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IMPROVEMENT OF ENERGY EFFICIENCY IN HOSPITALITY - TOWARDS SUSTAINABLE HOTEL

Abstract: Over the past few decades, tourism has seen significant expansion. The number of newly built hotels and the number of trips is in constant growth. While this economic sector is a financial backbone of many national economies, the other side of mass tourism expansion is a threat to the environment, considering excessive exploitation of natural resources, energy consumption and harmful gases emission. In order to provide comfort and services for guests, substantial amount of energy is being spent in hospitality, so in terms of its savings, in accordance with global trends, improving the energy efficiency of hotels imposes itself as a necessary choice. This paper summarizes information on the energy performance of hotels, based on survey of the relevant literature and web searches. More sustainable and compatible alternatives in terms of EE improving and environmental protection are considered. The need for implementation of new technical solutions is emphasized. An evaluation of economic cost-effectiveness is given as well, since the level of reduction consumption could affect the final financial outcome and market competitiveness, by reducing prices and improving the quality of service provided.

Key words: tourism, hotel, energy efficiency, comfort, sustainability

УНАПРЕЂЕЊЕ ЕНЕРГЕТСКЕ ЕФИКАСНОСТИ У ХОТЕЛИЈЕРСТВУ – КА ОДРЖИВОМ ХОТЕЛУ

Резиме: Током последњих неколико деценија туризам је доживео значајну експанзију. Број новоизграђених хотела и остварених путовања је у константном успону. И док је овај економски сектор финансијски ослонац многих националних економија, другу страну масовне експанзије туризма представља претња за животно окружење, ако се узме у обзир прекомерна експлоатација ресурса, потрошња енергије и емисија штетних гасова.

Како би се обезбедио комфор за госте, значајне количине енергије се троше у хотелској индустрији, па се у погледу њене уштеде, а у складу са глобалним трендом, унапређење енергетске ефикасности хотела намеће као нужан избор. У раду су сумиране информације о енергетским перформансама хотела, базиране на истраживању референтне литературе и веб извора. Разматране су алтернативе које су одрживије и компатибилније у погледу унапређења енергетске ефикасности и заштите животне средине. Наглашена је потреба за имплементацијом нових техничких решења. Дата је и процена економске оправданости, с обзиром да би степен смањења потрошње утицао на коначни финансијски биланс и конкурентност на тржишту, кроз смањење цена и побољшање квалитета пружених услуга.

Кључне речи: туризам, хотел, енергетска ефикасност, комфор, одрживост

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1. INTRODUCTION

Tourism and more specifically the hotel sector record a significant development in recent years and is becoming one of the leading sectors of the global economy. As a complex branch of economy, tourism represents an active and important factor in many national economies, providing jobs for over 200 million people, with the participation of about 10.7% of world's GDP. [11] In the EU, more than 6% of the active population is employed in tourism, generating about 5% of the EU GDP and foreign trade revenue. [2]

This rapid growth of tourism and hospitality, although very important both on the employment as on the consumer aspect, poses an increasing threat to the environment. Hotels are very content-specific facilities, due to the presence of different functional areas (accommodation, public, economic). A wide range of services, different levels of comfort, luxury and entertainment provided to hotel guests require the consumption of substantial quantities of energy. Globally, most of this energy is still a fossil fuel. The consequence of emissions of pollutants and greenhouse gases certainly is environmental degradation.

Hotels constantly interact with the environment, and this influence is often negative. On the other side, the very essence of tourism is based on the availability of an unpolluted natural environment. In order to conserve the quality and attractiveness of tourist destinations for future generations, which is crucial for the benefit of hotel industry, it is important to induce a more environmentally sound development, operation and performance in this sector. All this underlines the implementation of measures in the energy consumption management as the most important goal, which will lead to more energy-efficient hotel operation, reduction of exploitation costs while comfort will be enhanced and quality of services erected to a higher level. Defining the ways to achieve greater energy efficiency of existing and newly built hotel facilities, in accordance with the principles of sustainable development, is at the centre of interest of the profession, hotel management, and consumers of hotel services.

