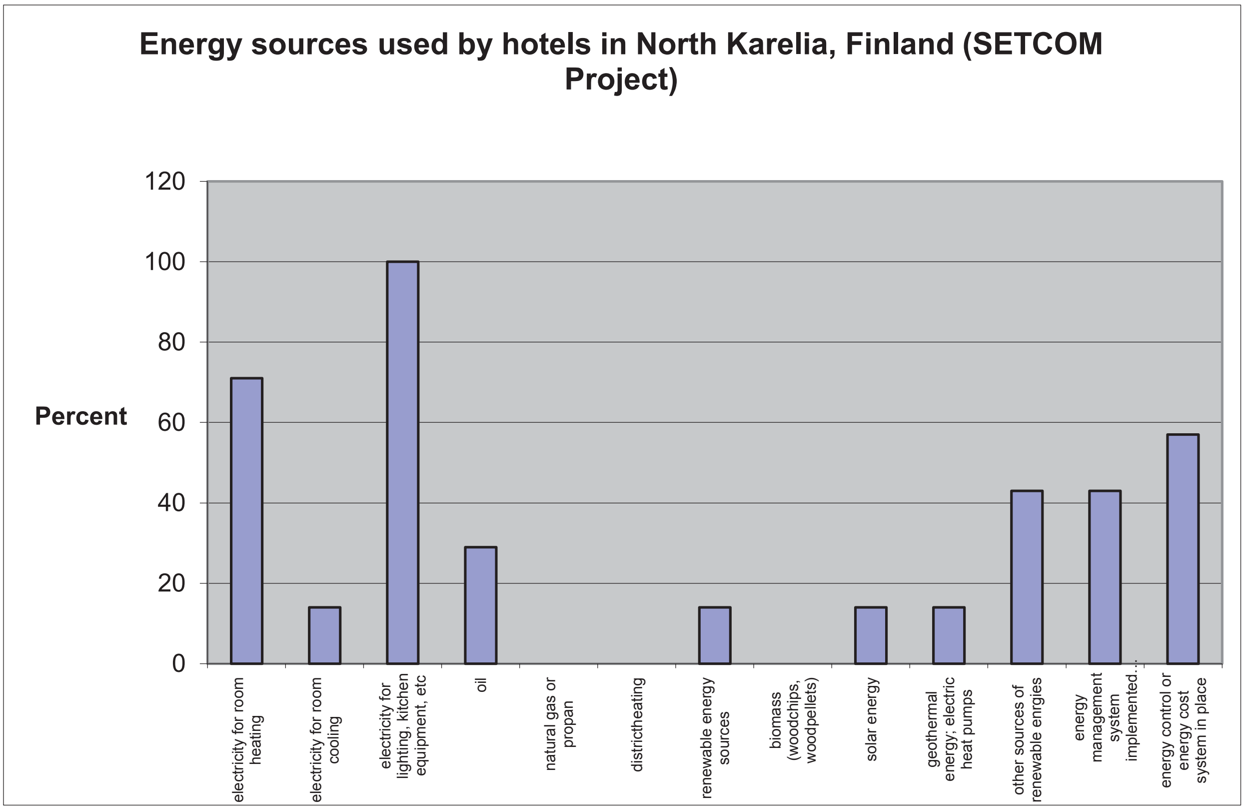

Energy sources used by hotels in Ascoli Pieceno, Italy
Percent
120
100
80
60
40
20
0
electricity for room heating
electricity for room cooling
electricity for lighting, kitchen equipment, etc
oil
natural gas or propan
districtheating
renewable energy sources
biomass (woodchips, woodpellets)
solar energy
geothermal energy; electric heat pumps
other sources of renewable enrgies
energy management system implemented...
energy control or energy cost system in place

