NEW ENERGY MEASURES FOR SUSTAINABLE LOCAL DEVELOPMENT – A CHALLENGE FOR HOTEL INDUSTRY

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Abstract
The hotel industry consumes large amounts of energy in order to maintain the high level of comfort and service quality. The purpose of this paper is to analyse and propose new measures to increase energy efficiency, reduce energy costs and achieve sustainable local development.
Design of the paper presents a cost-benefit analysis of investment projects, and in the methodology are used secondary internal data on energy consumption obtained from hotel companies on the Crikvenica – Vinodol Riviera. The analysis was conducted on a small, medium and large hotel in order to determine whether the hotel size affect the return on investments.
This research approach can be used as a base for decisions on the introduction of new energy efficiency measures.
Findings demonstrate that the introduction of new energy saving measures plays an important role in reducing energy costs. According to the conducted analysis, the quickest return on investment is achieved in the medium size hotel, since ROI is affected not only by the size of the hotel, but also the manner of energy consumption.
Only few studies have been carried out by academics in tourism and hospitality, so this paper tends to fill the research gap. Based on the conducted economic-financial analysis, the authors suggest new measures for reducing energy costs, which at the same time represents the practical contribution and originality of this research. The proposed measures provide the guidelines for tourism management on how to achieve successful creative development in their hotels, which in turn leads to a sustainable local development.
Keywords sustainable local development, new energy measures, hotel industry, economic and financial analysis

INTRODUCTION

Accommodation capacity is an essential part of the tourism offer; without it, tourism development is virtually impossible. It includes hotels, campsites and facilities that provide catering services in the household (OG 88/2007, OG 56/2016). These are classified by stars (1 to 5), allowing the tourists to evaluate the quality of provided services and to choose the category that would best meet their needs (Čavlek et al, 2011). In addition to the hotel category, the tourists also base their decision on the location. Hence, the most attractive locations are the sea coast, forests, parks (Bilen, 2008), which makes them the most environmentally sensitive areas. Construction of accommodation facilities (such as hotels) in these areas causes numerous adverse environmental effects on the local ecosystems. The negative effects on the environment are the result of the daily operations of accommodation capacities. One of the major problems is excessive energy consumption. Hotels are the largest consumers of energy since they offer a number of energy-intensive contents and consume energy day and night. Most energy (nearly half of the total consumption) is used because of the constant need for heating or cooling. About 15% of total energy consumption in hotels is used for hot water production, while the share of energy consumption for lighting varies between 12 and 18% (Hotel Energy Solutions, 2011). The irrational, excessive energy consumption in hotels and the energy consumption related to the flow of traffic both increase the emission of greenhouse gases (mainly carbon dioxide) into the atmosphere. The UNWTO predicts that by 2035, tourism accommodation facilities and transportation will become the largest emitters of carbon dioxide, with a share of 24% (UNWTO, 2008). A number of everyday hotel operations and activities such as heating, cooling and lighting, hot water production, meal preparation and various energy-consuming guests' activities are dependent on the consumption of electricity and heat. Energy consumption is significantly influenced by various factors such as: the size of the hotel, its classification, location and occupancy rate, as well as the different rules, procedures and policies of the hotel. Therefore, the aim of this paper is to analyse and propose new measures to increase energy efficiency, reduce energy costs and achieve sustainable local development, using the example of hotel companies on the Crikvenica - Vinodol Riviera. The analysis can be used as a base for decisions on the introduction of new energy efficiency measures. The analysis was conducted on a small, medium and large hotel in order to determine whether the hotel size affects the return on investments. To the best of our knowledge, there has been no previous attempt to address the relationship between the hotel size and the return on investment on the Crikvenica-Vinodol Riviera. Many studies have been initiated and conducted by engineers and architects, but only few have been carried out by academics in tourism and hospitality. Therefore, this paper tends to fill the research gap. Based on the conducted economic-financial analysis, the authors suggest new measures for reducing energy costs.

The paper is structured as follows. The following section provides the conceptual framework of the analysis. Section two explains the used methodology and hotel characteristics used as the research sample. The preliminary analysis of the payback period on investment for the hotels on the Crikvenica-Vinodol Riviera is undertaken in section three. Section four provides the model of empirical investigation and proposes new energy measures needed for the achievement of sustainable local development. Section five concludes.

