The Energy Management as a sustainability factor on Tourism.

Case studies of accommodation services and other services in Sintra.

Ana Rita Figueiredo Fernandes Agostinho

Extended Abstract

November 2014

ABSTRACT

Currently the energy is essential for the development of activities, and the tourist sector is not an exception. The tourist activity is one of the most dynamic areas of the services sector, characterized by an enormous expansion over the last years. Inclusively, it is impossible to dissociate the tourist activity from the energy consumption, not only due to the unambiguous energy needs for accommodation services and cultural and leisure services, but also due to the energy consumption by the transport facilities.

The main objectives of this thesis are the characterization and the analysis of the energy performance and the searching for sustainability of tourist buildings, particularly the accommodation services and the cultural and leisure services, where the Almáa Sintra Hostel, the Casa do Valle *bed and breakfast*, the Lawrence's Hotel and the cultural and leisure services managed by the enterprise Parques de Sintra – Monte da Lua were selected as case studies, being all located in the village of Sintra. Therefore, their main performance levels, namely energy indicators, were systematized, being positioned in relation to the international performance indicators.

The obtained indicators, regarding energy monthly consumption, are the following: Almáa Sintra Hostel – 1,09 kgoe/guest/night, Casa do Valle – 6,98 kgoe/guest/night, Lawrence's Hotel – 8,36 kgoe/guest/night and Parques de Sintra – Monte da Lua – 0,19 kgoe/visitor.

In order to improve the conservation and the management of energy resources and, consequently, the energy performance, should be hinged factors like the environmental issues awareness, the competitiveness increase, the importance of reducing costs and the renewable technologies development.

Keywords: Energy audit, energy management, energy performance**,** tourism sustainability

1. INTRODUCTION

Energy is essential to carry out daily activities, either on ecosystems or on human activities. Nonetheless, the world energy demand reached levels that will be unsustainable in the future, mainly due to the increase of population, its style of life and the fact that fossil fuels are limited and their use cause significant adverse environmental impacts (Dall'O', 2013).

According to IEA (2013), the energy consumption has been increasing over the years. In 2011, the primary energy consumption was 13.113 Mtoe and the final energy consumption was 8.918 Mtoe, corresponding to the emission of 31.342 $MtCO_2$-eq (approximately 12,34 $kgCO_2$-eq/person/day).

The growing concern among national and international governments and global institutions has led to the establishment of laws and to the adoption of strategies to minimize energy consumption, as well as greenhouse gases emissions. As examples, there is the Kyoto Protocol adoption, at international level, and the 20-20-20 targets setting, at European level.

With respect to tourist activity, it is impossible to dissociate it from energy consumption, not only due to the unambiguous energy needs for accommodation services and cultural and leisure services, but also due to the energy consumption by the transport facilities. Accordingly, the performance levels systematization of tourist services is essential to assess and to enhance their performance,

contributing to the creation of favorable conditions to improve the conservation and the management of energy resources.

1.1. Objectives

The main objectives of this thesis are the analysis of the energy performance and the searching for sustainability of tourist buildings. Particularly, the accommodation services (hotel and local accommodation with different typologies) and the cultural and leisure services (natural parks) will be characterized and their main performance levels, namely energy indicators, will be systematized, being positioned in relation to the international performance indicators. As a result, critical performance issues can be identified, enhancing the implementation of retrofit actions.

1.2. Methodology

As a first approach, the methodology includes the state of the art review regarding energy management – performance and sustainability – namely concepts and management and assessment approaches that contribute to the building sustainability.

Subsequently, international energy performance indicators of accommodation services and natural parks are systematized, in order to be compared with the case studies indicators. As case studies, were selected three accommodation services with different typologies – the Almáa Sintra Hostel, the Casa do Valle and the Lawrence's Hotel – and a management entity of natural parks – the Parques de Sintra – Monte da Lua – which are located in the village of Sintra and joined the project "Sustainable Tourist Destination – Sintra", developed by LiderA, and expressed prompt and total availability.

