ENERGY MANAGEMENT IN THE SOUTH AFRICAN HOTEL INDUSTRY

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by

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DECLARATION

I, Brice Fouejio-Tsobze, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

Signed

Date

ABSTRACT

In recent years, the South African hotel industry has experienced increasing demand for hotel's services. At the same time, mounting costs of energy affects energy performance and public image. Energy management is a new approach to address those widespread problems. This study aimed to suggest good management practices and develop a "self-help" approach, to reduce the demand and costs of energy for the South Africa hotel industry. This is expected to result in monetary savings and conservation of energy resources. This has been done by conducting survey within seven selected hotels in Cape Town, metropolitan of South Africa.

The result of this study range from presenting the energy conservation awareness, barriers, method of conservation, financial and institution mechanisms, policy measures, status of energy use and propose strategy to develop a "Self-help" guide for energy management in South African Hotel industry. It has been found that energy monitoring has been done in the South African Cape Town hotels. From the total energy consumed by this industry, electricity accounts 80% of it of which air conditioning takes the biggest share (about 50%).and the remaining for Liquefied Petroleum Gas (LPG), diesel and others fuels.

In addition, through the "self-help" guide, approaches to energy management system are also described, showing the ways for hotels to achieve better energy performance. Potentials for savings from good housekeeping are estimated to 10 – 15%. The "self-help" guide is recommended to be improved through implementation in pilot hotels; and the proposal set of benchmarks need to be different for hotels in different provinces of South Africa considering the differences in climate conditions.

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DEDICATION

To my lovely first son PAVEL MAEL, FOUEJIO TSOBZE

And

my late father NESTOR, TSOBZE AZEBAZE.

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LIST OF ABBREVIATIONS AND ACCRONYMS

ACEEE:	American Council for an Energy-Efficiency Economy
CFL:	Compact fluorescent light
CO_2	carbon dioxide
CPUT	Cape Peninsula University of Technology
DME	Department of Minerals and Energy
DSM:	Demand-Side Management
DoT	Department of Tourism
EE	Energy Efficiency
EEDSM:	Energy Efficiency and Demand Side Management
ESCO:	Energy Service Company
EPRI:	Electric Power research Institute.
ENCON:	Energy Conservation.
ERI	Energy Research Institute
FIFA	Federation Internationale de Football Association
GDP:	Gross Domestic Product.
GNP:	Gross National Product.
GHG	Green House Gas
HVAC:	Heating, ventilation and air conditioning
HV:	High Voltage
IRP:	Integrated Resource Planning
ICEE:	Industrial and Commercial energy Efficiency
IEP:	Integrated Electricity planning
IIEC	International Institute for Energy Conservation
ISO	International Standards
KW	Kilowatt
KWh	Kilowatt Hour
KVA	Kilovolt-Ampere
KVAR	kilovolt-Ampere Reactive
LED	Light Emitting Diode
LV	Low Tension
LV	Low Voltage
MW:	Mega-Watts.
NERSA	National Electricity Regulator of South Africa

PUC:	Public Utility Commission
RESCO:	Retail Energy Service Company
SABS:	South African Bureau of Standards
SANERI:	South African National Energy Research Institute
TES:	Thermal Energy Storage

CHAPTER ONE
INTRODUCTION

1.1 Background

In the last 30 years, the global energy system was about 34% efficient. This number equates to a third of the world's energy input being converted into useful energy (Nakicenovic et al., 1998). An inefficient energy generating system translates to high amount of green house gasses emitting into the atmosphere which contribute to climate change and poses a direct danger to food security and other humanitarian needs. As a result of the growing population around the world, there is a movement to reduce Green House Gasses (GHGs) as they contribute to climate change. Due to this, it is important for both domestic use and the hospitality industry to conserve energy or to use more energy renewable sources (Sanchez et al., 2008).

In 2005, the US attributed 85% of its total energy consumption to fossil fuel sources (EIA, 2007a). This amount of CO_2 rich energy makes up about 19% of the whole world's total energy consumption (EIA, 2007b). Tragic impacts on the environment and world population will continue if major consumers of fossil fuels, such as the United States and China do not address the growing GHG problem (EIA, 2007b & Berz, 2001). Carbon sequestration technologies can be part of the solution to help stem climate change damage (Berz, 2007). This leads to the considerable benefit of reducing carbon emissions that stem from using less energy and in turn leads to health benefits for the wider community.

According to Herzog and Golomb (2004), Carbon capture and sequestration (CCS) consists of collecting carbon emissions, transporting the carbon waste material, and finally storing the carbon waste in various reservoirs and of preventing future emission into the atmosphere. In short this forms the explanation for climate change. A high level of energy consumption contributes to climate change as it contributes to a high level of carbon emission into the atmosphere. It thus logically follows that if companies and industries decrease the amount of carbon emissions into the atmosphere, there will be positive effects on climate change.

In the late 1970s, the electric utilities of the United States first began implementing programs aimed at changing both the level and timing of electricity demand among their customers. These programs collectively are known as Demand Side Management (DSM). They emerged in response to rising oil and gas prices and perceived long-term shortages in energy supply (Kulick and Loughran, 2004). DSM developed most rapidly in California and the Pacific Northwest. By the mid-1980s DSM had spread throughout the United States as a means of reducing the need for new power plant construction. A study done in 1999 discovered that U.S. electric utilities spent $14.7 billion on Demand Side Management (DSM) programs aimed at encouraging their customers to make investments in energy efficiency.

In South Africa the City of Cape Town's initiative to improve energy efficiency in government and hotels buildings, an energy audit was carried out to determine potential energy saving opportunities. As a result of the audit, certain measures were implemented to reduce energy consumption including timers on electric geysers so that water is only heated when needed, replacement of inefficient urns with insulated electric water heating systems, installation of energy efficient lighting and installation of solar water heaters. Resulting from these measures, 20 per cent saving in electricity were achieved per month (equal to 24 476 kWh/month) equivalent to a reduction in greenhouse gas emissions of about 323 tons of CO_2 per year (Energy management new, 2004).

The world energy crisis of the early 1970s started in the United States of America (US). This energy crisis had a profound impact on the electricity industry and as such it gave rise to the development and use of the Demand Side Management (DSM) strategies (Gellings & Chamberlin, 1993b:9). The DSM was then implemented in the early 1980s (in the US), as resurgence of interest in energy and DSM occurred. DSM programs reached their largest size in implementation in 1993 (Gellings & Chamberlin, 1993b:9). The next question that comes to mind is whether Demand Side Management (DSM) has any support outside of the premise of the energy management of the hotel industry. In order to conduct this literature review two specific questions must be asked. First what is Demand Side Management and second what literature or other countries have employed DSM?

DSM is a method of decreasing the use of energy. It is thus an indirect manner of reducing the carbon emission which is released into the atmosphere. For instance, in 1992, the Thailand government officially promulgated the Energy Conservation Promotion Act (ECP Act) to promote energy conservation and the development of renewable energy in a comprehensive manner in Thailand (Yamtraipat et al., 2006:765). The idea was to promote the efficient use of energy, to save resources, to reduce air pollution and reduce dependency on energy sources from foreign countries and to protect for large commercial and government buildings from energy exploitative practice (Yamtraipat et al., 2006:766).. The target set by the government regarding the ECP program was to reduce the annual growth rate of energy consumption from 13% to less than 10% of the annual growth rate. DSM was employed as a method to reach these targets.