1. LITERATURE REVIEW

Hotel energy consumption is affected by various physical and operational factors (Chan, 2012). Some of the physical factors that affect energy use and are common to most facilities (including hotels) are: the size, structure and design of the building, its geographical location and climate, the age of the building, the type of energy and water systems installed and the way they are operated and maintained, local availability of energy and water resources, and energy-use regulations and costs (Bohdanowicz and Martinac, 2007). On the other hand, operational factors include operating schedules for the different functional facilities in the hotel building, the number of facilities (restaurants, kitchens), 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 question is whether there exists an ideal tourist who has a less harmful effect on the environment (Dwyer, 2016). Many authors have attempted to measure the environmental impact of various types of tourists (Lundie, Dwyer and Forsyth, 2007).

Schipper (1982) identified human behaviour as the main global driver of energy consumption in all the sectors of a society. A set of behavioural change indicators (attitudes) and practices were assessed. The prioritisation of behavioural change stemmed from the previous finding by Farrou et al (2012) which concluded that this energy saving method had a more significant impact on reducing energy consumption than technical processes. Behavioural change was also found to be the cheapest energy saving method amongst engineering and alternative energy use.

Since the interactive industry effects must be taken into account, a CGE model gives us an ideal tool with which to explore the broader sustainability aspects of yield. Thus, with a model such as MMRF-Green (Pezzey and Lambie, 2001), it is possible to estimate the environmental impacts of tourism in more detail.

Rational management and control of energy costs can lead to significant energy savings in hotels. Namely, a large part of the total energy consumption in hotels refers to certain unnecessary actions and losses. The guests are usually given full control over the heating or cooling of the room. The problem arises when they (consciously or unconsciously) adjust the device to the wrong temperature, often leaving windows and doors opened simultaneously to the operation of the cooling or the heating system, thus causing an irretrievable loss of energy. Likewise, energy is often wasted when guests leave the heating or cooling system running throughout the day, although the room is unoccupied for long periods of time (60-65% of the day). This problem can be solved by using intelligent hotel rooms (Krstinić Nižić, Karanović and Ivanović, 2008). Thus, it can be said that 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, depending on the operating procedures, the age and size of the hotel, and the equipment and its maintenance, the hotels have the potential to save 10-15% of the energy they consume (Deng, 2003).

In general, hotel energy efficiency represents the relationship between the achieved level of energy performance and the amount of energy consumed to achieve it (Hon-Wan, Xu, Qian, 2011). In the building industry, energy efficiency means using less energy for heating and cooling, ventilation, lighting and hot water production, without lowering the level of comfort and sense of well-being in the room. The implementation of the EU Directive aims to reduce energy consumption by 20% by 2020 (European Commission, 2012). The building sector has been recognized as having the greatest potential to reduce overall energy consumption and emissions (Peršić Živadinov, 2013).

Energy efficiency in a hotel is achieved through "basic changes in technology usage, the mode of employees' behavior and the set policies and procedures of the hotel" (Pavlović, 2008). Therefore, in the attempt to achieve greater energy efficiency, there is a growing trend of using renewable energy sources for producing electricity and heat, as well as the increased implementation of a variety of new energy-efficiency measures (energy-efficient equipment, new rules, procedures and policies) in the hotel business. It is estimated that hotels in general can save 15-20% of the energy they consume, while in case of replacing the existing equipment with energy-efficient one and improvements in insulation and design, hotels could save over 45% of energy (HES, 2011).

