The Energy Management Strategies for the Hotel Industry in Papua New Guinea

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ABSTRACT---- ***The non-renewable energy is largely used in hotel industry for its operation and customer satisfaction.The extensive energy consumption is detrimental to the environment as it contributes to the greenhouse gas emissions that cause climate change. It is essential to reduce the use of energy in hotels without compromising guest comfort.In this paper a review has been done to identify the strategiesof energy management in hotels to reduce the cost of operation and for protecting the environment. The simple energy management initiatives require a change of operational practice which could be achieved by minimal cost. The capital intensive initiatives require capital investment based on the size of the propertyand customer service. The small,medium and largehotelsin Papua New Guinea (PNG) need to make useof the energy efficiency and renewable energy technologies tosustain business and help reduce their impact on environment.***

Keywords---- energy, management, hotel, environment

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1. INTRODUCTION

The non-renewable fossil fuel is the primary source of energy relied by the hoteliers in Papua New Guinea (PNG).This resource supplies electrical energy for most of the activities performed in hotels. The electricity is substantially used in hotel industry for providing a variety of facilities and services to meet the diverse requirements of customers. A significant amount of energy is consumed bycatering; heating, ventilation and air conditioning (HVAC); housekeeping; lighting system; and office equipment (Hotel Energy Solutions, 2011, p.4). The cost of hotel operation is becoming high since there is an increased demand for electricityto providemodern guest comforts and services.The excessive electricity consumption has impact on environment and is believed to be a major contributor for climate change. The climate change is a result of burning of fossil fuels for energy thatemit greenhouse gases (GHG). The climate change increases the risk of floods, droughts and hurricanes that affect the biodiversity, water resources and human health.It is now crucial to reduce the GHG emissions by decreasing the amount of energy used from fossil fuels. The fossil fuels are limited and depleting faster (Hotel Energy Solutions, 2011, pp. 15-16). The quality of human life relies on clean and safe energy. To assure a continuous flow of energy and operate business at minimal cost the small, medium and large hotels are encouraged to conserveelectricity by practicing green technologies. Green technologies includeuse of energy efficiency and renewable energyto alleviate industry's impact on the environment. Energy efficiency means using less energy for hotel operation without compromising standard guest service. Energy efficiency saves energy costs, decreasesGHG emissions and enhances the corporate reputation for reduced footprint on environment. Renewable energy is produced from sources such as wind, solar, bioenergy, hydropower, and geothermal.The renewable energy sources generate electricity straight from the natural environment without causing any damage to the surrounding (Hotel Energy Solutions, 2011, p.31). It is an alternative to achieve sustainable energy at low cost for hotel operation and preserve the quality of environment.

The energy management in hotels is the practice of controlling the consumption of electricity required for the delivery of products and services to customers. The powerutilization can be lowered by adapting strategies such as change of organizational practice with low or no cost;implementation of energy efficient technologiesthat require capital investment; and encouraging guest to consumelow power in all their activities in hotel buildingtowards supporting the efforts of hotel in minimising their GHG emissions (Melbourne City Council, 2007, p. 17). The energy efficiency is able to elevate the level of service of the hotel by lowering its energy consumption and cost of operation.

The hotel industry is growing rapidly in PNG as it is one of the significant tourist destinations in South Pacific. It is apparent that the hotels are the large energy consumers however they are less proactive in protecting the environment due

to lack of knowledge and negligence. The small, medium and large hotels need to use energy efficiency and renewable energy technologies to reduce their impact on environment. The purpose of this paper was to review the simple ways of conserving energy in hotel operations for the sustainable development of Papua New Guinea. Theacademic literature and technical reports were reviewed to identify the hotels energy consumption patterns and examinethe possible ways of using energy efficiently and adopting the renewable energy technologies.