1.2 Energy consumption in the commercial sector of South African

Electricity consumption has become one of the major challenge in the industrial and commercial sectors in South Africa. These sectors have experienced a phenomenal growth in recent years and the growth has placed more strain on the electricity supply. South Africa has in recent years hosted many internationally events. These events are beneficial to the economy as well as the hospitality industry which has resulted incredible growth as a result. Due to the developing economy, economic growth has resulted in an expansion of services; consequentially electricity consumption is quite closely related to that growth. As see from the year 2001 of figure 1.1, the commercial sector was the fifth highest energy consumer with 6.1% of the total South African energy use after the fourth being mining with 7.8%, third residentia l (18.0%), the second transport (26.9%) and finally the first industrial (35.5%) among South African sectors.

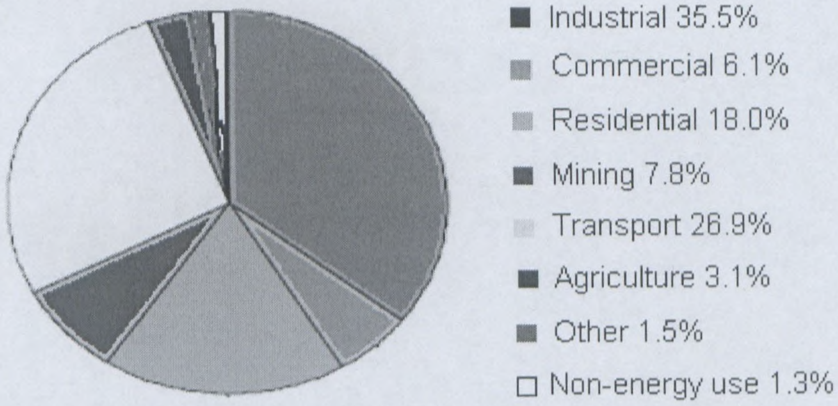

Figure 1.1: Sectoral consumption of energy-2001

(Statistic SA. Census, 2001)

The market potential for Energy Efficiency and Demand Side Management (EEDSM) in South Africa is estimated to be 7407 MW (medium load factor) over the next 5 years the figure 1.2 and

1.3 shows respectively the five years DSM plan and EEDSM of the South African commercial sector.

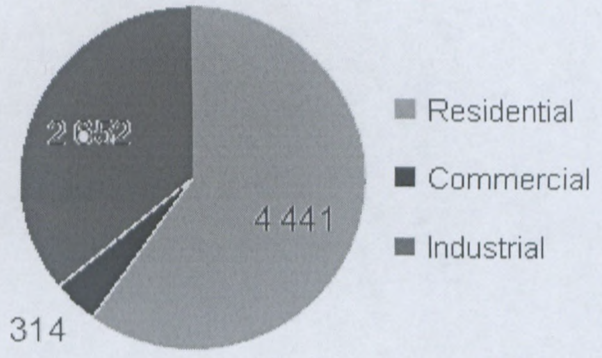

Figure 1.2: The 5 years DSM plan by sector in South Africa

(Source: Eskom 2008. NERSA, 2006 - 2007)

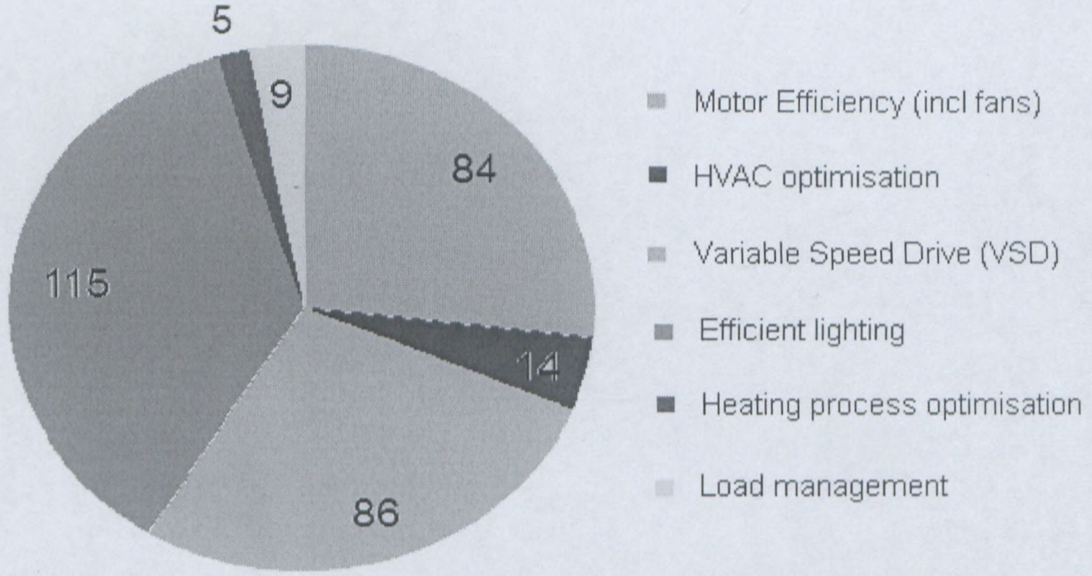

Figure 1.3: The breakdown of EEDSM in the South African commercial sector

(Source: Eskom 2008. NERSA 2006 - 2007)

Table 1.1 shows the annual maximum internal demand. The figure given includes (imports) and excludes exports, while table 1.2 illustrates the available net installed capacity. Since 1980, the electricity grew at a compound of 3.7% higher than the Gross Domestic Product (GDP) growth rate of 2.1%. While past 1989, electricity and GDP grew at similar rates, I-net Bridge (2007). Eskom's growth assumptions were bases on a GDP growth of 4%. This translates to power demand growth of 2.3%. as from the year 2008, the GDP growth exceeded 4% while electricity demand grew by 4.9% in 2007 (kohler, 2008).

1.3 Economy growth of South Africa

According to South Africa's statistics (2005), foreign tourist arrivals grew by 14% in 2006, three times the global tourism growth rate of 4.5%. South Africa tourism has flourished since the fall of apartheid: while only 3-million foreign visitors visited the country in 1994, the number had more than doubled to 6.7-million by 2004, and increased to a record 8.4-million in 2006. According to the Department of Tourism (DoT), "tourism's contribution to the country's gross domestic product (GDP) grew from 4.6% in 1993 to 8.3% in 2006, and the government is looking to further increase its contribution to 12% of GDP by 2014". There is a potential increase in the number of tourists visiting South Africa in the near future as a result of the 2010 FIFA World Cup. It is a large scale tournament, where many countries are competing against each other: Players, managers, dignitaries and fans have to be accommodated. It is expected that thousands of people who visited South Africa during 2010 could in turn necessitate the need for an increase or growth in the types of accommodation.

Table 1.1: Annual maximum internal demand (in MW) drawn by a Southern African Power Pool (Adapted from SAPP, 2007).

