Energy-Efficiency and Conservation in Hotels – Towards Sustainable Tourism

Paulina Bohdanowicz*, Angela Churie-Kallhauge**, Ivo Martinac*
paulinka@egi.kth.se; angela@infra.kth.se; im@egi.kth.se

*Department of Energy Technology
**Department of Regional Planning
Royal Institute of Technology
100 44 Stockholm, Sweden

David Rezachek
drezachek@hotmail.com
Rezachek & Associates
Honolulu, HI 96813, U.S.A.

Abstract

Over the past decades, the hospitality industry has grown to become the single largest business sector world-wide, currently employing in excess of 200 million people. In some parts of the world, tourism is, indeed, the most important source of income. According to most prognoses, the numbers of people traveling for business or pleasure will continue to increase, in some regions very rapidly. While providing a significant boost to many local and national economies, tourism, particularly mass-tourism, has been shown to pose a significant environmental and socio-cultural threat to many of the environments in which it is developed and pursued.

Among other resources, the hospitality industry uses substantial amounts of energy for providing comfort and services to its guests, typically with an alarmingly low level of energy-efficiency. The effects on the environment include emissions to and pollution off water resources, soil, and the air, noise, as well as the excessive use of locally available and/or imported natural and other resources.

This paper focuses primarily on the use of energy in hotels. It aims at providing an overview of the current situation worldwide, and at discussing more environmentally compatible and sustainable alternatives. The need for an increased use of renewable energy resources/technologies, as well as passive cooling/heating, and lighting/shading strategies in meeting the complex energy requirements in hotel buildings and other facilities is emphasized. It is further pointed out that the development and operation of sustainable hotels requires the close and continuous cooperation of specialists from a broad spectrum of disciplines, including architects, spatial planners, building and services engineers, mechanical (systems) engineers, as well as environmental and marketing specialists, preferably already during the stages of planning and design.

Properly planned, designed and operated hotel facilities offer convincing environmental and socio-cultural advantages, as well as attractive opportunities for sustainable business.

1. Introduction

Over the recent decades, the international hotel industry has rapidly grown to become the world's largest employer, providing jobs for over 200 million people [1]. On a global scale, the tourist industry is estimated to account for one out of every 15 jobs [2]. In some parts of the world, tourism represents the main source of income. In the European Union (EU), more than 6% of the active population is employed in tourism, generating about 5% of the EU GDP and foreign trade revenue [2]. There are over 300 000 hotels world-wide, accounting for more

than 11 million rooms, of which 70% are located in Europe and North America [3]. The rapid growth in international travel has resulted in a sustained growth in the hotel industry.

While providing significant benefits to local and national economies, the accelerated growth of the hotel industry simultaneously poses a range of serious environmental and socio-cultural threats. The short-term-profit-oriented overexploitation of naturally and culturally attractive environments is in many cases straightforwardly self-destructive. To a large degree, this is due to the high resource-intensiveness of this industry. In order to preserve for future generations the quality and attractiveness of tourist destinations, as well as their potential for generating valuable income, a wholesomely sustainable approach needs to be adopted. This is particularly true with regard to energy use.

2. Energy Use in Hotels

The hotel industry constitutes one of the most energy- and resource-intensive branches of the tourist industry. Substantial quantities of energy are consumed in providing comfort and services to guests, many of who are accustomed to, and willing to pay for exclusive amenities, treatment and entertainment. The energy efficiency of the many different end-users in hotel facilities is frequently low, and the resulting environmental impacts are, therefore, typically greater than those caused by other types of buildings of similar size. The effects on the environment are caused by the excessive consumption of local/imported resources (e.g., water, food, electricity, and fuels), as well as by emissions released to air, water and soil. The large quantities of waste products generated in hotel facilities pose a further significant environmental threat.

The energy use varies substantially between different types of hotels, and is affected by hotel size, class/category, the number of rooms, customer profile (guests visiting for business/on vacation), location (rural/remote or urban), climate zone, as well as by the types of services/activities and amenities provided to guests [2].

