ENERGY PROFILE AND ENERGY CONSUMPTION IN HOTELS IN THE WARM HUMID CLIMATE OF SOUTH EAST NIGERIA

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Abstract

Preliminary survey on the energy profile and usage in selected hotels in the warm humid climate of South East Nigeria are presented. The survey shows the various energy sources utilized by the hotels. A detailed analysis of a number of physical and operational factors that may influence the energy use in the hotels is being carried out. The statistical methodology employed to determine the magnitude of effects of the factors; utility bill for one year, age of building, worker density, average monthly occupancy level, power for lighting, power for water heating, power for cooling, air-conditioning, lifts, kitchen equipment, gross floor area, year of construction, hotel class, weather, etc on energy use is described. The study would establish the energy use index (EUI) of the hotel buildings and determine the energy saving potential of the hotel buildings under the prevailing climatic conditions. The study reveals huge potentials for integrating renewable energy technology such as solar outdoor lights, solar water heaters and solar cookers to replace fuel wood in the hotels. It is anticipated that the results of the full study will lead to the development of an energy rating scheme and building energy code for hotel buildings in Nigeria.

1. Introduction

Energy is an essential ingredient for socio-economic development and economic growth. The objective of any energy system is to provide energy services which are the desired and useful products, processes or indeed services that result from the use of energy, such as for lighting, provision of air-conditioned indoor climate, refrigerated storage, transportation, and appropriate temperatures for cooking. The energy chain to deliver these services begins with the collection or extraction of primary energy, which is then converted into energy carriers suitable for various end-uses. These carriers are used in energy end-use technologies to provide the desired energy services (Sambo, 1997). Thus, energy is an essential input to all aspects of modern life. It is indeed the livewire of industrial production, the fuel for transportation and for the generation of electricity in conventional power plants.

Over the past decade the hospitality industry has grown to become the single largest business sector worldwide, employing over 200 million people. On a global scale the tourist industry is estimated to account for one out of every 15 jobs (Bohdanowicz 2001, Zanki 2008). In general tourist activities bring income and jobs, increased understanding of foreign cultures, preservation of cultural and natural heritage, infrastructural investment and socio-cultural benefits. (Beccali et al 2009).

As one of the fastest growing sectors, tourism is rapidly gaining influence in energy consumption worldwide. At many destinations, the inefficient use of energy and other resources is causing severe environmental damage, and jeopardizing the very basis of sustainable tourism development. (Zanki2008). Hotels rank amongst the highest energy consumers in the tertiary building sector (Moia-Pol, (2005) Bohdanowicz 2001). There are over 300,000 hotels worldwide, accounting for over 11million rooms (Bohdanowicz 2001). Rapid growth in international travel has resulted in sustained growth in the hotel industry.

The hotel industry while providing benefits to local and national economies poses a range of serious environmental and socio-cultural threats. Substantial quantities of energy are consumed in providing comfort and services to guests, the effects of this on the environment are caused by excessive consumption of local/imported resources (e.g. water, food, electricity and fuels) as well as by emissions released into air, water and soil'. The energy use in hotels varies substantially between different types of hotels, and is affected by hotel size, class/category, number of rooms, customer profile, location (rural or urban), climate zone as well as the type of services, activities and amenities provided to guests (Bohdanowicz 2001, Deng 2003, Santamouris et al 1996).

Lukas (2008) highlights some problems that must be understood; the sector encompasses a wide variety of structure sizes, geometries and thermal envelope materials, and occupant behaviour varies widely and can impact energy consumption. According to R. Priyadarsini (2009), S. H. Deng (2000), there is no fixed methodology for evaluating or assessing the energy performance of hotels. Therefore analysis of energy consumption in a hotel must take into account the geographical location and local environment. These factors may impact the design of the hotel and many of the characteristics affecting the energy consumption of equipment and plant.

Introduction of energy efficient and passive design strategies in the hotel sector might increase efficiency and reduce costs without any increase in overall supply. There have been studies in Nigeria on alternative energy sources, and energy performance in various sectors; industrial (Unachukwu. et al 1998, Aderemi, 2009), universities (Adeleja, 2008, Okoro et al. 2008, Akpama, 2010) but studies on hotel buildings a major energy user have been lacking. The energy performance of a building is defined as the amount of energy actually consumed or estimated to meet the different needs associated with a standardized use of the building.