2. CHANGE OF PRACTICE IN HOTEL OPERATION

The electricity is considerably consumed by lighting, space conditioning (heating and cooling), housekeeping, and kitchen in general hotel operating system.Lighting creates a comfortable, safe, relaxing and enjoyableenvironment for both staff working on premises and guests stay in hotel rooms. The lighting requirement of the facilities and amenities offered must be monitored by hoteliers to enhance energy performance. A number of general best practices and measures can be applied for reducing energy consumption.These practicesdo not require large investment, yet bring noticeable improvement in energy management. One of the easiest ways to save energy is to turn off lights in unoccupied areas (Sustainable Energy Ireland, 2004, p.5).The common areas must be vigilant around the clock when lighting is unnecessary or natural light is enough to turn lights off. Thelighting controllers such as timers and photocells used in public areas should be well maintained and properly set for efficacy.The housekeeping in guest rooms and hotel premises may be carried out during day hours to make use of natural light. The housekeepers are advised to open curtains and blinds to allow natural light into guest room while servicing. They are discouraged to turn on television while cleaning. Once a room is made up, curtains and blinds must be closed and make sure all lights turned off. Dirty lamps and fixtures reduce the level of lighting by 50 percent. Therefore cleaning lamps and lighting fixtures regularly is necessary to ensure optimum efficiency.Reduce the number of lamps in areas where over lighting is apparent and install task lighting where it is needed. The exterior and swimming pool area lighting must be turned off when not needed for safety and security reason(Natural Resources Canada, 2003, p. 38).

Different kinds of heating, ventilation and air conditioning systems are used in hotels for guest comforts. If occupancy level of the hotel is known these systems can be used efficiently to lower the energy consumption. The equipment such as ventilation, space cooling and heating must be shut off when not required especially during off-hours or while facilities are closed. The timer switches and thermostats can be set to meet the minimum heating, ventilation and cooling loads. The thermostat must be kept away from the heat producing appliances such as television, computers and hair dryers since they lead the thermostat to work longer to cool the place and thereby increases the energy consumption (Hotel Energy Solutions, 2011, p. 29). It is necessary to keep windows and doors closed when the heating or air-conditioning equipment is on. The lobby main entrance door must always be kept closed to prevent the ingress of heat from outside that adversely affects air conditioning. The amount of lighting can be adjustedto minimum levelin areas such as bars, entertainment venue, toilet, souvenir shop and poolside as the lighting load affects the hotels cooling system. The air from the heating and cooling units must circulate freely without having obstructions on the way. The objects lay on the floor or bench may hinder the air flow and makes the units work longer. It is the responsibility of the hoteliers to check thoroughly the individual rooms and remove if any obstructions seen. The cooling towers must be serviced regularly to avoid clogged nozzles, and poor pump performance (Natural Resources Canada, 2003, pp. 38-39). By regularly cleaning condensers, intake louvers, evaporator coils and air filters the energy losses caused by dirt or pipe/duct leakage can be prevented. A routine maintenance check-list may be developed to insure peak efficiency (ICF International, 2008, p.21).

To help set guest room cooling-and-heating equipment, a weatherboard can be installed in housekeeping area. While guestrooms are being cleaned the housekeeping personnel adjust the settings of the equipment according to the temperature of the day. The ceiling fan in guest room is the better option towards saving energy cost.The housekeeping staff can also be advised to operate the laundry machines only when they are loaded fully. The drying tumblers and washing machines must be kept clean at all times (Natural Resources Canada, 2003, pp. 40-41).