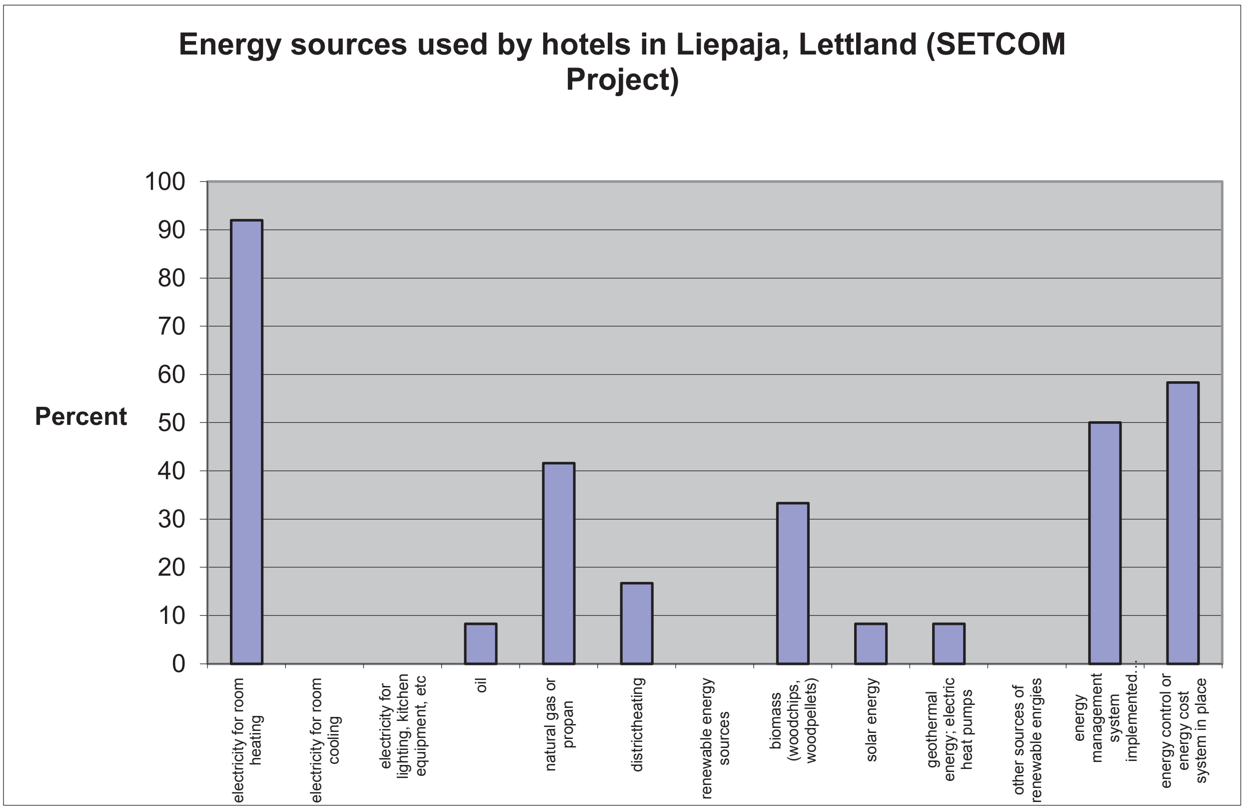

Energy sources used by hotels in Oberhavel, Germany (SETCOM Project)
Percent
120
100
80
60
40
20
0
electricity for room heating
electricity for room cooling
electricity for lighting, kitchen equipment, etc
oil
natural gas or propan
districtheating
renewable energy sources
biomass (woodchips, woodpellets)
solar energy
geothermal energy; electric heat pumps
other sources of renewable enrgies
energy management system implemented...
energy control or energy cost system in place


Energy sources used by hotels in Austria (SETCOM Project)
Percent
120
100
80
60
40
20
0
electricity for room heating
electricity for room cooling
electricity for lighting, kitchen equipment, etc
oil
natural gas or propan
districtheating
renewable energy sources
biomass (woodchips, woodpellets)
solar energy
geothermal energy; electric heat pumps
other sources of renewable enrgies
energy management system implemented...
energy control or energy cost system in place


Energy sources used by hotels in Ardeche, France (SETCOM Project)
Percent
60
50
40
30
20
10
0
electricity for room heating
electricity for room cooling
electricity for lighting, kitchen equipment, etc
oil
natural gas or propan
districtheating
renewable energy sources
biomass (woodchips, woodpellets)
solar energy
geothermal energy; electric heat pumps
other sources of renewable enrgies
energy management system implemented...
energy control or energy cost system in place


Energy sources used by hotels in Pomurje, Slovenia (SETCOM Project)
Percent
120
100
80
60
40
20
0
electricity for room heating
electricity for room cooling
electricity for lighting, kitchen equipment, etc
oil
natural gas or propan
districtheating
renewable energy sources
biomass (woodchips, woodpellets)
solar energy
geothermal energy; electric heat pumps
other sources of renewable enrgies
energy management system implemented...
energy control or energy cost system in place


Energy sources used by hotels in North Karelia, Finland (SETCOM Project)
120
100
80
60
40
20
0
Percent
electricity for room heating
electricity for room cooling
electricity for lighting, kitchen equipment, etc
oil
natural gas or propan
districtheating
renewable energy sources
biomass (woodchips, woodpellets)
solar energy
geothermal energy; electric heat pumps
other sources of renewable enrgies
energy management system implemented...
energy control or energy cost system in place


Energy sources used by hotels in Liepaja, Lettland (SETCOM Project)
100
90
80
70
60
50
40
30
20
10
0
Percent
electricity for room heating
electricity for room cooling
electricity for lighting, kitchen equipment, etc
oil
natural gas or propan
districtheating
renewable energy sources
biomass (woodchips, woodpellets)
solar energy
geothermal energy; electric heat pumps
other sources of renewable enrgies
energy management system implemented...
energy control or energy cost system in place

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