A hotel can be seen as the architectural combination of three distinct zones, all serving distinctly different purposes [2]:

- The guest room area (bedrooms, bathrooms/showers, toilets) - individual spaces, often with extensive glazing, asynchronous utilization and varying energy loads.
- The public area (reception hall, lobby, bars, restaurants, meeting rooms, swimming pool, sauna, etc.) - spaces with a high rate of heat exchange with the outdoor environment (high thermal losses) and high internal loads (occupants, appliances/equipment, and lighting).
- The service area (kitchens, offices, store rooms, laundry, staff facilities, machine rooms and other technical sections) – energy-intensive areas typically requiring advanced air handling (ventilation, cooling, heating).

The energy flows occurring in these three areas are usually very different, and need to be handled accordingly.

Past investigations of the energy use in hotels have shown that electricity is the primary source of energy in the hotel industry, while the shares of gas and oil are considerably smaller [4-6]. The amount of electricity consumed in hotels is thus a good indicator of the overall energy expenditure in this sector.

Energy costs in hotels typically amount to 3-6% of overall operational costs [2], and to an even smaller fraction of the overall turnover. While energy costs are, therefore, often dismissed as too insignificant to bother with, they do represent a substantial proportion of controllable costs – often second only to labour costs. Cases where energy costs have

amounted to more than half the overall operational costs have been reported in the literature [7].

The energy consumption within the hotel sector is highly diversified and often difficult to grasp in detail. Today, most hotel facilities only monitor their overall energy expenditure without detailed attention to the different end-uses. Detailed monitoring and documentation of the various energy flows is technically possible but generally regarded as prohibitively complex and expensive. A number of investigations have been carried out, aimed at obtaining a more detailed understanding of the energy flows in hotels, providing a valuable basis for estimating the energy consumption profiles of similar type facilities [2, 4, 5, 6, 9, 10, 12].

Table 1 [2] provides an energy efficiency rating for different types of hotels, while the energy use intensity (EUI) in hotel facilities in different parts of the world is shown in Table 2 [4,9,10,11]. The energy use intensity (EUI), is an energy use index defined as the site energy consumption per unit of gross floor area.

The dependence of EUI on a variety of parameters was investigated. However, no clear-cut correlation was found between the value of EUI and the year of construction, hotel class, total gross floor area or hotel occupancy. However, the average monthly outdoor air temperature was observed to have a pronounced influence on the EUI, see also Figure 1 [4].

Table 1: Energy efficiency rating for different types of hotels [2]

Efficiency rating	**Good**	**Fair**	**Poor**	**Very poor**
A) Large hotels (more than 150 rooms) with air conditioning, laundry and indoor swimming pool				
Electricity (kWh/m^2 year)	< 165	165-200	200-250	> 250
Fuel (kWh/m^2 year)	< 200	200-240	240-300	> 300
Total (kWh/m^2 year)	< 365	365-440	440-550	> 550
Hot water (kWh/m^2 year)	< 220	230-280	280-320	> 320
B) Medium-sized hotels (50-150 rooms) without laundry, with heating and air conditioning in some areas				
Electricity (kWh/m^2 year)	< 70	70-90	90-120	> 120
Fuel (kWh/m^2 year)	< 190	190-230	230-260	> 260
Total (kWh/m^2 year)	< 260	260-320	320-380	> 380
Hot water (kWh/m^2 year)	< 160	160-185	185-220	> 220
C) Small hotels (4-50 rooms) without laundry, with heating and air conditioning in some areas				
Electricity (kWh/m^2 year)	< 60	60-80	80-100	>100
Fuel (kWh/m^2 year)	< 180	180-210	210-240	> 240
Total (kWh/m^2 year)	< 240	240-290	290-340	> 340
Hot water (kWh/m^2/year)	< 120	120-140	140-160	> 160

Table 2: Annual average energy use intensity (EUI) for hotel buildings in different parts of the world [4,9,10,11]

	London, UK (1988)	Ottawa, Canada (1991)	Oslo, Norway (1993)	US (1995)	Hong Kong (1995)	Sweden (1999)
EUI, kWh/m^2 (energy)	715 [4] 322 [11]	688.7 [4]		401 [4]	564 [4]	100–200 [9]
EUI, kWh/m^2 (electricity)			282 [10]			