A study of the energy performance of hotel buildings in the study area will provide a basis for determining the energy consumption patterns, reduction of the energy use which will positively affect greenhouse gas emissions, and introduction of energy efficient strategies in the design of hotel buildings in Nigeria. This will put Nigerian tourism industry in line with other countries where sustainability is the key word for all development in the tourism industry.

1.1 Nigerian Energy Status

Energy is inevitable for poverty alleviation and the production of goods and services. Globally, more than 1.6 billion people live without access to electricity and 2.4 billion people are without modern energy services for cooking, cooling and heating. (Uyigue, et al, 2007). Poor governance and endemic corruption plague Nigeria and negatively impact the energy sector. Despite being the world's seventh largest oil exporter and being blessed with the tenth largest oil reserves in the world, the country (Nigeria) remains a net importer of petroleum products and cooking kerosene fuel. (Obadote, 2009). An estimated 60-70% of the Nigerian population does not have access to electricity (Uyigue, et al, 2007).

Nigeria's primary energy source (coal and hydro) has evolved over the last sixty years. During the 1950s and 60s, coal was the primary energy, followed by hydro in the 1970s and 80s. Currently, gas is the primary energy source. Despite Nigeria's steady access to fossil based and renewable energy sources, its per capita electricity has been among one of the lowest in Africa. As power demand studies have projected a medium- to long-term electricity demand of 30,000MW and 192,000MW respectively, need to be substantial improvement in the energy production and supply sector if this demand is to be met (Obioh, I. B., et al, 2009).

A National Energy Policy was approved by the Federal Government of Nigeria in 2003 with the ultimate goal of optimal utilization of the nation's energy resources, both conventional and renewable, for sustainable development. The policy articulated amongst other things the extensive development of electric power with a view to make reliable electricity available to75% of the population by 2020 as well as broadens the energy options for electricity generation.

In 2006 with the assistance of UNDP, a renewable energy master plan was produced for Nigeria with a major aim of articulating a road map for national development through the accelerated development and exploitation of renewable energy. The master plan is to provide a comprehensive framework for renewable energy by

i. expanding access to energy services to Nigerians

ii. raising standards of living especially in the rural areas.

iii stimulating economic growth, employment, and empowerment.

iv reducing environmental degradation and health risk, particularly to vulnerable groups such as women and children.

This is with a view to achieving an economy that will gradually move from a monolithic fossil economy to one driven by an increasing share of renewable energy mix, while exploiting renewable energy in quantities and at prices that will promote the achievement of equitable and sustainable growth. Renewable energy is derived from natural forces that are continuously at work in the earth's environment, and which are not depleted through use. The Renewable Energy Master plan advocates a solar PV and solar thermal contribution of 5MW by 2010, 121MW by 2015 and 505MW by 2025 into the Nigerian energy mix. Renewable energy sources produce few or no greenhouse gases. Increasing their usage will therefore contribute to reduction of emissions nationally and world-wide.

2. Literature Review and Conceptual Issues

Since the Rio Conference on Sustainable Development (UNEP, 1992), governments, industrial bodies, researchers and communities have proposed various paradigms, policies, strategies, frameworks and accreditation schemes designed to personalise one or more dimensions of the sustainable development philosophy. Due to its environmental and socio-cultural impact, the tourism industry has featured prominently in such initiatives (Warken et al 2005). This has lead to a growing interest in studying the energy and water use performance in hotel buildings. Unlike other types of commercial buildings, such as an office building, a hotel building is operated on a 24 h basis, and there are usually functional areas other than guestrooms. Therefore, hotel buildings have their own unique operational (and thus energy and water use) characteristics when compared to other types of commercial buildings. (Deng 2003)

In the study by Warken et al (2005) to develop a benchmark process for the consumption of water and electricity by accommodation providers, a major obstacle identified was that consumption rates are influenced by a multitude of site specific characteristics such as age of building, building size and layout, nature of operation, extent of communal facilities, climate, etc. With such a large number of factors affecting energy and water consumption, this implies that many benchmarking groups need to be developed in order for benchmarking accommodation complex resource consumption to be a meaningful exercise. The results of the study showed that per capita energy and water use are significantly affected by the physicality of buildings(i.e. whether a building's design incorporates factors such as a large open, high ceiling foyer), as well as the expected extent and grandeur of customer service. The study observed that the most efficient resource consumption outcomes were evident where resource use efficiency was factored in at the early stage of resort planning.