2. OVERVIEW OF ENERGY CONSUMPTION IN HOSPITALITY

Hotels, with the exception of hospitals, have been found to have the highest negative impact on the environment [13] and are ranked among the largest energy consumers of all commercial buildings. Although precise data on the global annual energy consumption in the hotel sector are not available, it is estimated that amounts to about 100TWh. 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 in 2000, half of which is in the form of electricity. [8]

Energy management in the hotel industry has special requirements that are not known in any other branch. Hotels operate around the clock, routinely carry out a variety of different services through a number of distinct departments. All these activities often get difficult power management in the hotel, and that does not mention the factor that consumes energy at most - customers. The main goal of a hotel is to provide comfort and services of high quality to its guests, and so guests have a direct impact on energy consumption and related energy costs.

Hotels are mutually very distinguished typologically, functionally, substantively, as well as by capacity. There is a huge variety of hotel types, but they are generally classified by number of rooms (small, medium, large hotels), or by the number of stars a hotel has and the luxury they provide (air conditioning or not, size of the room, inside or outside swimming pool or no swimming pool,...). Functioning of the hotel often takes place not only within a single facility. The location, local environment and the architecture of the building also play an important role in the hotel's energy consumption. All of these differences significantly affect that energy use varies in a wide range, so analysis of the energy consumption must take into account what kind of hotel it is. Energy consumption costs in continental type hotels, for instance, range from 15-18% of total hotel operating costs, and occupy second place among total operating costs of the hotel (just behind labour costs). Energy costs are divided among individual hotel departments in the following ratios (Figure 1):

- heating and cooling 43%
- hot water (DHW) 15%
- kitchen 10%
- lighting 22%
- other 10%. [12]

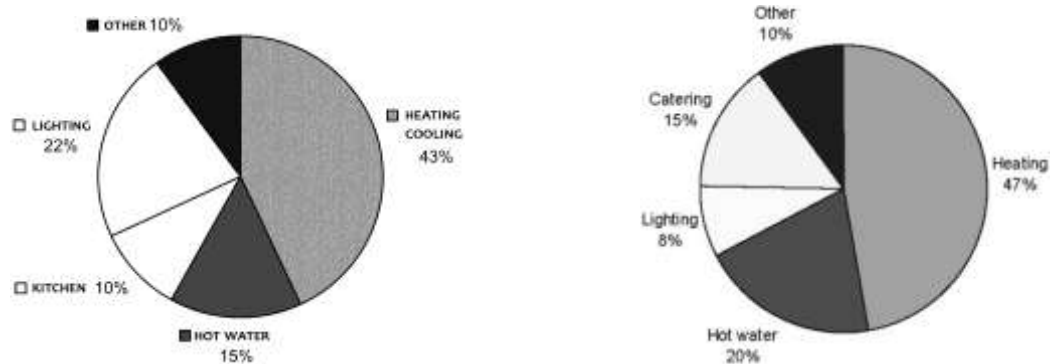


Figure 33 – Distribution of energy costs in the continental type hotels, U.S. Environmental Protection Agency and the U.S. Department of Energy: Energy Star for Hospitality 2006. [12]; Figure 34- Energy consumption break down of a typical hotel in the UK, UK Energy Efficiency Best Practice Programme: Energy Efficiency in Hotels – A Guide to Owners and Managers, [4]

Table 1- Energy consumption by end-use for a standard 3-star hotel located in Southern Europe[2]

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

Table 1 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 of 5000 m², operated year-round, 50000 guests/year). [2] What proved to be indicative, based on the previously exposed, is that space conditioning is the largest single end-user of energy in hotels, accounting for approximately half of the total consumption and thus the average monthly outdoor air temperature has a considerable influence on energy use.