Country	Utility	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Angola	ENE	181	219	241	265	291	322	354	389	427	468	502	5.11	581	624
Botwana	BPC	222	238	266	290	300	313	330	343	356	370	387	407	423	441
Lesotho	LEC	76	79	89	101	112	124	136	147	159	171	183	195	207	219
Malawi	ESCOM	164	180	193	203	214	223	236	252	267	284	302	321	342	365
Mozambique	EdM	192	230	259	811	820	829	841	848	854	1310	1317	1.323	1330	1338
Namibia	NamPower	321	331	342	562	626	644	753	767	781	794	810	825	842	859
SouthAfrica	ESKOM	27967	28329	28705	29723	30405	31403	31917	32701	33486	34354	35292	36215	37153	37991
Swaziland	SEB	128	134	141	144	151	159	168	178	188	198	209	220	231	243
Tanzania	TANESCO	412	445	478	520	568	624	684	746	805	874	950	1.032	1120	1214
Zaire	SNEL														
Zambia	ZESCO	1028	1048	1100	1161	1200	1230	1270	1275	1272	1292	1326	1311	1390	1362
Zimbabwe	ZESA	1752	1841	1874	1906	1978	2052	2129	2210	2294	2382	2373	2569	2669	2773
Total		32443	33074	33688	35686	36665	37923	38818	39856	40889	42497	43/51	44.995	46288	47457

Notes:

(i) The period considered is beginning April of the year indicated until end march of the following year

(ii) The values given related only to the internal consumption in each country.

Table 1.2 : Available Net Installed Capacity (in MW) drawn by a Southern African Power Pool (Adapted from SAPP, 2007).

Country	Utility	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Angola	ENE	326	326	326	326	586	586	586	586	816	846	846	816	846	846
Botwana	BPC	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Lesotho	LEC	2	2	2	74	74	74	74	74	74	74	74	74	74	74
Malawi	ESCOM	214	214	214	214	278	278	278	342	387	432	432	432	432	432
Mozambique	EdM	186	186	186	245	245	245	245	245	198	198	198	198	198	198
Mozambique	HCB	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Mozambique	MepUncuo										1200	2000	2000	2000	2000
Namibia	KUDU							650	650	1.300	1300	1300	1300	1300	1300
SouthAfrica	ESKOM	31972	32914	33856	34853	35520	36187	36187	36187	36187	36187	36187	36187	37051	38209
Swaziland	SEB	41	41	41	41	56	56	56	56	56	56	56	56	56	56
Tanzania	TANESCO	514	644	644	783	783	783	833	833	1.037	1037	1197	1197	1197	1197
Zaire	SNEL	2480													
Zambia	ZESCO	1774	1774	1774	1774	1774	1854	2054	2454	2.454	2454	2454	2454	2454	2454
Zimbabwe	ZESA	1593	1624	1708	1708	1708	2008	2008	2308	3.108	3258	3258	3.708	3708	3708
Total		41604	40227	41253	42520	43526	44573	45473	46237	48.149	49544	50160	50360	51674	52832

Notes:

(i) Available generating plan to meet annual peak load

(ii) Excludes any generating installed plan high is currently mothballed

(iii) Excludes demand side management initiatives (e.g. interruptible loads)

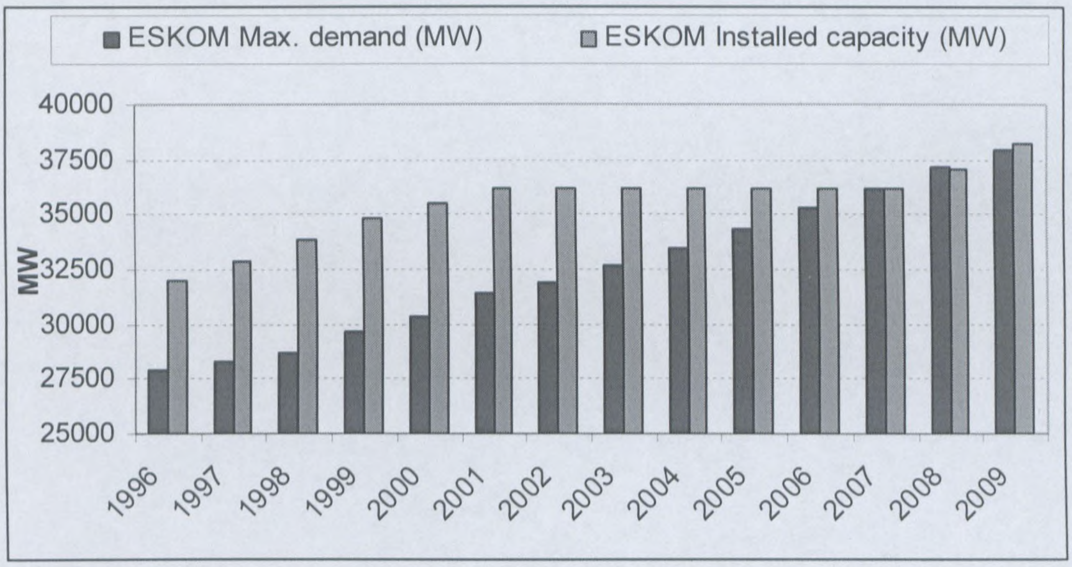

Figure 1.4: Eskom generating capacity and max demand forecast.

(SAPP, 2007)

1.4 Problem statement

From figure 1.4, it is evident that growth has placed more strain on the electricity supply as seen from the year 2007. South Africa is a developing nation with large commercial and industrial sectors which is, by nature, energy intensive. This energy intensive economy largely relies on indigenous coal reserves for its driving forces which has resulted its Gross Domestic Product (GDP) to be rising steadily. The electricity consumption is quite closely related to growth of the economy. Since the economy is overhanging for strong growth, the trend towards increased consumption in the commercial sector is expected to continue. The hotel industry is one of the most promising areas of the commercial sector. Tourism and travel services are the driving force behind its growth.

The electricity consumption in the hotels is expected to increase much above the rate of the growth of economy and rate of growth of electricity consumption in the commercial sector. Hence, it may be worthwhile to explore possibilities of electricity conservation in this important growing industry South Africa has enjoyed electricity production surplus for years due to overinvestment in electricity generation by Eskom and this has eliminate the need to build new power generators and through which Eskom achieved the position of being the world's cheapest producer of electricity (Kohler, 2008). However, this situation is now ended and South Africa is in urgent need for additional power capacity.

Between December 2005 and May 2006 outages were experienced in the Western Cape. In January 2007, outages were experienced across the country and the year after (2008). Daily load shedding events were experienced. There was sustained daily load shedding lead the SA Government to declare a national power emergency. For Eskom, to stabilise the cut off electricity an immediate reduction of demand of 3600MW was required to satisfy everybody. That equates to a 10% reduction in electricity consumption. Those power cuts had a severe impact on production levels in all sectors of the economy. Electricity prices have increased substantially and new legislation is being enacted which will introduce punitive tariffs through a programme known as the Power Conservation Scheme (PCP). The conservation procedure provides sufficient incentive for electricity users to become more energy efficient and manage their consumption more effectively. and the economy slow down due to many companies that could not operate without electricity. According to Kohler (2008) and Eskom annual report (2007), the recent large scale power outage and load shedding events have been contributed by a shedding reserve margin (see figure 1.5 below).