Beccali et all 2009 used an empirical approach for ranking environmental and energy saving measures in the hotel sector in an Italian region. In the study a short set of indexes, referring to energy and environmental performances, where defined and calculated for different clusters of hotels, grouped on the basis of site characteristics, opening periods, number of beds, and building age. Such indexes are utilized to establish lists of actions with assigned priorities stemming from energy, environmental and economic issues.

The study with regard to energy consumption, identified various types of energy required to operate engineering services installations in a hotel building, thus maintaining a suitable indoor built environment (thermal, visual, indoor air quality, etc.) and providing guests and staff with quality services, such as lift services and hot water supply. These building service installations mainly include heating, ventilating and air-conditioning (HVAC), lighting and hot water supply. In addition, since there are usually food and beverage facilities in a hotel, natural gas will be generally consumed in the kitchens.

In the study of the energy and water uses in hotels in Hong Kong Deng (2003) identified electricity, gas and diesel as the main sources of energy in hotels and also asserted the following; total number of food covers, gross floor area (GFA), in house laundry etc., as some of the energy and water use performance explanatory indicators for hotels.

The study in surveying energy and water use in 36 quality hotels in Hong Kong indicated a diversified energy use and water use situation in hotels in Hong Kong. This showed that no clear consumption patterns and obvious underlying factors that may be used to explain energy and water use can easily be identified generally. This result gives the implication that there are no standard or fixed performance indicators to be adopted in studying the energy use in hotels.

This conclusion agrees with the result of studies on energy consumption in hotel buildings by Priyadarsini (2009), and Deng (2000), that there is no fixed methodology for evaluating or assessing the energy performance of hotels.

Santamouris et al (1996) agreeing with the result of the study by Beccali (2009) and Deng (2003) asserts that energy consumption can vary significantly, depending on the category and use of the building, type of construction, maintenance, existing heating, cooling and lighting systems (type, number, size, efficiency) and other types of equipment and services. Hotels have one of the highest energy consumption rates, as a result of their unique operational characteristics and nature of their occupants. In order to identify the most suitable retrofitting actions and assess their effectiveness when implemented in a certain type of building, it is necessary to have

available specific information on the energy characteristics, thermal performance, comfort conditions and existing problems. These data can also be used to identify

whether there is room for improvement in new or existing hotels by comparing it against predicted or actual building energy performance.

Occupants are also very demanding in terms of their thermal and visual comfort needs when they are in a hotel. The type of building construction directly affects the energy consumption levels for heating, cooling and lighting. The building envelope influences heat gains or losses, while the existing system determines the overall performance. Internal space layout influences the general use of lighting, since areas

away from exposed facades do not take advantage of day lighting.

Zanki et al (2008) agrees with other researchers that the analysis of energy consumption in a hotel must take into account the geographical location and local environment. These factors determine the design of the hotel and many of the characteristics affecting the energy consumption of equipment and plant. Important considerations are the availability of conventional and renewable energy sources and the climatic and environmental conditions of the location.

Zanki (2008) agrees with Priyadarsini,(2009) and Deng (2000) that hotels and tourism accommodation facilities are tertiary commercial buildings and high energy density consumers, he concludes that by assuming sustainable building design, with passive architecture elements and better building materials is possible to reduce loads in the building for 40-60%. Secondly, design of efficient energy systems that would utilize renewable energy sources will provide electricity and environmental savings.

Moi-Pol et al (2005) in their investigation into the energy consumption of hotels in the Mediterranean Island concludes that energy consumption per night spend charges are dependent on various factors; facilities provided; category of hotel; occupancy; geographical situation; weather conditions; nationality of clients (habits); architecture of the building; design and control of the installations etc. The study asserts that the major difference in energy consumption was as a result of the source of energy, depending on the local policies, energy prices and services of energy companies.

Various studies have provided some basic knowledge on energy use and consumption patterns in hotel buildings in various parts of the world. the method for energy assessment are numerous and basically rely on the same principles. these principles however have been adapted in the studies to suit the local conditions of the hotel locations. The results of these studies have not been conclusive in recommending standard methodologies and parameters for assessing and evaluating hotel energy performance.