In the case studies, for each tourist service, initially are made on-site visits, in order to conduct a detailed survey concerning all the energy consuming and producing equipments. The energy survey starts with the areas identification where energy consumption or production occurs. Afterward, it is registered the number of equipments and, where it is possible, the power. When it is not possible to obtain the exact power, it is estimated. Then, are defined operation periods of each equipment, taking into account the information given by the employees and the assessed information during on-site visits and, regarding the accommodation services, monthly occupancy rates are registered as well. After that, it is developed a model to estimate the average monthly consumption and the use patterns and, after new on-site visits and adjustments in each model element, it is validated. Its validation is made by comparison with the average monthly consumption obtained from the energy consumption bills, enabling the tourist services characterization. Thereafter, the performance of each tourist service is evaluated, positioning them in relation to the previous analyzed international performance indicators.

Lastly, it is held a discussion of the approach, where the limitations and the potentialities are demonstrated, and are suggested recommendations for improving energy management.

2. ENERGY MANAGEMENT: PERFORMANCE AND SUSTAINABILITY CHALLENGES – STATE OF THE ART

Energy is a physical quantity, defined as the capacity of objects and systems perform mechanical work. Being the work an indirect energy measure, the energy is usually explained taking into account

its behavior, instead of using a definition of what it “is”. One property of energy is its conservation, meaning it can neither be created nor destroyed, but can be transformed (Krarti, 2010). There are several energy transformation processes, energy sources and energy forms.

Energy management consists in the operational planning of energy production and consumption units, contributing for energy resources conservation and minimization of adverse impacts and costs. According to ISO 50000 family standards, there are four forces in managing energy: the management system implementation, the acquisition of energy efficient tools and techniques, the periodic evaluation of the energy performance and the organizational engagement (ISO, 2014).

The importance of the built environment, which is responsible by 40% of energy consumption and by 38% of greenhouse gases emissions in the world, has been setting challenges and shifting the building paradigm because of its vast impact on the environment, economy, health and productivity of the building occupants (WBCSD, 2008). At European level, besides the 20-20-20 targets promulgation, it was defined in 2002 the Energy Performance Building Directive (EPBD) about the energy performance of residential and service buildings.

Worldwide, in order to ensure the sustainability of the built environment during its life cycle, there have been created assessment systems, as the BREEAM, the LEED and the LiderA. The first two are the main systems at a global scale, while LiderA is the main one in Portugal (Ganhão & Amado, 2012).

With respect to the energy performance assessment, the main employed approaches are: measurement, simulation models and energy auditing.

Starting with the measurement approach, there are plenty instruments to measure environmental parameters and systems performance, where the more common instruments categories are: thermal comfort, envelope performance, mechanical systems and electric systems (Capehart et al., 2011).

On the topic of simulation models, they are tools that enable the execution of a complex, 3D and accurate simulation of the buildings behavior. There are several softwares used worldwide, like EnergyPlus, TRNSYS, ESP-r, eQUEST and DesignBuilder (U.S. DOE, 2014).

As regards energy auditing, depending on the operational level, it can include not only the performance comparison with a referential, but also the environmental parameters and systems measurement and the use of simulation models. It is a systematic verification of a building or a system, which main goals are: characterize and quantify each energy form; evaluate the performance and management of energy production and consumption systems; identify energy rationalization opportunities in economic, technological and environmental terms (Dall’O’, 2013).

With concern to management approaches, the implementation of an environmental management system (EMS) is one of the most efficient ways to ensure the optimization of the production processes of any organization, while its environmental aspects are managed in a systematic and consistent manner (Nogal, 2007; Staniskis & Stasiskiene, 2005). There are several guidelines for EMS implementation and certification in organizations, like the ISO 14001 standard and the Eco-Management and Audit Scheme Regulation. Regarding energy, exist the ISO 50001 (energy management systems) and the ISO 50002 (energy audits) standards, and there are under development four more ISO 50000 family standards. In relation with the tourism, there are also

available instruments, such as the International Tourism Partnership, the Green Key, the Eco-Hotel and the Green Globe (Sebastião, 2010; Nogal, 2007).