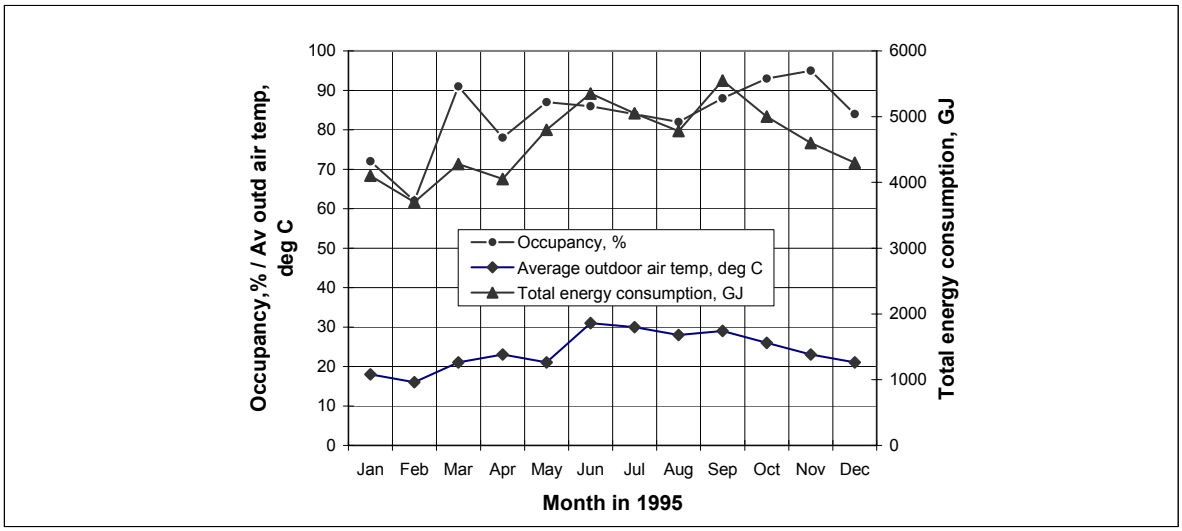

Figure 1: Monthly total energy consumption, average monthly outdoor air temperature and average monthly occupancy profile for a hotel facility in 1995 [4]

This is not surprising, as heating, air conditioning, ventilation and cooling systems typically account for a major, and frequently the largest, portion of the energy consumed in a hotel, see also Fig. 2. Other significant end-uses include domestic hot water production (DHW),

lighting, electricity for elevators, escalators, catering, etc. While Figure 2 [12] provides a typical breakdown of the energy consumption in a hotel, variations betwen different types of facilities may be appreciable.

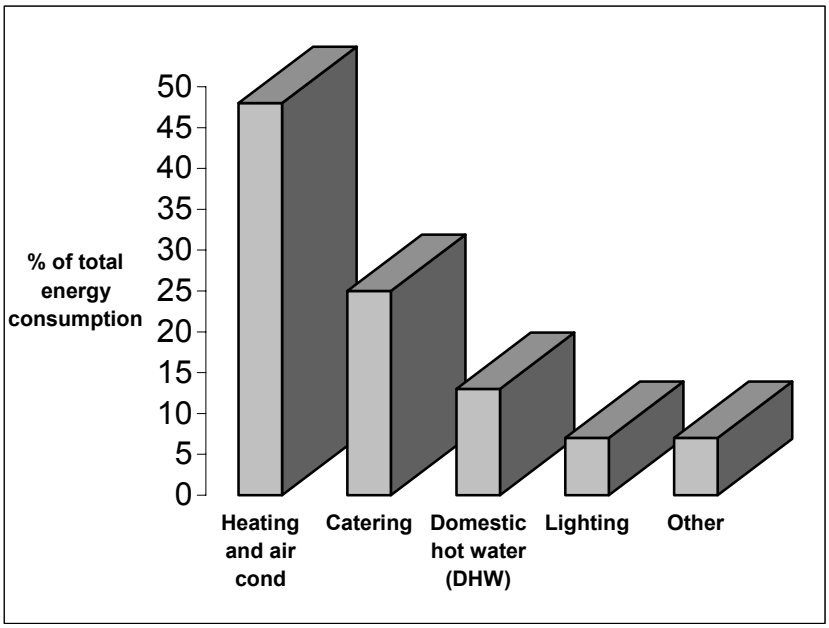

Figure 2: Breakdown of the energy consumption in a typical hotel [12].