The goal of energy efficiency in hotels is reducing energy consumption with financial savings, reducing maintenance costs and extending the hotel lifetime, as well as contributing to environmental protection and reducing harmful emissions and global climate change (Su, Hall and Ozanne, 2013). Likewise, investments in energy efficiency contribute to the increased value of the facility in case of sale. While energy efficiency is becoming a priority in the operations of the hotel, there are still many obstacles which hinder energy-efficient investments in hotels (Chan and Siu, 2008). Some of the obstacles are: the lack of data on energy consumption and costs; the lack of knowledge and awareness of hotel management about the benefits of achieving energy efficiency; the perception that high energy consumption is required to ensure the desired comfort for the customer; the reluctance of hotel management to implement more measures than prescribed; the high cost of modern energy-efficient equipment; non-recognition of financial interests and profit opportunities, etc. (Palm, Thollander, 2010). Since the Croatian accession to the European Union, all hotels must have an energy certificate. Energy certificate is a document showing the energy performance of the building, which has a prescribed content and layout, and is issued by an authorized entity (OG 76/07, 38/09, 55/11, 90/11). It is based on the calculated energy requirements for heating and hot water production and the conducted energy audit (OG 81/12, 29/13 and 78/13). Energy audit was examined in the study by Burritt and Saka (2006), who pointed out that it is useful for identifying operational activities, appliances and services for which energy is used and for prioritising energy saving by providing the operators with key information.

2. METHODOLOGY

Although the factors affecting hotel energy consumption are clear and precise, there is still no universal model for the evaluation of energy consumption in relation to the significantly different types of facilities in the hotel sector. The attempts to find a unique model for estimating energy consumption have resulted in several differences: the applicability, the number of variables involved, the data collection, control procedures, as well as the modelling methodology. The total energy consumption is generally described by the linear regression model (UNWTO, 2011). The analysis of the actual energy consumption and data on hotel facilities uses the regression model (Xuchao, Priyadarsini, 2010) to identify the most significant variables that influence energy consumption. Although many variables affect energy consumption in hotels, in practice only a few of them are considered, depending on data availability. These are:

hotel standard, hotel floor area (or the number of rooms or beds), heating and cooling degree days, occupancy rate, hot meals sold, heated swimming pool, food preparation facilities, comfort level, chain affiliation, and the awareness of staff and guests regarding the efficient use of resources. Although the structural characteristics of the building (wall insulation, etc.) and the equipment used for heating, cooling, hot water production, lighting, etc. can have a significant impact on energy consumption, these are generally not considered in modelling studies due to a lack of data.

Outdoor temperatures, hotel floor area and sometimes the number of overnight stays, hotel standard and the presence of a heated swimming pool are the most common factors that influence observed variations in specific consumption figures, although this may vary depending on the characteristics of the hotel sample used and the availability of data. These are therefore the major determinants to consider in energy consumption modelling and hotel benchmarking (HES; 2011).

Creswell et al (2009, 245) state that "case study focuses on an issue or concern in one bounded case". In this study, the case refers to the hotel and its energy consumption. The survey was conducted in the northern Adriatic region of Kvarner, the Crikvenica-Vinodol Riviera. 18 hotels categorized with 3* and 4* were registered and accessible online on the Kvarner Tourist Board database. 6 hotels were selected for analysis: two small (A1 and A2), two medium (B1 and B2) and two large hotels (C1 and C2).

This study aims to analyse the correlation between hotel size and reactive energy consumption. The study uses primary and secondary data sources to answer specific research questions. Interviews were conducted with the managers of the 6 selected hotels. In order to adequately answer certain research questions, the authors were allowed insight into electricity invoices for the year 2016. This provided information on the annual reactive energy consumption and its ratio in the total energy consumption.

Reactive energy is the energy required for the operation of various inductors such as electric motors, lighting and other inductive consumers. Reactive energy is the result of a phase shift between the current and voltage at the angle φ, i.e. the current lagging behind voltage at the zero crossing point.

The authors wanted to know whether the managers knew which energy-consuming product used the most reactive energy; whether there were any measures implemented in order to reduce the overall energy consumption and whether the hotels used renewable energy sources. The research questions led to the development of the following hypotheses:

H1: There is a correlation between hotel size and reactive energy consumption
H2: There is a correlation between new technologies and reactive energy consumption

The examination of the costs proves the fact that energy costs have a significant role in every hotel. Also, part of every hotel's total energy consumption is the reactive energy. This ratio is the lowest in large hotels (below 1%); in small hotels it amounts to around 3.5%, while the highest ratio (above 5%) is in the medium-size hotel B2.

50% of the managers have already implemented energy efficiency measures. Table 1 shows the characteristics of each hotel in relation to the star-category, hotel renovation (facade, rooms), the number of rooms, and the use of new technologies.