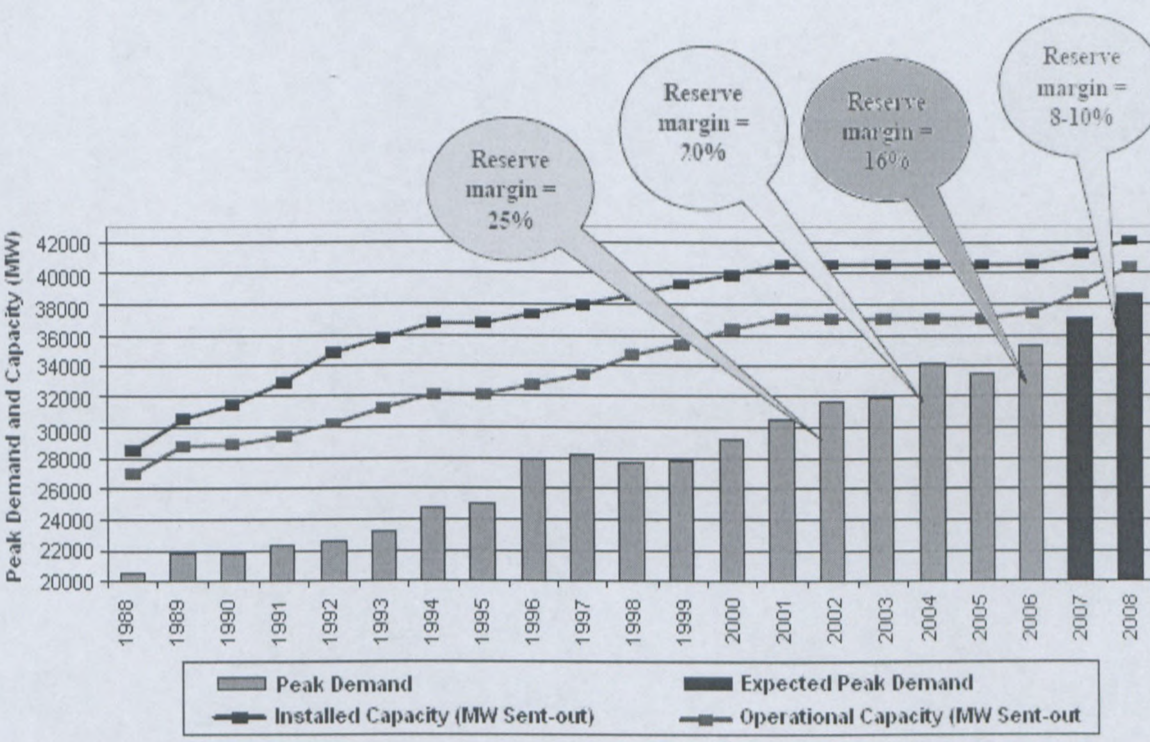

Figure 1.5: Electricity capacity, demand and reserve margin;<yhu7

(Source: S. A Government: National response to address electricity shortages, 2008)

According to the National Energy Regulator of S.A, the reserve margin target is set to a minimum of 15%. This allows time for maintenance throughout the year as well as power plant to be operated at levels where equipment is not highly stressed. The decline in the reserve margin has resulted in:

- Limited opportunities for maintenance, and
- Necessitated that Power Stations are run harder

It can be seen from the above figure that the reserve margin of 20% was still acceptable from the year 2001 to 2004 and after that, the reserve margin start decreasing from 20%, 16% to 10-8%; this was due to the increase in demand of electricity and the generating plants that had already reaches its maximum capacities. An acceptable reserve margin would be between 15% and 20% of various factors contributed to the supply problem. The reserve margin of 8 – 10% would have being achieved as indicated in figure 1.5. This study is needed because little empirical research has been conducted to examine the energy management in the hotel industry

The need to ensure that the accommodation and hospitality are of a high quality of service mostly depends on electricity. To meet the challenge of providing electricity to the fast growing tourist population, there is a need to manage the energy consumed and to create awareness to the public and industries in order to reduce electricity consumption so as to avoid interruption in the electricity supply.

1.5 Investigative questions

The following questions will be addressed to investigate whether the energy management measures are taken into consideration.

- Can the energy management programs in the Western Cape of South Africa hospitality sector contribute to minimising energy consumption?,
- Are there any energy conservation measures in place in the hotel sector in South Africa?, and
- How does the increase in cost of electricity impact on the hospitality industry in South Africa?

1.6 Aim and objectives

The aim of this study is to explore the cost effectiveness of the energy efficiency in saving energy consumption in the selected hotels in the Cape Town of South Africa.

In meeting the principal aim, the study will have to focus on the following objectives:

- To investigate and analyse the energy consumption in the hotels industry in Western Cape of South Africa.
- To explore the significance or impact of energy efficient equipments for lighting, air conditioning and water heating systems in energy management.
- To explore the benefits which are associated with Demand Side Management and such relates to the hospitality industry in South Africa
- To investigate possible energy-conservation measures through behavioural and operational changes in the hotel industry.

1.7 Methodology

To study the energy consumption in the hostel industry, an interview will be arranged with the management of the different star hotels in Cape Town. The study will explore the perception of these hotels regarding the installation of load management systems or energy conserving technology. The findings of this study will be serving as an indication on how the Department of Energy (DoE), the national electricity utility, Eskom, and National Electricity Regulator of South Africa (NERSA) should approach the hotel industry to minimize its contribution of energy consumption in South Africa.

An energy audit of selected hotels in energy consumption and saving category will be determined. Quantitative and Qualitative methods will be used to investigate the outcomes of energy conservation. A questionnaire is given to the selected hotels to give detailed information on appliances ratings and consumption for the appliances they are using. Also, person to person interview with the hotel management during early stage of the study whereby the size of equipment, hotel layout, efficiencies of individual equipment, monitoring and control will be discussed.

1.8 Limitation

The study is confined to the Cape Peninsula geographical area in the Western Cape Province of South Africa where seven hotels have been accessed and it is utilized a self-reported only survey method due to time and financial constraints. The implementation of an energy management strategy for small, medium and big size hotels in the Western Cape has been investigated and the low response rate and non-responses might have biased the results of this study.

1.9 Assumptions

- It is assumed that all relevant employees approached to participate in the survey will have sufficient knowledge about the subject and co-operate and respond accurately without any prejudice to the questions asked to them.
- It is assumed that records from projects documentation regarding the energy conservation will be accurate and participants will be honest in providing correct information.
- It is assumed that proposed participant hotel companies for the survey will cooperate and allow access to their sites and documentation records as required by the study.

1.10 Ethical considerations

In order to comply with internationally accepted standards, the name of participant organisations (hotels) and individuals will not be recorded on research instruments. No compensation will be paid to any respondent or participant in the study. Quality assurance will be done with respect to the following aspects:

- Quality of data capturing; and
- Accuracy in calculations.

1.11 Organization of the thesis and chapter outline

Figure 1.6 below show the thesis structure from the introduction to the conclusion and recommendation.