Hotels are, in terms of architectural organization, consisting of four distinctly differentiated functional groups of premises, which are also, in addition to the function, highly diversified in energy requirements and consequently consumption. These functional zones are:

- The guest units area (rooms and suites with private baths) - individual spaces, often with large glazing on the facade and with extremely unbalanced regime of energy use and different loads
- The public area (reception, lobby, bars, shops, restaurants, convention and banquet halls, meeting and conference rooms, swimming pool, sauna, casino, etc.) - mutually highly different functional areas with high rate of heat transfer with the outdoor space (meaning high thermal losses) and high internal loads (large number of occupants, intense lighting, electrical equipment and appliances)
- The service area (kitchen, staff facilities, warehouse, laundry, technical operation) - spaces in which energy consumption is primarily related to HVAC installation
- The administrative area (support staff and hotel management) - standard office space, characterized by intense lighting, a numerous IT appliances and full HVAC installations.

Significant variations in the presence of these facilities in hotel make it difficult to provide a general model explaining the energy consumption that could be universally applicable to all types of hotels. Nevertheless, a number of attempts have been made to develop such models. A numerous 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. Although the specific energy consumption of a hotel is strongly related to the type of hotel, these survey

have not revealed a clear correlation between energy consumption and hotel class, year of construction or occupancy. Table 2 provides an energy efficiency rating for different types of hotels, classified by number of rooms. Table is given in EUI index (the energy use intensity), defined as the energy consumption per unit of gross floor area annually. [2]

Table 2- Eenergy 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 a)	< 165	165-200	200-250	> 250
Fuel (kWh/m ² a)	< 200	200-240	240-300	> 300
Total (kWh/m ² a)	< 365	365-440	440-550	> 550
Hot water DHW (kWh/m ² a)	< 220	220-280	280-320	> 320
B) Medium hotels (50-150 rooms) without laundry, with HVAC installations in some areas				
Electricity (kWh/m ² a)	< 70	70-90	90-120	> 120
Fuel (kWh/ m ² a)	< 190	190-230	230-260	> 260
Total (kWh/ m ² a)	< 260	260-320	320-380	> 380
Hot water DHW (kWh/ m ² a)	< 160	160-185	185-220	> 220
C) Small hotels (4-50 rooms) without laundry, with HVAC installations in some areas				
Electricity (kWh/ m ² a)	< 60	60-80	80-100	> 100
Fuel (kWh/ m ² a)	< 180	180-210	210-240	> 240
Total (kWh/ m ² a)	< 240	240-290	290-340	> 340
Hot water DHW (kWh/ m ² a)	< 120	120-140	140-160	> 160

3. GREENING THE HOTEL

Ecotourism - tourism that is nature-oriented and environmentally focused - is nowadays rapidly developing, representing a growing and increasingly important branch of tourism. The term "green hotels" refers to the hotels which tend to be more environmentally oriented through more efficient use of energy, water, and raw materials while providing quality services. Green hotels conserve and preserve the environment by saving water, reducing energy use, and reducing solid waste.

How "green" is my hotel? This question is being asked by an increasing number of hotel guests. A survey conducted in the USA by Kimpton Hotels & Restaurants showed that 16% of guests choose their facilities precisely because they are environmentally friendly. These results were also confirmed by the Natural Marketing Institute. Almost 90% of respondents in a survey conducted in Britain on a sample of 2000 hotel guests believe that hotels and tourism companies have the obligation and responsibility to operate in an environmentally friendly manner. [12]

Hotels are constantly becoming greener, but how do we know when hotel became a "green hotel"? There are green hotel certification opportunities and benchmarking tools available to help chart progress in becoming a green hotel:

- International Hotel Environmental Initiative (IHEI) - provides a benchmarking tool and a variety of suggestions
- CERES Green Hotel Initiative - provides an online best practice survey checklist and suggestions for step-by-step process in starting a green hotel
- Green Hotel Association - provides more information on green hotels and some general steps for the hotel greening
- Green Leaf Program - uses a 1-5 scale to help a hotel track its progress toward becoming green
- Cool Companies - offers tools for looking into energy efficiency improvement and presents case studies, policy information on energy, a "how-to" guide on saving energy, and much more. [1]

The hotel management must accept the policies and standards of environmental behavior, ie. rational behavior in the management of resources, especially energy, water and waste. The majority of significant hotels worldwide systematically introduces the so-called 3R measures, ie. reuse, recycle, reduce.