Table 1: **Hotel characteristics**

Hotel	**Category**	**Hotel renovation**	**Number of rooms**	**New technologies**			
				LED lighting	Intelligent room	Heating and cooling systems – Heat pump system	RES
A1	3*	2002	17	no	no	yes	yes
A2	4*	2004	15	partially	yes	partially	no
B1	3*	2014	50	yes	no	yes	no
B2	3*	2002	54	partially	no	partially	no
C1	3*	2002	93	partially	yes	yes	no
C2	4*	2016	152	yes	yes	yes	no

Source: Authors' research

When asked if they knew which energy-consuming product used the most reactive energy, all but one of the managers responded negatively. Only the manager of the C2 hotel answered affirmatively, which was to be expected since that is also the hotel with the lowest ratio of reactive energy consumption.

Reactive energy is calculated using the following formulae: (Riese, 2012)

Q = reactive energy
P_{max} = maximum active energy
$\tan \varphi 1 = \frac{reactive\ energy}{active\ energy}$
$\cos \varphi = 0{,}95$ – defined by HEP (the national power company); the maximum power factor at full load
$\tan \varphi 2$ is obtained from the table
$Q = P_{max} \cdot (\tan \varphi 1 - \tan \varphi 2)$

The resulting value determines the required strength of the compensator to be installed. From Table 1 and the data obtained, it can be determined whether there is a correlation between the size of the hotel and reactive energy consumption and whether new technologies influence that consumption. The results are shown below.

3. FINDINGS AND EVALUATIONS

The resulting values and the data from Table 1 indicate that the size of the hotel does not correlate to reactive power consumption.

The highest reactive energy consumption is recorded in the medium-size hotel B2 with 54 rooms, while the lowest is in the large hotel C2, which has 152 rooms.

Therefore, the first hypothesis can be rejected since it has been proven that the number of rooms (as indicator of the hotel size) does not affect reactive energy consumption.

However, the correlation between new technologies and reactive energy consumption does exist. The hotels that use new technology (LED lighting, smart rooms, central heating and cooling system - heat pump) have lower annual reactive energy consumption.

Table 2 shows the annual reactive energy consumption of each hotel (in HRK), the value of reactive energy (Q), the amount of investment (price and installation of a compensator - assessment of the company RITEH in Rijeka, in HRK), and the anticipated return on investment period.

Table 2: **Economic and financial analysis**

Hotel	Annual reactive energy consumption (HRK)	Reactive energy Q (damage)	Investment in compensator installation (HRK)	Payback period
A1*** (17 rooms) Selce	**1.852,50**	**8,62**	**13.616,50**	**7,5 years**
A2**** (15 rooms) Novi Vinodolski	**1.948,75**	**7,86**	**13.616,50**	**7 years**
B1*** (50 rooms) Selce	**3.647,63**	**15,27**	**25.654,13**	**7,5 years**
B2*** (54 rooms) Crikvenica	**7.102,44**	**20,85**	**26.301,50**	**4 years**
C1*** (93 rooms) Selce	**1.626,75**	**6,13**	**25.654,13**	**15 years**
C2**** (152 rooms) Selce	**222,94**	**1,76**	**-**	**-**

Source: Authors' research

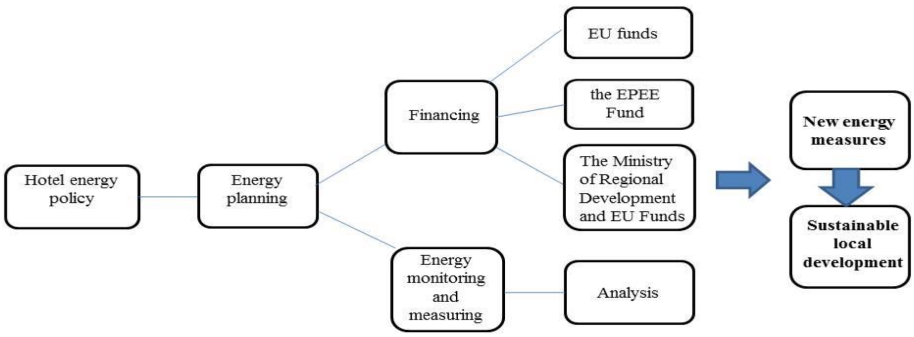
Table 2 shows that the payback period for investment is shortest in the medium-size hotel B2, followed by the small hotels A2 and A1. The large C2 hotel does not even require compensator installation as its consumption of reactive power is insignificant.