Another management approach relies on energy service companies (ESCOs), which develop, execute and finance retrofit projects, assuming the risks (eu.bac, 2014).

To sum up, the energy management is crucial to reach a good energy performance and the sustainability of the built environment, being available several energy performance assessment and management approaches, which should be used in accordance with the concerned situation.

3. INTERNACIONAL GOOD PRACTICES

With the purpose of analyzing the current strategies implemented by the management entities of tourist services, namely accommodation services and natural parks, it was conducted a survey where were obtained international environmental performance indicators, in order to assess the performance of the case studies of this thesis. The international indicators concerning accommodation services are presented in table 1, whilst international indicators regarding natural parks are presented in table 2.

Table 1 – International indicators regarding the energy performance of accommodation services (LiderA, 2013)

Units	Higher values	Average values	Best practices
kWh/guest/night	229,50 Aparthotel Miravillas (Portugal)	46,40	9,22 Apartamentos Nova (Spain)
kWh/room/night	293,27 Aparthotel Mirante (Portugal)	75,10	12,80 Scandic

Table 2 – International indicators regarding the energy performance of natural parks (adapted from Magalhães, 2013)

Form of Energy	Units (monthly)	Higher values	Average values	Best practices
Electricity	**kWh/km^2**	260,19 Zion Natural Park (USA)	32,36	7,39 Parco Nazionale Gran Paradiso (Italy)
	kWh/visitor	3,75 Glacier National Park (USA)	0,17	0,01 Parque Nacional de Teide (Spain)
	kWh/employee	257,50 Central Balkan NP (Bulgaria)	110,11	53,83 Parque Nacional de Teide (Spain)
Gas (facilities)	**m^3**	1.446,25 Parco Nazionale Dolomiti Bellunesi (Italy)	533,83	284,02 Parc Nacional d'Aigueestortes i Sant Muriol (Spain)
Diesel (vehicles)	**l**	11.602,92 Glacier National Park (USA)	259,58	45,53 Parco Naturale Regionale Di Montemarcello-Magra (Italy)

As it is possible to notice, the energy performance depends on diverse factors like the level of offered services, the geographic context, the architecture, the systems, the users and the environmental policies and management. With respect to accommodation services, the Apartamentos Nova and the Scandic have the best practices. Regarding the natural parks, the Parque Nacional de Teide has the highest number of best practices indicators.

4. CASE STUDIES

The selected case studies, as referred previously on the methodology, can be divided in accommodation services – the Almáa Sintra Hostel (ASH), the Casa do Valle (CV) and the Lawrence's Hotel (LH) – and in other tourist services – the tutored parks by the Parques de Sintra – Monte da Lua enterprise (PSML) – being all located in the village of Sintra. The tutored parks by PSML, and their buildings, are the Park of Monserrate, the Farmyard of Monserrate, the Park of Pena

and the PSML Information House. The Park of Pena is formed by the National Palace of Pena, the Moorish Castle, the Chalet of Countess of Edla and the Pena Stables, which are national heritage.

In the absence of a record of the several energy consuming and producing systems and equipments, that are presented on the accommodation services, under the scope of this thesis was conducted a detailed survey of all the equipments, regardless of the consumed energy form. With regard to the other tourist services, it was updated the survey conducted in 2012. Thereafter, it was developed a model to estimate the consumption values and the use patterns, making possible the tourist services characterization. Sequentially, it was conducted the following methodology, for each case study:

1) Identification of all the areas where exists energy consumption and production;
2) Performance of a detailed energy survey in each area, registering the number of equipments and, where is possible, the power (Watt/unit), otherwise the power was estimated;
3) Definition of operation periods of each equipment (hours/day), taking into account the information given by the employees and the information assessed during the energy survey. Besides, about the accommodation services, the monthly occupancy rates were registered;
4) Calculation of the average monthly energy consumption (kWh/month);
5) Validation of the model by comparing the estimated value with the billed energy consumption, and after further adjustments of each model element.