The summary of the various studies in various parts of the world is that the energy use varied substantially between different types of hotels and is affected by hotel size, class/category, the number of rooms, customer profile, location, climate zone as well as the types of services and amenities provided to guests.

3. Methodology

The study was carried out in hotels located in five major towns in the South Eastern part of Nigeria namely; Enugu, Awka, Abakiliki, Owerri and Umuahia. The study embraces both quantitative and qualitative methods of data collection and utilized both secondary and primary sources of data. Primary information was collected from the hotel managers by direct interviews and personal observations. The main primary information was obtained from responses to questionnaires administered by the author and trained assistants.

The study observed that hotel rating and classification was a common variable to all the existing studies on energy use in hotels. Hotels in Nigeria are not rated and there is no documented evidence or proper records of number of existing hotels. A preliminary investigation and pilot survey of 85 randomly selected hotels representing about 80% of the total number of hotels in the study area was conducted in order to categorize the hotels. The hotel rating scheme of the National Tourism Development Cooperation (NTDC) of Nigeria was applied to the 85 selected hotels.

After evaluation of the hotels for categorization, 15 hotels constituting 27% (twenty seven percent) of the total was selected for the energy performance study. An questionnaire was developed and distributed to the hotels. The study and collection of data which is still ongoing has been faced with series of delays, as the researcher has had to drop some hotels not cooperating half way into the study and replaced them with others more willing to cooperate with the researcher, by allowing access to records and willingness to be interviewed.

In this study the energy performance of individual hotels will be evaluated in terms of the energy use index (EUI), which is the site energy consumption per unit floor area. The study will collect energy consumption data and other pertinent information will be collected from the 15 hotels in the study area through a survey by the distribution of questionnaires, interviews and observation by the researcher.

Utility billing data for one year will be collected from the 15 hotels, supplemented by site operational records and by on-site survey and measurements to determine indoor environmental conditions. There will be a percentage breakdown of the total energy consumption by various energy types and by various building systems

Furthermore it is expected that the energy survey of the hotels will help determine the air-conditioning usage patterns and the data used for computer simulation. This will help establish an ETTV calculation methodology for hotels in the study area. The ETTV presents a measure of the thermal performance of building envelope, and is a measure of the average heat gain into a building through its envelope and will be used to correlate the heat gain through the building envelope.

Statistical tools such as regression will be used to determine relationships while ANOVA will be used to determine differences. Computer simulations will also be used for energy calculations.

The study is largely quantitative and builds on existing research studies and methodologies. In this study, the researcher used two methods to test the hypothesis on the various relationships between hotel energy consumption and building characteristics and operational characteristics. The analytical techniques that will be used for this study include linear regression, analysis of variance, ETTV correlation formula and a building simulation program eQuest.

3.1. Linear Regression

Linear regression is a statistical technique which determines and quantifies the relationship between variables. Regression is mainly used to establish whether one variable is dependent on another or a combination of other variables. It entails establishing the coefficient(s) of regression for a sample and then making inferences on the population. It is a widely used energy management tool which enables standard equations to be established for energy consumption.

The multiple linear regression technique will be used to determine the effects of the operational characteristics of the hotels on energy consumption. It will be used specifically in the first hypothesis to determine whether significant relationship exists between the energy consumption in hotels (the dependent variable Y) and the

operational characteristics of the hotels namely, utility bills for one year, average monthly occupancy level, power for lighting, power of water heating, power for cooling (air conditioning, lifts, kitchen equipment,), gross floor area and year of construction, hotel class (the independent variable).

The Multiple Linear Regression (MLR) is given as:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + \ldots\ldots\ldots\ldots b_nx_n + e_1 \quad \text{(eq. 1)}$$

Where:

Y	=	the dependent variable
a	=	the constant of the regression equation
$x_1 - x_n$	=	independent variable (prediction variable)
$b_1 - b_n$	=	the co-efficient of the corresponding x's
e	=	the standard error

In order to estimate the regression model, a statistical package, Statistical Package for Social Sciences (SPSS), is used. The procedure involves specifying the dependent and independent variables; in this case, GDP is the dependent variable while FDI is the independent variable. SPSS is run and from the output, the values of the constant, α (slope), coefficient of regression, β and the error term, ε are obtained. In addition, the output shows the t-statistic and p-values for the coefficients which results in either rejecting or failure to reject the hypothesis at a specified level of significance. The p-value is the probability of getting a result that is at least as extreme as the critical value. The null hypothesis is rejected if the p-value is less than or equal to the critical value.