To keep energy consumption at a reasonable level, the kitchen staff should turn off the cooking appliances when not needed. The oven, grills, broilers, fryers and other equipment can be pre-heated before cooking according to manufacturer's instructions. However it should not be turned on when not required. The equipment should be operated at right temperature to produce quality food. The temperature set at high to increase the production during peak hours will intake more energy and destroythe quality of food. The overloading of equipment should be avoided as it may result in poor food quality. The right pot sizes that match with element sizes on ranges are advisable. If pots and pans are covered while cooking the energy can be saved to a large extent.The fans that are positioned directly onto the cooking ranges must be turned off. The kitchen appliances must be kept clean and a regular maintenance schedule can be strictly followed.The dishwashers must be turned on when fully loaded (Sustainable Energy Ireland, 2005, p.7). To conserve energy in kitchen refrigeration it is necessary to keep the doors of cold stores shut all the time (Australian Hotels Association, 2013, p. 4). A refrigerator door must seal completely to keep kitchen air out. Placing food in refrigerator shelves as per manufacturer's instruction reduce energy consumption. The shelves should not be overfilled to allow air circulation throughout. Storing hot food in refrigerator and freezer is not recommended as it increases the energy

consumption.Set refrigerator at 37˚F and freezer between 0˚ and 5˚F for efficient operation. Check frequently the door gaskets and replace any torn, cracked and worn out gaskets (Natural Resources Canada, 2003, pp. 41-43). To ensure efficient and safe operation of boilers servicing at least annually is prudent. The water heating in hotels is required for various purposes such as guestrooms, kitchen, public restrooms, janitorial work and swimming pools. In general water heaters are set to higher level than they need to be. It is good to turn them down to reduce energy waste. A thermostat fit into the hot water tank will enable the water not to heat more than necessary. A tank wrap or blanket can prevent heat loss and keep water hot for a long period. The hot water system is to be inspected once a year to ensure that there is no leaks and build-up of sediments in the system (ICF International, 2008, pp. 24-25).

3. INSTALLATION OF ENERGY EFFICIENT EQUIPMENT

3.1 Lighting System

The hotels consume a lot of energy towards its lighting needs.Lighting is one of the best opportunities for reducing energy cost in hotel facilities. Lighting technologies help minimize the consumption of energy in large extent in hotel premises. The lighting improvement can be made possible through efficient lighting fixtures and improved lighting controls. The efficient lighting is obtained by installing energy saving lamps and ballasts in efficient fixtures. Switching to T8 (26mm) fluorescents from most common T12 (38mm) fluorescents will save considerable amount of electricity and offer a similar quality of light (Sustainable Energy Ireland, 2004, p. 5).The most efficient T5 fluorescent lamps with electronic ballasts are ideal for the hotel bathroom, corridor, front office, housekeeping and kitchen lighting (Melbourne City Council, 2007, p. 24). The high frequency electronic ballasts are 20 percent more efficient than electro-magnetic ballasts. The inefficient standard incandescent light bulbs can be replaced with energy efficient compact fluorescent lamps (CFLs). The CFL usesup to 75 percent less electricityand lasts up to 10 times longer than incandescent bulb (Sustainable Energy Ireland, 2005, p. 6). Replacing an incandescent bulb with a CFL keeps a half-ton of CO_2 out of the atmosphere over the life of the bulb. The CFLs can be used in recessed fixtures, table lamps, track lighting, ceiling fixtures and porch lights. The CFL is suitable for guestrooms where a degree of lighting is required to perform a number of tasks such as entertaining, reading and watching television.The light emitting diode (LED), electroluminescent, photoluminescent and light-rope exit signs contribute to greater energy reductions and have approximate paybacks in less than two years. The LED used in exit signs is more popular that replaces the compact fluorescent exit signs. It provides a high luminous efficacy and can convert around 80-90 percent of electricity to visible light. It prevents heat build-up and thus reduces the cost of air conditioning.The LED has no mercury and lasts up to 50 years. The highintensity discharge (HID) lamps are suitable for both indoor and outdoor lighting due to their extremely high efficiency and long life. The HID lamp is extremely good in energy savings and providing safe and appropriate illumination (Natural Resources Canada, 2003, pp. 20-21). The high intensity fluorescent (HIF) lighting provides better light using less energy. The improved colour of the HIF lighting also enhances the property, hence considered for landscape and accent lighting (Fedrizzi & Rogers, 2002, p. 10). It is also excellent for swimming pools, tennis courts, recreational areas and parking garage. The halogen lights are better than incandescent bulbs to highlight artwork and other interior design features in lobbies. The halogen lights require low power and provide a more focussed beam. The decorative halogen lights are dimmable and thus suitable for ballrooms, conference rooms, restaurants and pubs where low-lighting level is required. The light output of lamps decreases over time, so consider group re-lamping at the end of their useful life than replacing a burnt out lamp. It is advisable to replace lamps in groups to achieve a full light output and reduce the maintenance cost (ICF International, 2008, p. 17).