4.1. Accommodation services

The **ASH** consumes energy in two different forms: electricity (lighting, heating and several equipments (informatics, kitchen, refrigeration, laundry)) and propane gas (cooker and a boiler for domestic hot water and heating). For the time period from April 2013 to March 2014, the obtained energy consumption values are: electricity – 987,92 kWh/month; 3,06 kWh/guest/night; 10,70 kWh/room/night; and for propane gas – 240 kg/month. In relation with the electric consumption distribution by end use, the sectors with the highest fraction of energy consumption are the “Others” sector and the “Heating” sector (31% and 25%, respectively). On the “Others” sector are comprised the informatics equipments, hairdryers and cleaning equipments, while on the “Heating sector” are enclosed the electric heaters presented in each room.

The **CV**, a bed and breakfast, consumes energy in two different forms: electricity (lighting, heating, ventilation, pumps (swimming pool and lake) and several equipments (informatics, kitchen, refrigeration, laundry)) and diesel (boiler for domestic hot water). For the time period from January to September 2013, the obtained energy consumption values are: electricity – 5.505 kWh/month; 27,27 kWh/guest/night; 54,53 kWh/room/night; and for diesel – 264,30 l/month. In relation with the distribution of the electric consumption by end use, the “Heating and Ventilation” sector and the “Laundry” sector have the highest fractions of energy consumption (20% and 18%, respectively). The “Heating and Ventilation” sector is constituted by the heating and ventilation equipments presented in each room, whilst the “Laundry” sector is composed by a washing machine and a drying machine.

The **LH** consumes energy in two different forms: electricity (lighting, air conditioning, boiler for domestic hot water and several equipments (informatics, kitchen, refrigeration, elevator, audiovisuals)) and propane gas (cooker, oven and grill). For the time period from September 2013 to January 2014, the obtained energy consumption values are: electricity – 17.934,40 kWh/month; 37,41

kWh/guest/night; 74,82 kWh/room/night; and for propane gas – 135 kg/month. In relation with the distribution of the electric consumption by end use, the "Boiler" sector and the "Kitchen" sector are the ones with the highest fractions of energy consumption (30% and 29%, respectively). On the "Boiler" sector are included three boilers for domestic hot water, whereas on the "Kitchen" sector are encompassed the equipments presented on the kitchen.

4.2. Other tourist services

The tutored parks by **PSML** consume energy in four different forms: electricity (lighting, acclimatization and several equipments (informatics, kitchen, workshop and appliances)), propane gas (kitchen equipments), agricultural diesel and gasoline (agricultural work and construction work). For the time period from January 2013 to May 2014, the monthly energy consumption values are: electricity – 75.868 kWh; 62.468,51 kWh/km^2; 0,82 kWh/visitor; 523,23 kWh/employee; for propane gas – 54,06 m^3; and for agricultural diesel and gasoline – 1.762,55 l.

With concern to the Farmyard of Monserrate, it was implemented a renewable energy system in 2013, where the power generation is made by wind, hydro and solar photovoltaic energy. The purpose was to become entirely autonomous the Farmyard of Monserrate, regarding energy point of view. It was projected the renewable energy production would be 393,39 kWh/month, but since the wind energy is not corresponding to the projected estimations, it is assumed the projected production (hydro and solar photovoltaic) is 358,81 kWh/month. Once the average energy needs of the Farmyard of Monserrate correspond to 288 kWh/month, the renewable energy production covers its energy needs.