3.2. Analysis of Variance (ANOVA)

Analysis of variance is used to test the second hypothesis, which is to determine whether a significant difference exists between the external heat gains of the twenty hotel buildings. The dependent variable is heat gain (Y) while the independent variable is thermal performance (X) (where thermal performance factors are, heat conduction through the wall, heat through the windows, solar radiation through the windows), for the twenty hotel buildings. Equation for the Simple Factor Analysis of Variance technique is given as;

$$SST = \sum X^2 - \frac{(\sum X)^2}{N} \quad \text{(eq. 2)}$$

$$SSB = \frac{(\sum X_1)^2}{N} + \frac{(\sum X_2)^2}{N} + \frac{(\sum X_3)^2}{N} + \frac{(\sum X_4)^2}{N} \quad \text{(eq. 3)}$$

$$SSW = SST - SSB \quad \text{(eq. 4)}$$

Where:

SST = Total variation (Total sum of squares)

SSB = Variation between groups (Sum of squares between)

SSW = Variation within groups (Sum of squares within)

3.3. Envelope Thermal Transfer Value (ETTV)

Many computer software packages have been developed to estimate the energy characteristics of buildings. the overall thermal transfer value (OTTV) was used to correlate the OTTV of a building envelope designs with other key building design parameters through DOE-2 computer simulations. The OTTV method is prescriptive in nature and has been criticized for restricting design freedom and innovation in architecture. The OTTV method only deals with the building envelope and does not consider other aspects of building design (such as lighting and air-conditioning) and the coordination of building systems to optimize the combined performance. The use of OTTV as the only control parameter is inadequate and cannot ensure energy is used efficiently in the building (Hui 2000). The OTTV was discovered not to truly reflect the thermal performance of building envelope because of several deficiencies, and was therefore found inappropriate for use in regulating the energy performance of air-conditioned buildings (Chua and Chou 2010). A review of the OTTV formula was carried out to derive a new formula that could provide a more accurate indicator of the thermal performance of building envelope. This review led to the derivation of the ETTV.

The ETTV is a measure of the average heat gain into a building through its envelopes. The ETTV correlation is particularly suited to buildings in the tropical climates where outdoor –indoor temperature difference and diurnal variations of temperature are relatively small. The ETTV takes into consideration three basic components of heat gain through the external walls and windows of a building. They are: (1) heat conduction through opaque walls; (2) heat conduction through glass windows; and (3) solar radiation through glass windows. These three components of heat gain are then averaged over the whole envelope area of the building to present an ETTV that accurately describes the thermal performance of the building's envelope.

The ETTV formula is thus presented as

$$ETTV = TD_{eq}(1 - WWR)(U_w) + \Delta T(WWR)(U_f) + SF(WWR)(CF)(SC) \qquad \text{(eq. 5)}$$

Where:

TD_{eq} = equivalent temperature difference (^oC)

ΔT = temperature difference (^oC)

SF = solar factor (W/m^2)

WWR = window to wall ratio

U_w = thermal transmittance of opaque wall ($W/m^2 K$)

U_f = thermal transmittance of fenestration ($W/m^2 K$)

CF = solar correction factor for fenestration

SC = shading coefficients of fenestration

The coefficients TD_{eq}, ΔT, SF vary according to the weather of the locality of the study. The coefficients are determined using computer simulations using the weather data of the locality. The coefficients for each particular heat gain component can be obtained using the following three equations (Chou and Chang 1996).

$$TD_{eq}(1 - WWR)(U_w) = \frac{\sum_{1\,year} Q_{wall,cond}}{\text{annual operating hours x A}} \qquad \text{(eq. 6)}$$

$$\Delta T(WWR)(U_f) = \sum_{1\,year} Q_{win,cond}$$

$$\text{annual operating hours x A} \quad \text{(eq. 7)}$$

$$SF(WWR)(SC) = \frac{\sum_{1\ year} Q_{win,rad}}{\text{annual operating hours x A}} \quad \text{(eq. 8)}$$

equations (5), (6), (7) account for the heat conduction through the walls, the heat conduction through the windows and the solar radiation through the windows respectively.