The lighting control can be achieved through installing key activated lighting in guestrooms; occupancy sensors in areas where lighting is not required continuously; timer control to turn on lights automatically when it becomes dark; and lux controllers (daylight compensation control) to turn lamps off and on, or dim them depending on the amount of day light received through windows.The application of energy efficient lighting products and controls reduces energy cost in hotel facilities while offering high quality lighting and low maintenance cost (Melbourne City Council, 2007, p.24).

3.2 Heating, Ventilating and Air conditioning System

The heating, ventilation and air conditioning (HVAC)system is a major energy user in hotels (Hotel Energy Solutions, 2011, p. 26).The HVAC uses 70 percent of a hotel's total energy consumption. It is an area where several energy saving opportunities are available. The energy efficiency improvement can be made through installation of higher efficiency chillers, cooling towers, condensing boilers, heaters, and variable speed drives. The new chillers are more efficient than traditionalchillers asthey have improved controls to optimize the chiller efficiency.A water-cooled turbo compressor fitted with variable speed drive (VSD) can improve energy efficiency by up to 400 percent (Australian Hotels Association, 2013, p. 4). The electro-mechanical expansion valve can be replaced with modern electronic valve to improve efficiency.The larger cooling towers result in higher chiller efficiency. A variable speed fan installed in cooling tower will operate the system efficiently using less fan energy. The condensing boilers used for heating hot water minimize the energy cost especially when they are operated at low loads. The thermal insulation of boilers helps keep water hotter for longer (Hotel Energy Solutions, n.d).For cooking, washing and swimming the hotels can install high

efficiency hot water heater that consumes less energy. If hot water pumps are installed with VSDs the pumping energy will be reduced. It reduces hotels energy consumption during off season. The premium efficiency motors are recommended to be installed in all pumps and fans. The smaller motors operate more efficiently than the oversized motors. The VSDs used in efficient motors can save half of the total energy consumption (Sustainable Energy Ireland, 2004, p. 6). The high performance lubricants used on motors can further reduce energy costs. The installation of automatic controls will increase the life span of motors. The automatic controls can be able to reduce the speed of the motors or even switch off during slack hours.For space conditioning hotels may consider the desiccant HVAC system as it treats humidity effectively. It also improves indoor air quality and saves energy (Fedrizzi& Rogers, 2002, pp. 15, 18-21).

The heat pump can be installed to dehumidify the indoor pool area and simultaneously heat pool water. The pool heating energy can be saved through solar water heating panels. A cover installed on heated swimming pool for night hours reduces heat loss. The SensorStat is a device used to save energy that turns off HVAC equipment in unoccupied areas of hotel accommodation (Fedrizzi&Rogers, 2002, pp. 23-24). Theheat recovery ventilators (HRVs) and energy recovery ventilators (ERVs) are energy efficient for all ventilation needs. The double-glazed windows reduce the cooling and heating load of the building.The installation of sun protectors may also be considered to keep a hotel cool and comfortable in addition to air-cooling system that has strong impact on guest comfort. A central air-conditioning system is better than individual room units as it helps hotel operators to control set-points and monitor performance. If individual thermostats are set in guest rooms, limit the temperature range to avoid extreme temperatures. The efficiency controls such as electronic thermostats and computerized energy management systems reduce energy consumption in HVAC systems. The electronic thermostats are used to adjust the temperature depending on programmed occupancy periods. The computerized energy management systems are able to control energy use based on occupancy, weather and time of day(Natural Resources Canada, 2003, pp. 25, 29).