The above data shows that the outdoor climate has a significant effect on the overall electricity use. Typically, about half the electrical energy is used for space conditioning purposes. Depending on the category of the establishment, lighting may amount to up to 12-20%, and in some cases to up to 40% of the total energy consumption [2]. The demand for domestic hot water (DHW) varies appreciably with hotel category (90–150 litres per guest per day) [2]. Supplying DHW typically accounts for up to 15% of the total energy demand. For a medium-category hotel with an average annual occupancy rate of 70%, this translates to an average annual consumption of 1500 to 2300 kWh/room [2]. Services including catering and laundry also account for a fair share of the overall energy use. By comparison, operating elevators, escalators, pumps and other auxiliary equipment accounts for only a small percentage of the total energy expenditure.

Table 3 gives an overview of the energy consumption by end-use for a variety of standard 3-star hotels in Southern Europe (120 rooms, total floor area = 5000 m^2, operated year-round, 50 000 guests/year, three elevators) [2], while Table 4 provides a similar breakdown for hotels located in different parts of the world [4-6,8,13].

Table 3: Energy consumption by end-use for a standard 3-star hotel located in Southern Europe [2].

	With AC throughout the building	With AC throughout the building	With AC only in common areas	With AC only in common areas
	With restaurant, 40000 servings/year	Without restaurant	With restaurant, 40000 servings/year	Without restaurant
Heating	12 %	13 %	13.7 %	16 %
Air conditioning (AC)	10.6 %	12 %	8.6 %	10 %
Lighting	11.8 %	13.3 %	10.6 %	12.4 %
DHW	34.3 %	38.7%	38.7 %	45 %
Various Equipment	19.5 %	22 %	14 %	16.3 %
Kitchen	12.5 %	-	14.1 %	-
Total	(171 kWh/m^2)	(150 kWh/m^2)	(150 kWh/m^2)	(128 kWh/m^2)

Table 4: Breakdown of energy consumption by end-use for hotels located in different parts of the world [4-6,8,13]. The figures shown in the table represent average values for different types of hotels in specific regions.

	Hong Kong [4]	US (1995) [4]	Florida [13]	Caribbean			
				General [5]	Large hotel [6]	Small hotel [6]	Mexico [8]
Heating		18.2%	17.5%	39% – 56%	55%	44%	
Air conditioning, ventilation, cooling	32%		30.5%	11% – 14%	2%	8%	42%
Lighting	12%	17.8%			12%	19%	36%
DHW	28% (gas and diesel)	40.4%	38.5% (incl. swim. pools)		15%		
Catering			6.3%			7%	
Refrigeration				12%-14%	12%		5% – 7%
Laundry							5% – 7%
Elevators, escalators	5%			14%	4%	9%	5% – 7%
Pumps, and motors						7%	5% – 7%
Other	23%						

3. Efficient planning for higher energy-efficiency

As appealing as the concept of energy-efficient hotels certainly is to a very diverse range of stakeholders, carrying out energy conservation measures is a complex task that should be done within the broader context of planning for sustainable tourism.

However, in many parts of the world, tourism is not given prominence in public planning, which is necessary to influence, direct, organize and manage tourism with all its complex implications and impacts [22]. The effectiveness of planning for tourism is thus likely to depend on the extent to which appropriate planning and management functions exist to guide and monitor its development [21]. The successfulness of planning further depends on the extent to which all stakeholders concerned recognize the need for an integrated approach in developing this significant sector.

There is a widespread misconception in the hotel sector that substantial reductions in the energy use in hotels can only be achieved by installing and using advanced, high-maintenance, and prohibitively expensive technologies. While this may be true in some contexts, in the majority of cases, major energy savings can be achieved by adopting a common sense approach, requiring neither advanced expertise nor excessive investments. This is particularly true, when the concepts of energy efficiency and resource conservation are accounted for already when planning and designing a hotel facility. A wholesome evaluation of the sustainability of a specific site needs to integrate considerations from the domain of regional land planning, appropriate site selection and site planning and design.