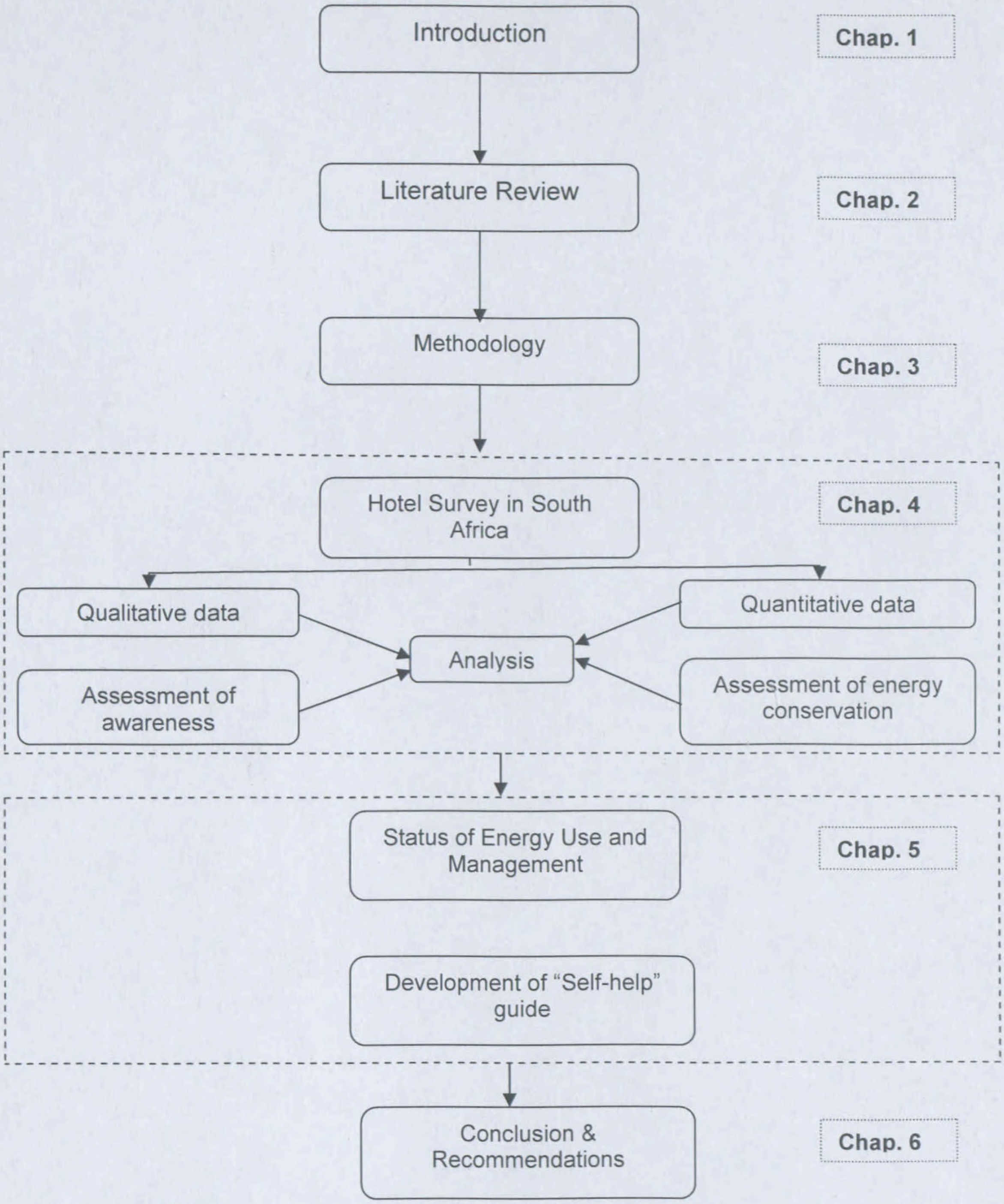

Figure 1.6: Organization of the thesis

Chapter One: Introduction – This chapter is a synopsis of the background of the participation of energy conservation in the hotel industry, highlighting factors of the historically Demand Side Management (DSM) dominated of the industry. The problem statement, hypotheses and objectives of the study, which are congruent to this background, are included in this chapter.

Chapter Two: Literature Review – This chapter highlights and discuss literature on the energy conservation and demand side management, the hotel industry as well as past and current energy situation, in order to formulate an understanding of the subject of the study. Literature on past research conducted, which is relative to this study, will also be discussed.

Chapter Three: Methodology – The research discusses the methods to be used for data gathering, which are use to effectively achieve the objectives of the study will be discussed in this chapter.

Chapter Four: Analysis of the questionnaire – This chapter constitutes the presentation and analysis of data gathered at the first stage of the research and audit of hotels which contribute to achieve the set objectives of this study.

Chapter Five: Data analysis and results – This chapter is the presentation and analysis of data gathered at the late stage of the research and the survey of the hotels participant to the study.

Chapter Six: Conclusion and recommendations - In this chapter, the study will be summarized and conclusion will be drawn based upon data analysis. Recommendations will be made relative to the problem statement and objectives of the subject under investigation.

1.12 Chapter summary

This chapter outlined the framework of the entire research study. The preliminary literature review focused on the historical background of the energy conservation and demand side management in the hospitality industry particularly with regard to the hotel industry. Subsequently, the problem statements relating to the participation of energy conservation and management of the hotel industry are stated in this chapter. The aim of this research was to study and explore Demand Side Management as a cost effective measure of saving energy consumption in the hotel industry. The data collection complied with internationally accepted ethical standards. The research outline provides an overview for each chapter of the study.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The introduction of electrical energy management in the hotel industry aims to be an effective method of minimising the energy consumed by this industry, as well as to facilitate the improvement in reliability of the power supply system. The focus on the energy management is to do the conservation of electricity and reduction of demand for power. This chapter review the literature on energy conservation / Demand Side Management (DSM) measures with emphasis on the existing activities associated with energy management of hotels industry.

In the last decades there have been expressions of concern that continuous of economic growth and the associated increasing production of goods and consumption of energy will lead to the exhaustion of known resources. The concern was directed more towards the energy which was used in the production process, as well as in households. Indeed most actively seek to promote increases in production as a means of reducing unemployment levels. However call for reductions in the growth of energy consumption is required. Further, restraint on energy growth can be achieved by improving the efficiency of energy use and reducing energy losses under the broad heading of energy conservation which can leads to claims that, energy consumption can be 'decoupled' from economic growth to give the comforting illusion that economic growth can be continued by making a given amount of energy go further (Greenhalgh, 1990).

From 1973 to 1979 the energy conservation strengthened by the oil price rises has ended an era of cheap energy, it brought home to public and governments similar the vital role of energy in economic development and the often undue dependence of many countries on imported oil (Greenhalgh, 1990). As solution to solve the problem, special bodies were formed to promote these activities and the whole range of government-backed programmes were introduced to encourage consumers to adopt energy conservation measures, particularly those which would reduce oil consumption, these included information, energy audits, financial incentives, demonstration programmes, energy labelling and the adoption of energy-efficient regulations and standards (EERS). The Demand Side Management (DSM) was the method used for the approach.

From the results of previous research conducted in different geographical regions by Erdogan & Baris, 2007; Bohdanowicz, 2006, Mensah, 2007, energy and environmental management practices were widely adopted by the sample hotels. Using energy efficient lighting was the most widely adopted measure to save energy. With hoteliers' growing focus on energy management as a way of lowering operating costs, various energy saving measures have been highly recommended and reported by related organizations. Installing energy saving equipment and products was also reported to be a primary energy saving practice adopted by the sample hotels. Energy Star-qualified products, in particular, are not only being widely used, but also considered to be a yardstick of energy efficiency of a property.