The economic and financial analysis in our study has shown that the return on investment is not affected only by the hotel size. There are many factors that should be considered: the structure and design of the building, the age of the hotel, the types of energy sources used, and whether the hotel uses energy-efficient equipment and appliances, central heating / cooling systems, adequate lighting, and renewable energy sources. All of the above represents a limiting factor for this work, but also a recommendation for calculating energy costs for future works. Rational management and control of these factors can lead to significant energy savings.

4. NEW ENERGY MEASURES – RECOMMENDED IMPLEMENTATION

Based on the conducted economic and financial analysis, the authors propose a number of measures for energy management, energy saving and increasing energy efficiency according to the following proposed scheme.

Figure 1: **New energy measures – way to sustainable local development**



Source: Authors' research

The first step towards energy saving is the hotel's energy policy. Every hotel should have a defined energy policy, which implies both short-term and long-term goals related to energy and energy consumption.

The second step is energy planning. Planning implies the adoption of action plans necessary to improve the energy features of the hotel in accordance with its energy policy.

Energy monitoring and measuring is the third step. According to Baker (2008), monitoring energy use also gives an indication of how important are the energy use and its related costs for hotel managers. One of the solutions is staff training which would enable them to monitor energy consumption. Another solution is the installation of energy monitors which provide real time data on energy consumed for the achievement of the desired level of comfort.

The fourth step is financing. The Environmental Protection and Energy Efficiency Fund, the Ministry of Regional Development and EU Funds play a key role in promoting energy efficiency measures. The Fund also co-finances the service sector.

Analysis is the fifth step. Data analysis provides guidelines for developing action steps in order to continually improve energy planning at the hotel.

All of these steps lead to new energy measures, which in turn contribute to sustainable local development. Thus, energy efficiency has multiple effects on both local development and the hotel itself, since it reduces air pollution and greenhouse gas emissions, encourages investment in infrastructure and creates new jobs.

5. CONCLUSION

From the beginnings of tourism development until today (when tourism is seen as a mass phenomenon with steadily increasing hotel occupancy rates) there has been a significant increase in hotel energy consumption. In addition to the increased capacity utilization, higher energy consumption in hotels is also the result of new guests' needs and wishes. Modern guests are demanding more services and activities, expect a fast Internet connection, TV, air conditioning and similar energy-intensive equipment. Irrational and inefficient use of energy in hotels represents a major environmental and economic problem. Therefore, the hotels are advised to transition to a sustainable business model by using renewable energy sources and implementing different energy efficiency measures. This would improve their economic situation (reduction of energy costs) and reduce the negative impact they have on the environment in which they are located.

One of the possibilities for increasing energy efficiency in hotels is the use of renewable energy sources. However, since the high price of renewable energy systems is often a barrier to their implementation, another option is the introduction of new energy measures that do not require large financial expenditures. By systematic planning and creation of hotel energy policy, results can be quickly achieved.

Our research has several important limitations. This primarily refers to the factors that were not included in the analysis, such as outdoor temperature, hotel floor area, the number of overnight stays, the presence of a heated swimming pool etc. These are the most common factors that influence observed variations in specific consumption figures, although this may vary depending on the characteristics of the hotel sample used and the availability of data. Another limitation is the research sample. The analysis included 33% of the total number of 3* or 4* hotels on the Crikvenica –

Vinodol Riviera. Recommendation for future research is to expand the sample to the whole Adriatic part of Croatia.

This work contributes to the scientific and professional community in that it suggests new energy measures to reduce negative impact on the environment while improving energy sustainability, which in turn facilitates sustainable local development. In order for these measures to be properly implemented, it is necessary to educate the personnel at all levels and to conduct further empirical research. Continued research on the development and operationalization of energy measures will allow destination managers to develop their marketing and production policies relying on empirical data, which will contribute to the achievement of sustainable local development.

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