5. DISCUSSION OF RESULTS

Through the followed methodology, it is confirmed that it was possible to characterize and assess the energy performance of diverse tourist services, being accomplished the thesis main objectives. For that purpose, it was necessary to estimate the energy consumption of a variety of systems and its quantification regarding end use, as well as to conduct a detailed survey of the energy performance data. The application of the developed model to the case studies has differences between 1% and 4% with the billed data, revealing a good calibration and validation of the models. The main energy performance indicators of the studied accommodation services, as well as the international performance indicators from table 1, are represented in table 3, in order to be compared.

Table 3 – International energy performance indicators and of the studied accommodation services

Accommodation Services		International			Case Studies		
		Higher values	Average values	Best practices	Almáa Sintra Hostel	Casa do Valle	Lawrence's Hotel
Electricity	kWh/guest/night	229,50	46,40	9,22	3,06	27,27	37,41
	kWh/room/night	293,27	75,10	12,80	10,70	54,53	74,82
	kWh/month	-	-	-	987,92	5.505,00	17.934,40
	kWh/m^2.month	-	-	-	2,02	18,65	12,51
Propane	kg/month	-	-	-	240	-	135
Diesel	l/month	-	-	-	-	264,30	-
TOTAL	kgCO_2-eq/month	-	-	-	705,53	3.286,14	8.826,03
	toe/month	-	-	-	0,352	1,410	4,006
	kgoe/guest/night	-	-	-	1,09	6,98	8,36

The values reveal that the three accommodation services have different performances among them, being positive in general, once when the accommodation services indicators are compared with the international indicators, they are below the average values.

With respect to electricity consumption, the ASH indicators (3,06 kWh/guest/night and 10,70 kWh/room/night) are lower than the best practices (9,22 kWh/guest/night and 12,80 kWh/room/night), representing an exemplar performance. On the other side, the CV indicators (27,27 kWh/guest/night and 54,53 kWh/room/night) and the LH indicators (37,41 kWh/guest/night and 74,82 kWh/room/night) are below the average values (46,40 kWh/guest/night and 75,10 kWh/room/night). This behavior is in function of each accommodation service typology and, consequently, depends on the level of offered services. Considering monthly consumption indicators, they have the same behavior as the previous indicators: the highest indicator belongs to the LH (17.934,40 kWh/month) and the lowest one belongs to the ASH (987,92 kWh/month). With regard to the area, since the LH has a higher construction floor area compared with the CV, the highest indicator belongs to the CV (18,65 kWh/m^2.month).

As concerns the propane consumption, the ASH consumption (240 kg/month) is higher than the LH consumption (135 kg/month). About the diesel consumption by the CV, it is 264,30 l/month.

The tendency of monthly CO_2-eq (carbon dioxide equivalent) emissions is, once more, led by the LH (8.826,03 $kgCO_2$-eq), followed by the CV (3.286,14 $kgCO_2$-eq). The ASH has lower emissions (705,53 $kgCO_2$-eq) and they only concern about propane consumption, since the hostel has a contract with the energy operator that aims the electricity production from renewable sources. In contrast, the CV and the LH emissions are marked by electricity consumption.

To conclude the discussion of the accommodation services results, the indicators regarding the conversion of final energy to primary energy (toe), as well as the indicators concerning the primary energy consumption per guest/night, are in function of the accommodation services typologies and the level of offered services. The ASH has the lowest indicator (1,09 kgoe/guest/night), followed by the CV (6,98 kgoe/guest/night), and the highest indicator belongs to the LH (8,36 kgoe/guest/night).

With concern to the obtained results of PSML, its main energy performance indicators are represented in table 4, as well as the international performance indicators from table 2.