Important issues that need to be considered when planning/designing hotel facilities with a focus on energy efficiency and conservation include:

- Appropriate site selection
- Availability of local building material and (renewable) energy resources
- Implications on customer-behaviour, services provided, and overall cost
- Design aspects.

3.1. Appropriate Site Selection. A key consideration in the sustainable development of a facility is to ensure equilibrium not only with the ecological system but also the social, cultural and economic aspects of the space within which the development is to be carried out. Therefore, facility developers must familiarize themselves adequately with the essential qualities of the sites chosen for development. Moreover, the choice of site will, by way of local climate and topography, have a substantial effect on the energy needs of the facility, as well as the availability of required material and energy resources.

Adequate siting, using environmentally friendly construction materials, maximizing the use of renewable and/or passive space-conditioning and shading/lighting technologies, and minimizing internal transport requirements, are only some of the bioclimatic design tools available for mitigating energy use and environmental impact already in the design phase. Crestwood Corporate Centre Building No 8. in Richmond, B.C., Canada, is an excellent example. This building was designed and constructed to the strict energy-saving and environmental requirements detailed in the C-2000 Advanced Buildings Program, and operates currently at less than 50% of the annual energy consumption of an ASHRAE/IES 90.1 Reference Building [16].

When a site has been designated as appropriate to meet the needs for, say, energy efficiency, due attention should be paid to the cultural and ecological sensitivity of the area, and how this relates to other factors such as accessibility, carrying capacity of the area, and availability of supporting services and amenities. It is within this light that the final decisions should be taken.

3.2. Availability of Local Resources. Renewable energy resources (solar, wind, hydro etc.) are considered as appropriate choices in improving energy use due to their low environmental impacts. Information on the estimated energy needs, or loads and the types of energy needed should be sought and compared with the locally available resources to determine the choice of technology [22]. While renewable energy technologies are finding more and more applications in the hotel sector, e.g. by using solar energy for providing DHW or heating swimming pools, there remains an immense unexploited potential. The choice of renewable energy technologies depends largely on what resources are locally available. Solar (thermal and PV) energy systems, wind power [19] and heat pump plants, biomass-fueled systems and mycro-hydro plants are most commonly used today, where available. However, future applications may come to employ on a large scale a variety of fuel cell systems, OTEC (Ocean Thermal Energy Conversion) systems, as well as geothermal [2, 12, 17, 18] or wave/tidal energy systems. The State of Hawaii is a picture-book example of a tourism-intensive environment where practically the entire energy demand could be satisfied by using amply available renewable energy. Yet more than 90% of the energy currently consumed in Hawaii is non-renewable (oil-based).

Combined heat and power generation for hotel facilities offers an additional range of energy-efficient options [12, 20].

3.3. Implications on Overall Cost and Services Provided. Measures of energy conservation are typically expected to be carried out without negatively affecting the guests' well-being, safety, or perception of comfort. The implementability of specific energy-saving measures is, therefore, likely to depend to some extent on the category of guests catered to. While the lack of (or modifications in) certain types of services/activities, or comfort- and pleasure-associated amenities in a hotel may be acceptable to a convinced eco-tourist, this may be totally unacceptable to the uninvolved mass-tourist or luxury-oriented guest. The goal of conserving energy and other resources in the hotel sector is thus just as much a behavioural and educational task, as it is an issue of optimizing energy systems and building structures. Educating all stakeholders, including the customers, is thus an essential requirement in the quest for more sustainable tourism. This is equally true of education relevant to environmentally sound practices and activities/services, as with regard to understanding the economics of sustainable tourism in a wholesome life-cycle-cost perspective. This clearly needs to be done in close cooperation between all interest groups concerned.

3.4. Design Aspects. Savings of 20–30% of the energy used for space conditioning can be achieved by zoning and/or using autonomous temperature control systems in individual rooms. These systems may, for instance, be used to switch off, or reduce the flow of air-conditioned air, when a room is unoccupied. As regards lighting, merely by installing occupancy sensors savings of 35–45% of the lighting cost may be achieved [2]. Additional savings can be achieved by using energy-efficient lighting equipment as well as by maximizing the use of natural light. Payback times for installing energy-efficient lighting equipment are usually less than three years [15].