Improving energy efficiency can be considered a key value-added strategy for hotel companies as energy costs rise, and consumers' cutback on travel under the recent economic recession. Energy management can lead to a breakthrough to tide over the recent unfavorable business environment and financial constraints. Energy management can reduce operating costs without sacrificing customer services or comforts. At the same time, hotel companies can use these energy saving initiatives to demonstrate their dedication to greening of their operations.

2.2 Energy consumption / reduced energy cost

As countries develop, the general pattern tends to be an increasing percentage of energy and peak power are being used in the commercial sector. This growth can result in serious strains on the energy infrastructure of a country. Energy efficiency can contribute immensely to the solution of these problems, even in the relatively short term. Instead, experience throughout the world shows that there are numerous, powerful market barriers to rational investment in energy efficiency. These barriers can be overcome by government policies. From a societal perspective, investments in energy efficiency in a commercial sector can be compared with the cost of capital investments necessary on the supply side of the energy system to produce a similar amount of peak capacity or annual energy production. In term of constructing new commercial building, energy efficiency in those buildings could be particularly important because the costs of retrofits are almost always much higher than the costs of energy efficient new construction (UNEP, 2007).

The increasing of energy consumed raised serious concern by the government of South Africa to overcome the phenomena by promoting the end-use energy efficiency which means using less energy while maintaining the same level of service (Ibrik & Mahmoud, 2005). This increase could be achieved either by decreasing total energy use or by increasing the production rate per unit of energy consumed. With this in mind, improving energy efficiency is the key to reducing green house gas (GHG) emissions (Priambodo & Kumar, 2001). Energy research organizations and governments are therefore actively engaged in developing methods of assessing energy efficiency. This evaluation could have provide a reference for establishing energy policy and can simultaneously reduce GHG emissions (David et al, 2007). One of the ways to attain the more efficient use of final energy in industry is determined by the energy consumed and energy losses in a plant. Various types of equipment and devices that consume energy at varying levels of efficiency depend on the characteristics and working conditions (Thollander et al, 2005).

2.3 Energy saving audit

According to Fromme (1996) energy audit is one of the methods that can be used to identify and quantify how energy is being used in a plant and numerous studies have been published on energy audit and energy analysis results for different industries. Energy use performances and energy efficiencies of the industrial have also been studied in different surveys (Ozturk, 2005) in different countries (Christoffersen, 2006).however the exiting literature study has identified and quantified the approximation of energy usage breakdown in commercial sector (Subrahmanya, 2006).

Of all the energy audit done in the industry automation, lighting upgrade at Nissan South Africa's manufacturing plant proved to be the most interesting through the introduction of the latest technology lamps and control gear, approximately 1 MW in power was saved and the overall lighting improvement was overwhelming (Thumela, 2005). However the installation of the submitter has not been taken into consideration to allow better management of the energy use in that sector. In 2007 during the winter and spring, the energy audits of the top-1000 enterprises was done and documented the level of energy consumption situation which has resulted to the identification of ener gy efficiency opportunities. These enterprises developed energy action plans delineation on how they expect to meet their energy-saving targets. On the other side, other enterprises have the expertise to conduct energy audits and identify energy efficiency opportunities, a number of enterprises found this task difficult due to the lack of qualified auditing personnel and needed to hire outside experts for assistance (Lynn et al, 2009 & 2010).

It has been said by Salah, (2008) that "several researchers have confirmed that more than 60% of total useful energy represents buildings electric energy consumption" energy management strategy was developed and they could integrate renewable energy and formulate adequate energy management strategies inside buildings. As for that reason, the use of other method of energy such as photovoltaic, wind...to generate electricity was becoming an important issue and could contribute to the saving of the energy.

2.4 DSM as an alternative to generating capacity

Demand Side Management (DSM) programmes save electricity and every unit of electricity saved reduces generating requirements more then one unit (Eskom, n.d.). This is because transmission and distribution losses are avoided; savings are at the consumer end. DSM programmes reduces peak load and thus reduce capacity expansion requirement for the utilities. DSM contributes to a stand-in to building power plants, and also has the advantage of short gestation period of 1 to 2 years compared to 4 years and more for power plants.

Energy management referred to practices and standards set forth in an energy management plan and its contributed to the outcome of improving business performance; Energy efficiency initiatives are selected for their potential to reduce expenses, build revenue capacity, and contains operating risk. (Christopher, 2005). Still in the same direction, he stated that "*Efficiency* should not be confused with *conservation*. As opposed to conservation, which often denotes sacrifice, energy efficiency is an indispensable component of any effort to improve productivity. Ultimately, energy efficiency contributes to wealth". By following this direction, energy efficiency should be the source of conserving the energy in the hotels industry.

2.5 DSM reduces resource and infrastructure requirements

Resources such as land, water and manpower, which are required to build and operate power plants, are saved as the DSM programmes are carried out in customer's premises. Resources such as fuel to produce power are saved and transport requirement eliminated. With rapid development of China's economy, demand for energy is constantly growing. Meanwhile, the conflicts between the shortage of energy and economic growth have become increasingly conspicuous. Buildings, an indispensable part in people's life, with their multiple comprehensive functions, consume energy of a large amount (Kai & Zhihui, 2009) in modern information and economic society.

2.6 Energy availability and price considerations

Energy prices in international markets have experienced sharp fluctuation in past. The fluctuation impact the growth of energy importing countries resulting energy conservation being seriously taken up by several countries, especially after the oil price shocks in 1973 to 1974 and 1979 to 1980. As a result efficient technologies for production and use of electricity were introduced. Growth of electricity consumption in several countries, especially in developed economies tapered after that. With increased tress on environmental issues, energy consumption is once again a focal issue. There is a possibility that restriction on energy (and electricity) consumption may be agreed by the international community to address global environmental issues. It is therefore worthwhile to get ready to face situation (Kilian & Park, 2009)

Optimisation of power quality and reliability of the energy supply are more important than ever. Power Factor Correction (PFC) in its various forms, such as static and dynamic filters and active filters, play a key role here. PFC systems help not only to satisfy basic demands for stable energy supply and power quality, but also to save energy cost and reduce capital expenditure at the same time (Norris, 2006). Given the right design, a PFC system soon plays for itself. Here are the key benefits of PFC at a glance:

- Reduce power consumption and lower costs.
- Less reactive power in the entire grid
- Lower power dissipation
- Reduced emission of greenhouse gases spares the environment
- Higher power quality and lower voltage drop.

Power capacitors for PFC and accessories such as controllers, reactors and contactors have been improving power quality and raising the power factor worldwide for many years (Norris, 2006). But automatic PFC systems take up a lot of space and require high capital expenditure. Although power capacitors are key components of PFC systems, they account for only 10 to 20% of total cost.