4. IMPROVING THE ENERGY PERFORMANCE OF HOTEL

Hotels may have large energy requirements, as can be concluded from the previous, particularly regarding HVAC installations. However, the energy saving potential of hotels is significant and energy costs may be controlled more efficiently than any other operating costs. Models for energy efficiency improvement in hospitality are nowadays numerous. Hotels worldwide are recognizing opportunities to implement energy-efficient projects which may include solutions from passive design to something as simple as improving the thermal insulation. There are also low-cost measures for energy management enhancing that refers only to the manner of equipment utilization as well as the behavior of personnel and guests. All these strategies could assist in lowering or completely eliminating the need for space heating and cooling. The main motivations for hotels to take these actions are, apart from reducing operating costs, demand from customers, improving the hotel's image, and reducing its environmental impacts. Implementation of measures for improving the energy efficiency of hotel facilities is possible from an early stage of planning and design of the hotel, but also through its exploitation. The latter can be further classified as short-term - low-cost and long-term - cost-effective measures.

4.1. Planning and design considerations

Incorporating a sustainable energy-environmental concept in the design and construction of the present-day hotels imposes itself as a necessary choice. The initiative for such a practice was launched by Leadership on Energy and Environmental Design (LEED), an organisation of professionals trained for planning and building ecologically acceptable and sustainable buildings. The Inn & Conference Centre by Marriott near the University of Maryland (USA) is the first LEED certified hotel. [12]

Although it is believed in the opposite, the construction of such hotels is not much more expensive than conventional construction, when measured against the benefits during the operating lifecycle of the facility. The most important principles that need to be considered when planning/designing hotel facilities with a focus on energy efficiency and environmental acceptability issues are the following:

- Appropriate site selection - good insolation and orientation of the building
- Provide the greater use of local raw materials, recyclable and ecologically sustainable materials and renewable energy sources – biomass, solar and geothermal energy etc.
- Ensure minimizing of thermal losses through the building envelope - install energy-efficient glazing and insulation materials in external walls, roofs and other structural elements while avoiding the thermal bridges
- Ensure maximized use of passive cooling, heating, ventilation and natural illumination
- Implement new technical solutions in energy-efficient equipment and installations - heat recovery devices, heat pumps, sensors and efficient lighting, etc.

In order to enable easier implementation of energy efficiency principles into designs, specific software packages have been developed. Baumschlager - Eberle's design book, "Building Envelope and Building Technology", describes the design targets based on a consensus between the investors, planners and designers. [5] These targets can be broken down into four types of comfort for the majority of designs - thermal, hygienic, visual and acoustic. The challenge for the designers is to fully achieve all the comfort standards. Baumschlager and Eberle made use of their own experience and specially developed software in order to achieve these goals. For evaluation of energy options, a software-supported process is carried out. The software calculates options of energy conservation methods and gives an assessment of the building energy performance. Eventually, a small number of precise indicators for energy requirements are presented, accompanied by proposing of the building technology and the building envelope. [9]

4.2. Improvement of existing hotel facilities

Several studies conducted in Europe indicate that the hotels have the potential to save at least 10 - 15% of consumed energy, depending on the age and size of the hotel, type of equipment installed and operating and maintenance procedures in use. In a series of scenarios ranging from basic to high-end energy conservation measures (study of 158 hotels in Greece - 140 hotels in Athens, and 18 hotels in other parts of Greece), energy savings were estimated to be almost 22% for basic energy efficiency measures, while a 43% saving could be obtained by using additional measures (Figure 3). [8]