It is further crucial to avoid thermal bridges and to ensure good thermal insulation of walls, roofs, and other structural elements, as well as of ducts used for transporting heated/cooled liquids and air. The sizing of glazed surfaces should be considered against the background of increased heat-exchange across glazing. Preference should generally be given to energy-efficient glazing. In all climates, buildings should be designed to minimize thermal losses across the building envelope. Whenever possible, passive and renewable space conditioning options should be adopted, including passive cooling or heating, passive ventilation and natural lighting.

Appropriately structured energy management schemes, as well as interactive/intelligent energy monitoring systems can be very powerful tools in trying to minimize the use of energy in hotels.

4. Economic Benefits of Sustainable Tourism

As stated previously, tourism is the world's largest industry. And, it is an industry that is highly dependent upon a clean and scenic environment [23]. Between the years 1989 and 1998, tourism grew at a rate of 4.7% per year. The projected growth rate through the year 2020 is 4.1% per year [24].

Eco- [sustainable] tourism is currently a small part of overall tourism, but may be the fastest growing sub-market [25]. Many tourists already demand that their hotel be environmentally friendly. With millions of environmentalists throughout the world, and even more consumers sensitive to environmental issues, environmentally sensitive tourism facilities will be in high demand. These data suggest that sustainable tourism is, and will continue to be, an industry with huge growth potential.

Unfortunately, many developers believe that sustainable tourism, while a worthy and admirable goal, will cost more up front and provide for smaller profits. They are also concerned that this approach will make for more complex projects and create project delays. This does not have to be the case. When properly conceived and executed, sustainable tourism facilities can actually cost less and generate substantially more profits.

Sustainable tourism can provide a wide range of economic and related benefits to all stakeholders involved. These benefits include:

4.1. Economic Development Opportunities. As the world's largest industry, tourism is also one of the largest sources of income and employment. In fact, tourism creates one new job every 2.5 seconds [1]. It is also one of few development options for many developing countries, and is often vitally important in sustaining their population.

The increasing number of tourists results in large amounts of foreign currency - tourism becomes a major export industry. Unfortunately, much of this foreign capital is used to import fossil fuels. Increased use of resource-efficient technologies and indigenous renewable resources will help to keep more of this money within the country for local use and further economic development. Infrastructure developed in conjunction with sustainable tourism facilities will help to support local needs. And, tourist user fees and an increased concern for the environment will help to protect the very resources that attracted tourists in the first place.

4.2. Customer Comfort and Convenience. One of the challenges of sustainable tourism is to maintain customer comfort and convenience. Customers expect and demand this. Resource efficient tourism facilities can save money without sacrificing customer comfort and convenience, and can even enhance the quality of life in a hotel [8, 25]. A properly designed facility will provide customers, and management, better control over their environment and comfort while using fewer resources. Indoor air quality can be improved.

4.3. Better Working Environment and Enhanced Productivity. Employees also benefit from the improved quality of life in tourism facilities. The better working conditions provided by sustainable design produce fewer health problems and reduce absenteeism [27]. By involving workers in an energy management plan, they will help to make it succeed and they will become more satisfied and productive members of the team.

All of these improvements will lead to increased worker productivity. And, owing to the high proportion of operating and maintenance costs devoted to personnel, a small increase in worker productivity can be comparable to the entire energy bill [27, 28].

4.4. Competitive Advantage. Sustainable design will encourage community support and facilitate and streamline permit approvals. It may allow developers to stay ahead of regulatory demands. It may even reduce the risks of litigation, liability and even such disasters as fires and floods [28].

Sustainable design allows tourist facilities to differentiate themselves from the competition. They are able to gain increased market share by targeting environmentally-conscious guests [23]. For example, one facility experienced a 25% increase in occupancy since they began marketing themselves as a "green hotel." People are coming to stay with them because they are a green hotel. Customers consider it an amenity [29]. Community interest in sustainable tourism facilities also provides marketing benefits in the form of free, positive press coverage [28].

If tourism facilities are able to pass some of the savings to customers, reduced rates may make them even more competitive.