3.3 Building Envelopes

The building-envelope improvements such as thehigh efficiency windows, doors and insulation avoid heat loss and infiltration (Smart Energy Design, 2011, p. 3).In winter heat loss occurs through windows, whereas in summer overheating takes place by glass surfaces of windows. The installation of thermal insulated window keeps the hotel warm while reducing the heating costs. The type of glazing and frame may also be given priority to protect the building from extreme temperature. The standard inefficient single-pane glazing should be replaced with double or triple pane glazing. The energy efficient tinted glazing, reflective glazing, spectrally selective glazing and insulated glazing with inert gas between the layers can also be considered. The solar glazing and reflective film inside existing windows are more cost-effective (Melbourne City Council, 2007, p. 23).The energy efficient wood and vinyl frames are better than aluminium. The conventional windows should be replaced with daylighting panels for diffusing light throughout the space and reduce glareIn summer the amount of heat entering rooms through sunlight could be reduced by using window coverings such as shutters, shades and draperies.The energy efficient well-insulated revolving doors installed in hotel lobbies assist in keeping wind and weather out of space.The air leaks and cracks can be easily detected if inspection is made regular. The energy efficient foams and high quality weather stripping can resort the insulation issues.The sun-shading devices are necessary for the hotels to keep the building cool and comfortable. The plastic secondary-door curtains may be helpful to reduce the energy cost. The light colour painting and roofing materials reduce cooling energy consumption in hotel buildings (Natural Resources Canada, 2003, pp. 30-31). A well maintained green environment reduces the cooling needs of the hotel. Planting indigenous shrubs and trees around the sunny side of the building maintains a comfortable indoor air temperature in the hotel building. The swimming pools and fountains play an important rolein cooling space by evaporation (Hotel Energy Solutions, 2011, p. 28).

3.4 Office Equipment

Theflat screen monitorsand laptops are energy saving equipment. The CRT monitors and desktops may be replaced with the energy efficient equipment (Australian Hotels Association, 2013, p. 4). It is always better to use the products such as copiers, fax machines, printers and scanners with energy star labels attached on them.The energy star equipment perform tasks with less energy; enter sleep mode or power-down mode automatically when not in use; and reduce the paper cost of the copier and printerby enabling double-sided copying and printing(Melbourne City Council, 2007, p.18).

4. RENEWABLE ENERGY TECHNOLOGIES

Renewable energy technology has a lower environmental impact than traditional energy sources. The renewable energy generation systems such as solar, wind, and hydropower can be installed to generate electricity at hotel buildings. This green and sustainable power reduces the energy bills and greenhouse gas emissions of the hotels. The solar photovoltaic (PV) panels generate clean electricity from the sunlight. This electricity is used up by the hotel electricity network through the electricity meter. The cost of a solar PV system varies depending on size, type of panels, installation type and equipment used (PowerWater, 2014). The solar swimming pool heaters installed in hotels generate hot water using sunshine which significantly reduces the cost of pool heating. The installation of solar water heaters depends on factors

such as solar resource, climate, local building code requirements and safety issues.The solar-powered heating is an efficient option for the hotels located in areas that receive a lot of sunshine (Department of Energy, 2012). The heating of domestic water for guest services is an energy intensive and expensive process. The solar domestic hot water system (DHWS) is a cost effective solution for hotels to run profitable business. The system pumps cool water into solar collectors where heat is transferred to the cool water then it passes to the insulated storage tank. The solar domestic hot water technology is used both by the solar combi systems and solar combi plus systems. The solar combi system uses heat from solar thermal collectors to provide solar space heating and domestic hot water.A solar combi plus system provides both solar space heating, cooling and domestic hot water from a common solar thermal collectors (Hotel Energy Solutions, n.d).