Table 4 – International energy performance indicators and of PSML (monthly)

PSML		International			Case Study	
		Higher values	Average values	Best practices	PSML – 2012	PSML – 2013/2014
Electricity	kWh/km²	260,19	32,36	7,39	50.903,46	62.468,51
	kWh/visitor	3,75	0,17	0,01	0,68	0,82
	kWh/employee	257,50	110,11	53,83	360,48	523,23
Propane	m^3	1.446,25	533,83	284,02	32,84	54,06
Agricultural Diesel and Gasoline	l	11.602,92	259,58	45,53	611,83	1.762,55
TOTAL	$kgCO_2$-eq	-	-	-	30.772,38	40.303,93
	toe	-	-	-	13,866	17,857
	kgoe/visitor	-	-	-	0,15	0,19

Regarding the electricity consumption in 2013/2014, the indicators that depend on the area (62.468,51kWh/km^2) and on the employees number (523,23 kWh/employee) are higher than the international higher values (260,19 kWh/km^2 and 257,50 kWh/employee). About the area, this is due

to the fact that PSML area is inferior, when compared to the areas of the international natural parks, and its monthly consumption is twelve times higher than the international average values. Relating to the employees number, although it is superior to the average values, it does not balance the monthly consumption.

In contrast, the indicator depending on the number of visitors (0,82 kWh/visitor) is in the range of the international values, being above the international average values (0,17 kWh/visitor) but below the higher values (3,75 kWh/visitor).

Comparing the electricity indicators obtained in 2012 with the ones obtained in 2013/2014, it is noticeable an increase in all the indicators. This is, perhaps, mainly due to the electricity consumption increase, which corresponds to an increment of 14.045,75 kWh/month. Although the PSML substituted lamps and equipments and renewed some infrastructures, for example on the National Palace of Pena, the increase on the visitors number and the construction of more visitor support areas, like on the Moorish Castle and the Pena Stables, contributed to the consumptions increase.

In relation with the propane consumption (54,06 m^3/month), it is lower than the best practices (284,02 m^3/month), since it was only used until November 2013 in one small fraction of equipments. The consumption increase, between 2012 and 2013/2014, is due to the introduction of a dish of the day on the menu of the Tea House of Monserrate.

With respect to the agricultural diesel and gasoline consumption (1.762,55 l/month), it is higher than the international average values (259,58 l/month) but lower than the higher values (11.602,92 kWh/month), due to the inclusion of agricultural vehicles consumptions and cars consumptions on the international indicator. Between 2012 and 2013/2014 occurred a significant consumption increment, mainly caused by the acquisition of new agricultural equipments and the construction work done.

Regarding the CO_2-eq emissions and the conversion of final energy to primary energy (toe), both indicators are strongly marked by electricity consumption. Both indicators augmented between 2012 and 2013/2014, as a result of the energy consumption increase. The indicator about primary energy consumption per visitor also increased, reaching 0,19 kgoe/visitor in 2013/2014.

Lastly, it is possible to say that the renewable energy project of the Farmyard of Monserrate is viable, covering its energy needs. Nevertheless, once the hydro exceeded the projected production estimation and, on the other side, the wind production is below the expectations, it is suggested to invest more on hydro and solar photovoltaic rather than on wind energy. Furthermore, the project could be adopted in other areas tutored by the PSML, where are available renewable energy sources.

Comparing the two tourist services, the primary energy consumption of the PSML is nine times higher than the consumption of the accommodation services, as well as the CO_2-eq emissions by the PSML are ten times higher. The characteristics of both tourist services are very divergent in terms of activities, offered services, number of involved people (employees and users) and areas management. Consequently, it is expected that the PSML has much higher consumptions, as result of its dimension and activities. Overall, it is clear the possibility to improve energy performance in all the case studies.

As regards the limitations and uncertainties, the estimation of monthly consumptions through the developed model has associated some uncertainty, due to the difficulty to assess operation periods, since they vary with the habits and the use patterns of users/employees. In addition, the power

estimation of certain equipments, where it was not possible to obtain the exact power, is another source of indetermination. Another point to consider concerns with the international performance levels, namely energy performance indicators, which are rarely infallible.

6. CONCLUSIONS AND FUTURE DEVELOPMENTS

The tourism is one of the sectors with significant direct impacts on the environment, being increasingly challenged to integrate and to enhance the environmental dimension and the sustainability. This can be achieved, for example, with the substitution of equipments, the awareness of employees and users and the implementation of environmental management systems and certification.