Sustainability is one of the major issues facing the humanity. National Electricity Company Utility of South Africa (ESKOM) is following the practices that help sustainable development. It is also widely accepted that present pattern of resource consumption is not sustainable. Therefore need for conservation of resources is a pre-requisite to sustainable development. Progressive and environmentally sensitive business and industry world over have pledged to follow practices that lead to sustainable development. It may have to be followed by all business in the future (Crane & Swilling, 2008)

2.7 LV motor as consumer of energy

The worldwide differences relate to several guidelines, agreements, specifications and standards that define efficiency levels, Low Voltage alternative current (LV-ac) electric motors are major consumers of electrical energy in developed economies of the world and are often called a "workhorse of industry". Several examples can substantiate this statement (Janicijevic & Hauptfleisch, 2006.). For example, the US Department of Energy estimates that as much as 63%of industrial usage and 25% of the total usage is attributed to electric motor; in some US process industries, such as mining and cement production, motors use over 70% of total electric power. The same source state that in the Australia, 30% of electric demand goes to three phase induction motors and 10 to 20% of Canada's total annual electricity consumption is being consumed by the motors in 0.75 to 150 kW range. In Finland, the situation is even more pronounced: apparently 80% of their generated electrical power is used to run induction motors. In Europe, in general, a typical figure for motor motors is approximately 60%, whereas in comparison, lighting consumes just about 10% (Janicijevic & Hauptfleisch, 2005).

In South Africa, the situation appears to be quite similar, where a large industrial consumer quoted its 25 000 motors to account for approximately 70% of electrical energy consumption (Terblanche, 2002). Due to such variety of criteria and absence of national guidelines, the South African suppliers often offer different efficiency machines under the banner of "high efficiency" and efficient utilization of existing energy resources can save energy and money(Janicijevic & Hauptfleisch, 2005). The energy savings reduce pollution and standards have been adopted to achieve significant savings in industrial processes, most significantly through requirements for use of more efficient electric motors through combined heat and power or cogeneration, utilizing the heat emissions from power plants either to produce additional electricity or for industrial hot water uses and domestic heating purposes (USEP, 2007).

2.8 Alternative energy source systems

As the world struggles to address global warming, renewable energy presents a crucial zero carbon alternatives to carbon-intensive fossil fuel generation. Renewable energy sources are by definition sustainable and unlimited, not subject to depletion. Most renewable energy sources, such as hydro, solar, geothermal, wind, tidal and wave power, have zero fuel costs, helping to reduce and hedge against energy price volatility (UNEP, 2007).

In the United States in 1891, the world's first commercialized solar hot water system was patented (Perlin, 2002). That Solar hot water quickly became popular in California and many other states as an alternative to burning wood or expensive fuel. a third of all homes In Pasadena had a solar hot water system by 1897. Adding to this in the early 1900s, many inventors improved upon the original systems, making them more durable and efficient. Solar hot water's popularity continued to grow in California until vast reserves of natural gas were discovered in the Los Angeles basin in the 1920s and 30s. The environmental and health costs associated with burning oil and gas for heat and electricity were underappreciated, and their cheap prices severely dampened demand for solar hot water systems (Perlin , 2002).

2.9 Demand shift, control and cost components

The South African electric utility companies (Eskom) generally charge for peak electrical demand. Peak demand is the maximum electrical capacity required to serve a facility at any time.(Eskom, n.d.) It is based on the electrical generation and distribution equipment needed to provide the power required when your greatest demand occurs. If for example, the greatest demand occurs between 6:30 am and 10:00 am on a heavy production day, the charge for the billing period will be based on that peak demand however by making use of the DSM method, scheduling equipment throughout the day rather than during one short period will reduce peak demand charges (Bjork & Karlsson, 1986)

With the rapidly increasing electricity tariffs in SA set to continue for the next few years, it is becoming vital for businesses to become aware of their energy cost and take advantage of energy efficiency opportunities in their business. The days South Africans and companies relying on relatively cheap electricity are over (Harpur, 2009). Energy cost will become a major priority for business, and the need for saving electricity will drive energy efficiency measures, and provide an opportunity for competitive advantage. The measurement of energy use in the business is the fundamental starting point from which staff behaviour, energy efficiency initiatives and energy management all stem.

The various charges rate structure are often difficult to understand without an explanation from the utility however, the utilities base their rate schedules on a variety of factors, such as type of customer (residential, commercial, and industrial), amount of usage, and type of electric service (primary or secondary distribution).. An on-going business typically does not question its rate structure even though its situation may have changed. This is an often overlooked as a cost savings opportunity (Eskom n.d.). The electricity has to be treated in a different manner from fuel oil and natural gas. The electricity cost is charged to the manufacturer using two different cost components such as electric consumption and demand however, a third charge, power factor (so called reactive charge) sometimes also applies.

In 2001, manufacturing industry accounted for 36% of global energy use, while the energy use of services was more difficult to estimate. A common breakdown of industrial energy use distinguishes energy use for processes (called process-specific) and other services like energy use for buildings, utilities and boilers (called cross-cutting). The wide variety of processes makes was difficult for the policy maker to design policies and regulations to manage all aspects of industrial energy use. Hence, industrial energy policies are often directed at overall goals, or at specific process and elements of the industrial production and energy consumption process (USEP, 2007).

In the United State, the Alliance to Save Energy, reducing energy costs while continuing to meet the diverse requirements of hotel customers can be challenging. Hotels consume enormous amounts of energy to provide a variety of customer services. According to Fedrizzi & Rogers (2002), the Alliance to Save Energy reported In 2000 in the lodging industry was the fourth most intensive user of energy in the U.S. commercial sector and the hotel industry alone were spending about $500 per room per year for fuel and electricity which approximately represent $2 billion for the more than four million hotel rooms in the U.S.

The Department of Energy (DOE) relate that the cost of electric consumption was similar to that for natural gas and fuel oil, i.e. all three are charges for units consumed. The usual unit of electrical consumption is the kilowatt or kWh. This is measured by the watt-hour meter and appears on the bill as kWh consumed each month and has an associated cost. Even this charge may be broken down into a charge for consumption on-peak (usually 8AM-10PM) and off-peak (the rest of the day).

2.10 Energy efficient lighting and efficient air conditioning system

The energy efficiency lighting system is the second largest energy-using system in a hotel therefore it may be the easiest and most cost-effective area for reducing energy costs. According to Sarah & Carter (2002), the fluorescent lamps produce four times as much light per watt than incandescent lamps, and they can last eight to ten times longer. If a compact fluorescent light is replaced by an incandescent light that is left on continuously for 12 months, all 8,760 hours of the year will pay for itself in less than one year. The example of the Sheraton Tacoma Hotel in the United State of America that developed a project to transition to compact fluorescent light fixtures. The staff replaced 2,000 incandescent light fixtures with quadruple-tube compact fluorescent light bulbs in various areas of the hotel such as the guest rooms and the lobby. The cost saving is then calculated up to $15,000 with a payback rate of 18 months (Sarah & Carter, 2002).

Electric lighting design strongly affects visual performance and visual comfort by aiming to maintain adequate and appropriate illumination while controlling reflection and glare and using less electric lighting reduces heat gain, thus saving air-conditioning energy and improving thermal comfort. Lighting is one of the priorities when considering hotel design; it is also a high-return, low-risk investment. By installing new lighting technologies, hotels can reduce the amount of electricity consumed and energy costs associated with lighting (United State Department of Energy, n.d.).