3.4. Building Energy Simulation Program

eQuest is a building energy analysis tool that allows users to perform detailed comparative analysis of building designs and technologies. It is equipped with a simulation engine that is derived from the latest version of DOE-2 which is a fully validated computer program that predicts the hourly energy use and energy cost of a building when information such as the hourly weather information, building model descriptions and its HVAC equipment and utility rate structure are provided.

eQuest is also equipped with the capacity to create virtual built-environment, in which the operations of the HVAC system and the lighting of the facility can be studied. eQuest is a building energy analysis tool which produces high quality results by integrating a building creation wizard, an energy efficiency measure wizard and a graphical results display module with an enhanced DOE-2 simulation program (Chua and Chou 2010).

3.5. Simulation Parameters

To obtain the hotel ETTV coefficients and energy estimation correlations, energy performance simulation with local data will be conducted. The weather file to be used is a compilation of typical climatic data ranging from dry-bulb and wet-bulb temperatures, wind velocities, cloudiness and hourly values of direct and diffuse radiation for all building operating hours of the year.

The window-to-wall ratio (WWR) of the buildings represents the ratio of the fenestration area to the total wall facade. Several multi-parametric simulations will be carried out on each of the reference buildings with lighting, equipment and occupancy schedules typical of hotel buildings.

4. Results

The data obtained from the pilot survey was analysed using a spreadsheet. A total of eighty five (85) hotels were selected out of which fifty-five (55) permitted the survey representing sixty-five percent (65%) and thirty representing thirty five percent (35%) did not return the questionnaire, refused to answer to the structured questions, or it was discovered that their responses were false. Table 1 shows the distribution of the hotels and their categories:

Table 1. Hotel Star Rating.

Star Rating	Frequency	Percentage
XXXXX (5 star)	-	Nil
XXXX (4 star)	-	Nil
XXX (3 star)	2	4%
XX (2 star)	30	54%
X (1 star)	23	42%
TOTAL	**55**	**100%**

Only 4% (four percent) of the evaluated hotels are three star, while 54% (fifty four percent) are two star, and 42% (forty two percent) are one star. However in applying the rating criteria of the National Tourism Development Cooperation (NTDC) to the hotels in the study area the following observations were made: firstly most of the provisions of the criteria seemed obsolete in comparison to what is happening with the hotel industry in the study area, secondly the criteria needs to be revised to meet with the standards for sustainability required in the industry currently, finally there is no existing criteria for monitoring the establishment of new hotels by setting out guidelines for location, parking provisions, site development potentials and building height.

Data from the main survey of the study shows all the fifteen hotels representing 100% have three major sources of energy; electricity from the national grid, petrol or diesel power generating plants and gas mainly for cooking. 35% of the hotels also used wood fuel mainly for outdoor cooking. 100% of the hotels are not aware of alternative energy or renewable energy sources that may be integrated into the hotel energy mix. All the hotels that ensured 24hrs electricity supply to their guests depended mostly on their power generating plants and this is very obvious in the rates charged. The availability of light is a major issue with the hotel guests.

40% of the hotels had some remodelling done in the last 5years. All the remodelling was in terms of physical expansion of the facilities by construction of new buildings and increasing the number of rooms available in the hotels. There were no considerations for retrofitting or improving the energy efficiency of the hotels. 100% of the hotel managers did not know what energy efficiency and retrofitting means. 100% of the hotels had air-conditioning and fans installed.

Generally, most of the hotels had poor lighting within the rooms and corridors. Leaving the bedroom lights on all the time definitely is a huge contribution to the energy consumption in the hotels.

5. Conclusion

The Nigerian Hotel industry is growing rapidly and the integration of solar energy technology into the design of new hotels or retrofitting of existing ones will be a laudable goal as there is no end in sight of the energy insecurity in the Nigerian power sector.

The National Tourism Development Cooperation (NTDC) needs to revise and update its rating criteria for hotels. There is need to produce guidelines and standards that will guide the development of new hotels and the remodelling of existing ones.

The study also reveals huge potentials for integrating renewable energy technology such as solar outdoor lights, solar water heaters and solar cookers to replace fuel wood in the hotels.

It is therefore hoped that the results of the full study will help in the development of an energy rating scheme and building energy code for hotel buildings in the study area.

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