In this sense, this thesis addresses the subject of energy management and it is intended to show that it is a factor of sustainability in tourism. Were selected three accommodation services – the Almáa Sintra Hostel (ASH), the Casa do Valle (CV) and the Lawrence's Hotel (LH) – and the natural parks, and their buildings, tutored by the Parques de Sintra – Monte da Lua (PSML) enterprise.

In order to analyze the energy performance and the searching for sustainability of each case study located in the village of Sintra, the used methodology resulted, in a first phase, in a detailed energy survey of all the energy consuming and producing equipments, regardless of the consumed energy form. Subsequently, it was developed a model to estimate the average monthly energy consumption and the use patterns, which was validated by comparison with energy consumption bills. The application of the model to the diverse case studies presents differences between 1% and 4% with the billed data, revealing a good calibration and validation of the models. In a last phase, the energy performance of each tourist service was assessed, positioned them in relation to the international performance indicators of accommodation services and natural parks. To summarize, through the followed methodology, it was possible to characterize and to assess the energy performance of the diverse tourist services, achieving the thesis objectives.

With respect to the international energy performance indicators, they were systematized. About the best practices of accommodation services, they show an electric consumption of 9,22 kWh/guest/night and 12,80 kWh/room/night. For natural parks, the best practices (monthly) are: electricity – 7,39 kWh/km^2, 0,01 kWh/visitor and 53,83 kWh/employee; propane gas – 284,02 m^3; and diesel – 45,53 l.

The obtained energy performance indicators of the accommodation services are the following: ASH – 3,06 kWh/guest/night and 10,70 kWh/room/night, regarding electricity consumption, and 240 kg/month of propane; CV – 27,27 kWh/guest/night and 54,53 kWh/room/night, regarding electricity consumption, and 264,30 l/month of diesel; LH – 37,41 kWh/guest/night and 74,82 kWh/room/night, regarding electricity consumption, and 135 kg/month of propane.

The values reveal the three accommodation services have different performances among them, being positive, in general, once when the accommodation services indicators are compared with the international indicators, they are below the average values. Generally, the obtained indicators are in function of each accommodation service typology, depending on the offered services level, where the ASH has the lowest values and the LH has the highest ones, as it would be expected. About the primary energy consumption and the indicator regarding primary energy consumption per guest/night, the previous described behavior is applied, where the ASH has the lowest values (0,352 toe/month

and 1,09 kgoe/guest/night), followed by the CV (1,410 toe/month and 6,98 kgoe/guest/night) and, ultimately, is the LH (4,006 toe/month and 8,36 kgoe/guest/night).

The monthly energy performance indicators for PSML are: electricity – 62.468,51 kWh/km^2, 0,82 kWh/visitor and 523,23 kWh/employee; propane gas – 54,06 m^3; agricultural diesel and gasoline – 1.762,55 l; total – 17,857 toe and 0,19 kgoe/visitor.

The electricity consumption indicators, regarding the area and the number of employees, are extremely higher than the international best practices, being above the higher values. In contrast, the electricity consumption indicator, concerning the visitors number, and the agricultural diesel and gasoline consumption indicator are higher than the best practices, but are not above the international higher values. Regarding the propane consumption, it is lower than the best practices.

As regards the renewable energy project of the Farmyard of Monserrate, it is viable, covering its energy needs. Inclusively, it could be adopted in other areas tutored by the PSML, being an economically advantageous solution in remote places without connection to the grid and availability of renewable resources.

Comparing the energy conversion of final energy to primary energy (toe) by the two tourist services, it is possible to conclude that the PSML monthly consumption is nine times higher than the accommodation services consumption, as it would be expected. Additionally, the CO_2-eq emissions of the PSML are ten times higher than the accommodation services emissions. This is due to the fact that the characteristics of both tourist services are very divergent in terms of activities, offered services, number of involved people (employees and users) and areas management.