On the other hand, failing to become more environmentally-friendly can have the reverse effect. Instead of deriving the economic advantages of sustainable design, those facilities that do not change may be termed as "brown" and actually lose market share [30].

4.5. Greater Profits. In many cases, a more efficient building can actually cost less to build, as well as to operate, if it is properly designed. Capital costs may be only slightly higher, or even lower. Many energy saving opportunities require little or no up front investment. It may be possible to downsize or eliminate systems owing to reduced demands. Use of less expensive local, reused, and recycled materials may also be feasible. Any small premium cost of more resource-efficient systems will quickly be recovered through reduced utility costs.

More efficient use of resources, reduced demand, and reduced waste generation will lead to lower operating and maintenance costs. Most of these savings will appear as profits. In just one energy end-use area (lighting), the US EPA has found that for every US$1.00 a hotel invests in energy-efficient retrofits, it can expect a profit of US$6.27 [7].

Higher worker productivity, reduced resource use, and increased occupancy and market share all have a positive effect on the bottom line - increased profits.

4.6. Increased Product and Asset Value. A sustainable tourism facility has a higher value to both customers and investors. Customers will demand environmentally-friendly and resource-efficient accommodations, and investors are often willing to pay a substantial premium to be part of a development with "green" features [28]. The potential for greater market share and increased profits also add to the asset (market) value.

The bottom line is that there are great new business opportunities for sustainable tourism facility design.

Conclusion

Tourism is traditionally geared towards offering entertainment, comfort and luxury, as well as a wide range of services and activities on an aggressively competitive international market. There is a definite need for a more efficient use of energy and other resources in the hotel industry. This is equally true from an environmental perspective, as with regard to long-term

economic considerations. Sustainable tourism, including the sustainable use of energy and other resources in the hotel sector can only be successfully developed and pursued in close cooperation between all stakeholders involved, preferably already at the planning and design stage. Maximizing energy efficiency, as well as the use of renewable energy resources and technologies in hotel facilities is a crucial step towards achieving this goal.

While this has, to some degree, already been addressed within the framework of a number of policies/practices and standards (e.g. environmental management systems, or ISO 14000), as well as different environmental programs and actions (including the Green Globe program, Australian Best Practice Ecotourism, and the Environmental Audits for Sustainable Tourism program, to name but a few), a lot remains to be done. This opens a wide array of exciting opportunities to architects, planners, engineers, developers, investors, hotel operators and many other interest groups. Environmental management makes good business sense. But, as is true with any technology trend, early users reap most of the benefits.

References

[1] Hoffmann, H.B. (2000) *The challenges of tourism at the turn of the century: the importance of sustainability*, http://www.jrc.es/iptsreport/vol28/english/REG1E286.htm, as accessed 2.10.2000

[2] EU (1994) *Rational Use of energy in the Hotel sector*, A Thermie Programme Action B-103

[3] International Hotel and Restaurant Association, IHRA (1996) *Into the new Millennium. Executive Summary – A White Paper on the Global Hotel Industry*

[4] Shi-Ming, D and Burnett J (2000) *A study of energy performance of hotel buildings in Hong Kong*, Energy and Buildings, vol. 31, pp. 7-12

[5] Adelaar, M and Rath, A (1997) *Energy efficiency and tourism: focus on the Caribbean – A discussion paper, Roundtable on energy efficiency – tourism sector*, Kingston, Jamaica, December 9-11, 1997, http://www.idrc.ca/industry/jamaica_e7.html, as accessed 2.10.2000

[6] Eaton Haughton, M I (1997) *Plant E., Energy efficiency in the hotel sector in Jamaica, Roundtable on energy efficiency – Tourism sector*, Kingston, Jamaica, 9–11.12.1997, http://www.idrc.ca/industry/jamaica_e9.html, as accessed 1.12.2000

[7] Blank, D (2000) *Energy-saving efforts help hotels reduce maintenance and expenses*, http://hmmonline.com/highlights/11-1-99energy.html, as accessed 27.09.2000

[8] The Alliance to Save Energy (2000) *Energy efficiency opportunities in Mexican hotels*, as accessed 1.12.2000 http://www.ase.org/programs/inter…mexico/energy/energyefficiencymexico.htm