The wind energy produces clean electricity for hotel buildings. The small wind electric system lowers the electricity bills, suppliescontinuous power and reduces the cost of providing electricity to hotels located in remoteareas.The wind resources can be efficiently used in PNG to mitigate the GHG emissions (Department of Energy, 2012).Modern wood heating, as a result of new wood-burning technology is clean, safe, efficient and cost effective. The biomass wood chip and wood pellet heating systems offer efficient automated space heating. The wood chips are small pieces of wood from the logging residues. The wood pellets are small cylindrical pieces produced from dried sawdust, wood shavings and straw and biomass crops such as maize, rape and willow compressed under high pressure. The wood chip and pellet boilers burn wood efficiently, waste little energy and cause less pollution (Hotel Energy Solutions, n.d).

The micro-hydropower system can be used to generate electricity from the flowing water. The small and medium hotels energy requirement could be easily met by this system. Themicro-hydropower system needs a turbine to produce electricity. It is cost effective and simplest form of energy(Department of Energy, 2012). The ground source heat pumps (GSHPs) system is an extremely efficient form of space heating and cooling and can also provide hot water for a hotel building.The system is popularly known as geothermal heat pumps. It makes use of heat energy stored below the earth's surface. This heat is brought to the surface in the form of water or steam and moved through turbines to generate electricity. Itrequires a capital investment with a payback period of five to 15 years (Johnston, 2012). The GSHP system saves energy, and reduces hotel electricity bills and carbon dioxide emissions.The combined heat and power (CHP) system generates electricity and thermal energy for heating and cooling in a single integrated system. The other terms used for this system arecogeneration and combined cooling, heat and power (CCHP). This system is energy efficient, reduces GHG emissions and improves the quality of power. The CHP ranges from micro-to large-scale multi-megawatt power sources (Hager, 2013).

5. STAFF AND GUEST INVOLVEMENT IN ENERGY SAVING PROJECT

In-service programs can be offered for staff to conserve energy. This program trains the technical and operational personnel in the areas of energy efficiency improvements in hotel operations and renewable energy technologies. This program will encourage staff to realise their responsibilities to save energy and reduce their impact on environment.It is also essential to involve guests in hotel's energy efficiency plan. The hoteliers should let their guests know that they care for the environment and invite guests to participate in their effort to minimize their environmental footprint. Guests can also be motivated to reduce energy use through display signage on energy. Most guests will participate to improve the environmental friendliness of their stay (Melbourne City Council, 2007, p.27).

6. CONCLUSION

The literature search revealed that energy use in the small and medium size hotels is highly inefficient. They pay heavy energy bills due to obsoleteequipment they use and poor management and operation systems in practice.Managing energy efficiently will significantly lower the energy costover time. The hotels can save up to 10-15 per cent of the energy they consume through efficient operation and maintenance, building renovation and installation of energy efficient equipment. It is necessary to train the staff to improve their performance and raise awareness on the benefits of renewable energy technologies. It is also apparent that hotels require financial and practical support to install and use energy efficient equipment and renewable energy technologies.

The hotel industry relies on energy for its business operation and customer satisfaction. The large amount of energy consumed by the hotels has negative impact on the ecosystem and human health. To help protect the environment from natural disasters the small, medium and large hotels in Papua New Guinea are advised to change their operational practice by adopting simple means to conserve energy and make use of renewable energy. Renewable energy technologies generate electricity from sources such as solar, wind, bioenergy, hydropower, geothermal and combined heat and power. The hotels can make use of the renewable energies for air-conditioning, space heating and water heating. The renewable energy reduces the reliance on fossil fuel, lowers energy bills, minimizes the GHG emissions and provides clean sustainable energy. This alternative energy used in hotel industry can also improve the reputation of the hotel in the society and boost up the nation's economy. By the way of protecting the environment the natural resources are sustained for the future generation. It is therefore recognised the importance of hotel industry as a large business sector involve in the process of energy conservation to support the environment.The government of PNG could also

encourage the hotel industry by offering tax reduction for using the renewable energy technologiesthat would improve the quality of environment and human life.

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