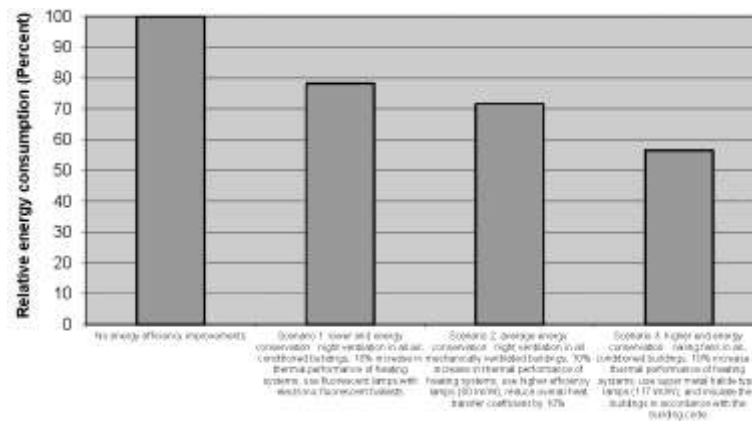


Figure 35- Energy efficiency savings potential estimated for hotels in Greece under low, average and high scenarios for energy efficiency measures [8]

4.2.1 Short-term strategies

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, there is a large potential to achieve savings through low or no-cost investments, since a great part of the energy consumption is due to unnecessary loss and wastage. The equipment and installations as they are designed and installed, are not always used in an optimal way. 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 while cooling or heating system are operating. Also, many rooms remain unoccupied for long periods of time, 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 whether or not the room is occupied. [8] The simplest thing to do is turn things off when they're not needed - every 1000kWh of saved energy by turning things off equals 100€ off the utility bill (assuming average electricity costs of 10 cents per kWh in Europe). It is estimated that energy savings up to 10 - 15% can be achieved by implementing the following short-term strategies:

- Proper and promptly maintenance of the equipment
- HVAC systems should operate at minimum/economy loads whenever guestrooms are unoccupied for prolonged period of time and during the regime of low use of lobbies, offices, etc.
- Control and adjustment of lighting
- Decreasing the room temperature during the heating season only for 1C° is equivalent to approximately 10% lower heating costs and additional lowering of temperatures in unoccupied rooms (16 - 18 C°) can result in heating energy savings in the range of 20-30% [3]
- Booking rooms in clusters, so that only occupied building areas or wings need to be heated or cooled to guest comfort levels
- Use the lowest water temperature that ensures regular laundry washing and disinfection (65°C instead of 85°C)
- Covering of all pools and hot tubs after hours to diminish heat losses [12], etc.

4.2.2 Long-term strategies

Although the actions covered in this section represent cost-effective investments, implementing several suggestions listed below can dramatically increase the energy efficiency of the facility and provided comfort, without compromising the hospitality environment:

- Recommissioning - a process in which engineers observe a building and perform a “tune-up” to ensure that its systems are operating appropriately and efficiently - periodically throughout a building’s life can provide big benefits
- Improving thermal characteristics of the overall building envelope (external walls, window systems and roof construction)
- Install HVAC and lighting systems with higher degree of energy efficiency than the existing ones

- Install occupancy sensors on lighting and HVAC systems
- Install a programmable thermostat which allows setting the temperature and using the unit only when appropriate
- Install sunshading systems against overheating and excessive insolation during the summer period
- Consider the possibility of using alternative energy sources (solar, biomass, heat recovery and other renewable energy sources), in accordance with the capabilities of the specific locations.

Estimated potential reductions in energy use range from 15 - 20% for most applications, and can exceed 45% for efficiency improvements in boilers, use of solar thermal panels for hot water production, and use of energy efficient lighting (Figure 4). [8]

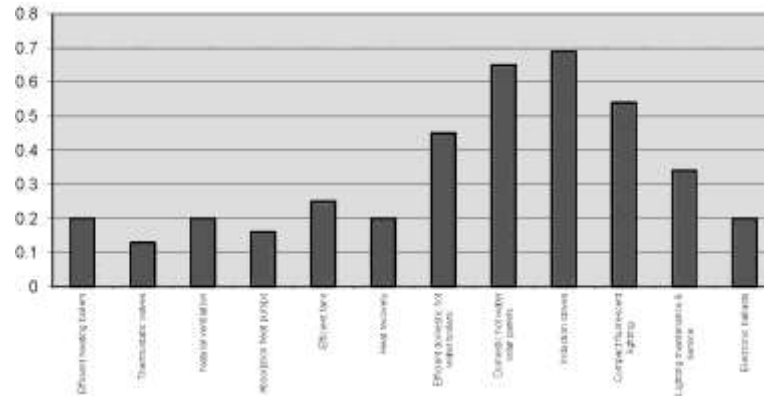


Figure 36 - Estimated potential savings from various energy efficiency technologies [8]