Therefore, it is expected the work done under the scope of this thesis would assist on the identification of critical energy performance aspects of the ASH, the CV, the LH and the PSML, in order to be improved, and on future requests of accommodation services and cultural and leisure services. With the role that accommodation services and cultural and leisure services have on tourism in general, their good practices and performance will have a reflection in the local environmental improvement and, subsequently, in the global one.

With interest to accomplish in the future, for covering the gaps in specific areas of the analyzed tourist services, it is important to think over:

- Analyze the energy consumption evolution of each tourist service;
- Enhance the developed models for each case study, allowing the improvement of some assumptions and the decrease of some uncertainties;
- Monitoring and reporting of energy performance data to employees and users;
- Analyze the retrofit actions implementation, like the equipments substitution, the awareness of users and employees, the change on spaces management and maintenance and the implementation of an environmental management system;
- Evaluate the need of specialized competences of an energy manager, for an efficient energy use.

REFERENCES

Capehart, B., Turner, W. & Kennedy, W. (2011). Guide to Energy Management (7th edition). The Fairmont Press.

Dall'O', G. (2013). Green Energy Audit of Buildings. A guide for a sustainable energy audit of buildings. Springer – Verlag London.

eu.bac (2014). About Energy Performance Contracting – European Association of Energy Service Companies. European Building Automation and Controls Association. (Retrieved August 2014 from http://www.euesco.org/index.php?id=2).

Ganhão, A. & Amado, M. (2012). Sustainable Construction : Energy Efficiency in Residential Buildings.

IEA (2013). Key World Energy Statistics. International Energy Agency. (Retrieved May 2014 from http://www.iea.org/publications/freepublications/publication/KeyWorld2013.pdf).

ISO (2014). Introduction to ISO 50002. How it fits into ISO 50001 family of standards. (Retrieved August 2014 from http://iet.jrc.ec.europa.eu/energyefficiency/sites/energyefficiency/files/files/documents/events/iso_50002_and_the_iso_50001_family_of_standards_-_iso.pdf , p. 6).

Krarti, M. (2010). Energy Audit of Building Systems: An Engineering Approach (2nd edition). CRC Press.

LiderA (2013). Avaliação de sustentabilidade em empreendimentos turísticos. Valores de referência do desempenho ambiental da indústria hoteleira, p.11.

Magalhães, D. (2013). Sistema de Gestão Ambiental aplicado à gestão do Carbono. Caso dos Parques em Sintra. Dissertação de Mestrado em Engenharia do Ambiente. Instituto Superior Técnico. Universidade de Lisboa.

Nogal, A. (2007). Implementação de um Sistema de Gestão Ambiental no sector da Hotelaria, Indústria de Viagens e Turismo, segundo o referencial EMAS. Implementação por fases baseada na Norma Britânica BS 8555:2003. Dissertação de Mestrado em Engenharia do Ambiente. Instituto Superior Técnico. Universidade Técnica de Lisboa.

Sebastião, I. (2010). Aplicação da Pegada Ecológica ao Turismo. Como a Pegada Ecológica pode Influenciar a Gestão Ambiental. Dissertação de Mestrado em Gestão e Políticas Ambientais. Faculdade de Ciências e Tecnologia. Universidade Nova de Lisboa.

Staniskis, J. & Stasiskiene, Z. (2005). Environmental management accounting in Lithuania : exploratory study of current practices, opportunities and strategic intents. Journal of Cleaner Production 14, pp. 1252–1261.

U.S. DOE (2014). Building Technologies Office. Building Energy Software Tools Directory. United States Department of Energy. (Retrieved May 2014 from http://apps1.eere.energy.gov/buildings/tools_directory/subjects.cfm/pagename=subjects/pagename_menu=whole_building_analysis/pagename_submenu=energy_simulation).

WBCSD (2008). Eficiência energética em edifícios. Realidades empresariais e oportunidades. Relatório Síntese. World Business Council for Sustainable Development.