[9] Noren, C (1999) *Load shape development for Swedish commercial and public buildings – methodologies and results*, Lund Institute of Technology, Lund, Sweden

[10] Feilberg, N and Livik, K (1993*) Energy and load structure at various categories of end-users*, EFI SINTEF GROUP report, EFI TR A 4074, September 1993

[11] CADDET (1994) *Energy efficiency in hotels – energy efficient space heating and hot water*, CADDET-Result UK-96-503, 1.01.1994

[12] CADDET (1997) *Saving energy with energy efficiency in hotels and motels*, Maxi Brochure 07, 1997

[13] Miller, K and Florida Energy Extension Service (1994) *Energy efficiency and environmental news: Hotel industry*, University of Florida, Cooperative Extension Service, Institute of Food and Agricultural Sciences, http://edis.ifas.ufl.edu/BODY_EH304, as accessed 1.12.200

[14] Energy savings for typical Caribbean hotels, RETEC International, http://www.fsec.ucf.edu/Ed/INTERNAT/typ_savings.htm, 1.12.2000

[15] Alliance to Save Energy (2000*) Lighting energy efficiency opportunities in hotels*, Alliance Programs, http://www.ase.org/programs/lighting.htm, as accessed 1.12.2000
[16] CADDET (1998) *Energy-saving requirements determine building design*, CADDET – Result 298
[17] UNEP and IH&RA (1997) *Environmental good practice in hotels, Case studies from the international hotel and restaurant association environmental award, Green Hotelier*
[18] CADDET (1997) *Geothermal heating and cooling system for hotel and office complex*, CADDET – Result 287
[19] CADDET (1998) *Ecotourism resort at Couran Cove, Queensland uses cost effective, sustainable energy system*, CADDET- Result AU-99-510, 1.01.1998
[20] CADDET (1999) *Cogeneration system in a hotel uses a highly reliable fuel cell*, CADDET, Demonstration project JP-00-503, 1.03.1999
[21] Page, S and Thorn, K (1998) *Sustainable tourism Development and Planning in New Zealand: Local Governmental Resources*. In: Hall, M C et al., *Sustainable Tourism, a Geographical Perspective,* Longman, London, 1998.
[22] Heely, J. (1981), *Planning for Tourism in Britain, Town Planning Review*, as quoted in [21]
[23] Vermont Agency o Natural Resources (2001) *What is a green hotel?* Environmental Assistance Division, http://www.anr.state.vt.us/dec/greenhotels/about.htm, as accessed 16.2.2001
[24] Centre for Development and Environment (CDE) (2001*) Mountains of the world: tourism and sustainable development - part I*, Institute of Geography, University of Berne, http://www.mtnforum.org/resources/library/magen99a.htm, as accessed 13.2.2001
[25] Eagles, P F J (2001*) International ecotourism management: using Australia and Africa as case studies*, IUCN World Commission on Protected Areas, Protected Areas in the 21st Century: From Islands to Networks, http://www.ahs.uwaterloo.ca/rec/ecotour.htm, as accessed 13.2.2001
[26] Levy, J (1999) *Improving the design, construction and management of buildings and facilities - facility management in hotels*, The Facility Manager - July 1999, No. 5, Year 6, http://www.jlevy.ch/press/press3.htm, as accessed 13.2.2001
[27] Romm, J J and Browning, W D (1998) *Greening the building and the bottom line - increasing productivity through energy-efficient design*, Rocky Mountain Institute, December 1994, Revised 1998
[28] Rocky Mountain Institute (2001) *Doing well by doing good: the benefits of green development*, , http://www.rmi.org/sitepages/pid221.asp, as accessed 13.2.2001
[29] Environmental New Network (2000) *Green hotels gain favor with guests*, Sunday, August 27, 2000, http://www.enn.com/news/enn-stories/2000/08/08272000/greenhotels_30887.asp, as accessed 13.2.2001
[30] Meade, H B and del Monaco, A (1999*) Environmental management: the key to successful operation,* First Pan-American Conference, Latin American tourism in the next millennium: Education, investment & sustainability, May 19-21, 1999, Panama City, Panama, http://www.hotel-online.com/Neo/Trends/PanAmerProceedingsMay99/index.html , as accessed 27.09.2000