5. ECONOMIC ASPECTS OF ENERGY EFFICIENCY IMPROVEMENT

Sustainable hospitality can provide a wide range of economic and related benefits to all stakeholders involved. The financial aspect of installing energy-efficient equipment and appliances is not only reflected in the reduction of monthly costs, but also in increasing the market value of hotel in case of its sale. The ability to invest in upgrading the energy efficiency with a longer payback period is based on rapid savings based on low-cost and equipment investments with shorter payback. In addition, such measures contribute to the comfort and aesthetics improvement which encourages guests to revisit, bringing the extra profit. Numerous examples of actual financial savings achieved in the hotel industry are present in referential literature, and some of them are listed below:

- Continuously monitoring and recommissioning a building's energy systems can lead to reductions of 10 to 15% or more in annual energy bills. For a typical 100.000ft² (9300m²) hotel, that's equal to about \$19,500 in savings per year [10]
- Only 10% reduction in energy consumption have the same financial effect as increasing the average daily room rate by \$0.62 in limited-service hotels and by \$1.35 in full-service hotels [6]
- In a medium sized seaside hotel with full HVAC, the savings achieved by better allocating of the guest rooms amounts up to annual saving of €4.000; the savings by lowering the set point of the heating in wintertime to 18°C instead of 20°C are estimated to be around €3.000 per year [7]
- Turning off the AC in a large hotel for the restaurant and conference rooms at night instead of turning down the air flow to 50% brings a financial saving of €3.626 per year [7]
- Savings of 35-45% of the lighting cost may be achieved only by installing occupancy sensors. Payback times for installing EE lighting equipment are usually less than three years. The US EPA has found that for every \$1 a hotel invests in EE lighting, it can expect a profit of \$6,27 [2]
- The cost savings up to \$15.000 with a payback rate of 18 months are achieved in Sheraton Hotel in Tacoma, Washington, by replacing 2.000 incandescent light fixtures with quadruple-tube compact fluorescent light bulbs with compact fluorescent light fixtures in guest rooms and the lobby [1]
- By lowering water temperature for laundry washing from 85°C to 65°C, The Sheraton Hotel and Towers, Auckland, New Zealand, saved \$2.000 in the first 3 months alone. [1]

6. CONCLUSION

The tourism industry and the hotel market will, regardless of the present economic crisis, continue with the rapid development and ecotourism, as nature-oriented sub-sector, will represent the most

important branch of tourism, due to the increasing environmental awakening of hotel clients. Therefore, the importance of acquiring a "green hotel" certificate is emphasized in the paper and, in this regard, certain guidelines for achieving of this standard are given.

According to the results of numerous studies, summarized through the survey of the reference literature, authors concluded that the energy consumption within the hotel sector is highly diversified and that it is difficult to provide a generally applicable model for energy efficiency improvement, due to a huge variety of hotel types. Nevertheless, the framework of the optimal energy consumption is defined for classification by the hotel size, ie. by number of rooms. Also, certain strategies are presented, whose implementation through planning and design or later in the exploitation phase, would result in a significant optimization of the energy management, despite the type of hotel. Further research in this field would certainly contribute to the formation of a more comprehensive policies and recommendations for the energy efficiency improvement.

Eventually it can be concluded that the benefits of energy efficiency improvement in the hospitality are multifaceted. First of all, what is the common good, reducing the consumption of raw materials, non-renewable energy and greenhouse gas emissions significantly contributes to protection of the environment on which, among other things, relies the entire tourism industry. Hotel owners and management will realize financial savings through reduction of operating costs and thus increase their incomes and market competitiveness by possibility for reducing the prices and improving the quality of service/comfort provided. Overall, price reduction and service/comfort improvement are crucial benefits for end-user of the hotel product - hotel guest.

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