In the North of America, Lighting represents almost a quarter of all electricity consumed in a typical hotel, not including its effect on cooling loads; Lighting retrofits reduces lighting electricity use by 50% or more, this was depending on the starting point, and cut cooling energy requirements was by 10 to 20% as well. Illumination requirements were vary throughout a hotel or motel depending on the type of space and Outdoor nighttime light levels could depend on local ordinances, but can generally be fairly low, depending on the level of activity and the potential hazards (Campbell, 2007). However, Since hotels are into decorating, there is a big numbers of Osram Deco-spot LEDs in the market and coming in different colour (red, green, blue or white) that can be use to decorate and also because they are energy efficient as well. There are also allowing to conjure up lighting effects at home in areas such as the living-room, bathroom or hall. The arguments for the new LED generation from Osram are self-evident. Those seeking to combine low power consumption, long service life and high safety with a familiar design should use this technology. The décor will be better in the new light with a flick of the wrist, this Deco-spot LEDs replace lamps with an E14 and GU10 socket (Bouchier, 2006)

The implementations of energy-efficient equipment in Hotels worldwide are the recognised projects opportunities for the space heating and cooling systems. For example, The Hyatt Regency International Hotel in New Zealand understood that guests often left appliances and heating and cooling systems on when they are out of their rooms. Therefore the hotel owners developed a project to link energy use with room occupancy. Consequently all energy appliances shut down when a guest leaves the room, with the exception of refrigerators, alarm clocks, and other essential appliances. The project costs were $16,000, while the payback period was only 14 months, with savings of $14,000 annually (Kennedy & Alexander, 2002). However, in an example highlighted in Guide to Industrial Assessments for Pollution Prevention and Energy Efficiency (IAPPEE), an economizer was installed with outdoor temperature switchover at 56.5°F on a continuously operating, year-round air conditioning system, with the preheated discharge temperature controlled at 40°F. Savings from the economizer totalled $2,280 per year and an economizer was installed using the enthalpy method and saved $3,520 per year (U.S. EPA, 2001)

According to Kennedy and Alexander (2002), the Sheraton Auckland Hotel and Towers realized that the daily washing of sheets, towels, flannels, tablecloths, and other linens accounted for 35% of the energy consumed in the laundry process, while drying consumed 65%. The hotel simply changed the temperature of the wash from 85 degrees Celsius to 65 degrees Celsius. This change saved $2,000 in energy costs in the first three (3) months alone, and the linens came out just as clean. This project, in addition to reducing energy costs, reduced the use of washing chemicals and decreased pollution of the hotel wastewater, allowing the hotel guests the option of having linens washed every other day rather than daily which can significantly assist in energy and water conservation.

2.11 Monitoring and auditing

Energy audit should be conducted on a regular basis to identify how seasons might affect resources, where surges and inefficiencies arise, and what changes to the manufacturing process are impacting electric consumption (Sandison, 2009).

The walking through generally produces three types of energy saving solutions.

- The first, behavioural changes are simple, low or no-cost solutions that can significantly impact the bottom line.
- Programming changes, the second type, are relatively low-cost changes to the facility's energy-consuming assets that can provide a quick payback. One of the plan floors, these changes can take the form of improving controls or upgrading older equipment for more effective use of electrical resources.
- the third type is capital investment which can range from boilers with advanced process control that help optimize fuel usage, to installing solar panels or other alternative energy systems.

Once the utility saving has been identified, the final step in the energy audit process is to prioritize, implement and continue to execute the suggested changes. While many companies will maintain the solutions put in place for a few months or even a year, the most successful will examine and monitor their energy consumption on an ongoing basis to optimise their usage and related cost savings(Sandison, 2009)

A survey in The Netherlands suggests that the availability of personnel is seen as a barrier to investing in energy-efficient equipment by about one-third of the surveyed firms. Such knowledge is important, because medium size enterprises are often a large part of the economy in developing countries, and are often inefficient. Information and monitoring programs are often established to help remove information barriers within industries to implement energy efficiency technologies or measures. Few countries have experience with energy manager programs, including Korea, Japan, Thailand, Finland and Portugal, as well as Denmark and Italy and had voluntary requirements for companies to have a dedicated energy manager onsite when a plant's energy use would exceed a certain amount of energy use per year (UNEP, 2007).

2.12 DSM as the fight again energy conservation

In the Mexico in 1989, the Comision National para el Ahorro de Energia (CONAE) and the National Commission for Energy Saving was founded to implement energy saving and efficiency measures and In 1990, Fideicomiso para el Ahorro de Energia Electrica (FIDE), the Mexican Trust Fund for Electric Energy Saving was established as a private non-profit organization to realize actions that promote the saving and the efficient use of electric energy, whereas CONAE it was responsible for energy efficiency in general as well for the promotion of the use of renewable energy. Both institutions have developed numerous energy saving programmes, which resulted in an estimated avoided consumption of about 41 billion kWh by the end of 2000, plus a reduction of the growth of peak demand which avoided about 2470MW of new plant capacity. The Investment in for the programmes was estimated to be about a factor 50 lower than the related economic savings (Praetorius & Bleyl, 2006).DSM was employed as a method to avoid these consumptions

Demand is the second cost component based on the highest rate of consumption during the billing period. It is usually obtained by the electric utility by measurement of energy consumed in chronological fifteen minute periods throughout the month. The maximum period for the consumption is then converted to an average rate of consumption in units of kilowatts (KW). This maximum KW value is then multiplied by a demand cost factor, which can vary considerably depending on whether one is talking about demand during the on peak time (daytime hours) or off-peak (night time hours). This demand charge is then added on to the consumption costs to yield the monthly electric cost.

Many utility companies charge an additional fee if the power factor is less than 0.85. Inductive loads (e.g. transformers, electric motors, and high intensity discharge lighting) constitute a major portion of the power consumed in industrial facilities, and they require current to create a magnetic field. In this case, the current used to create the magnetic field is required to operate the device, but does not produce work. The utility must provide both the power to produce the magnetic field (Reactive Power, measured in kVAR) and the power that produces useful work (Turner, 1997) (Real Power, measured in kW). Since the power factor is the ratio of Real Power to Apparent Power (all the power provided by the utility, measured in kVA) (Turner, 1997). Your electric bill is based on measurement of Real Power, measured in kilowatts (kW). However, low power factor requires an increase in the electric utility's generation and transmission capacity to handle the reactive power component caused by inductive loads. Low power factor reduces electrical system's distribution capacity by increasing current flow and causing voltage drops. Some strategies for correcting your power factor are:

- Minimize operation of idling or lightly loaded motors.
- Avoid operation of equipment above its rated voltage.
- Standard motors can be replaced as they burn out with energy efficient motors. However, the motor must be operated near its rated capacity to realize the benefits of a high power factor design.
- Capacitor suppliers and engineering firms can help determine the optimum of power factor correction and the correct installation of capacitors in the electrical system by . Installing the band gap capacitors to decrease the magnitude of reactive power

In the USA, a fund of US$30–70 million per year, mainly through collection of a levy on domestic consumption of oil, was used to engage consulting firms to conduct energy audits on over 1000 chosen commercial buildings and to upgrade 573 small government buildings. (Chirarattananon & Taweekun, 2003). However, these programs have not achieved the expected outcome by 2001 eventhough it started as far back as 1995. With an evaluation of the small government building program completed recently, the success rate of the program was at 40% and the actual savings at 46% of the predictions, amounted to an internal rate of return less than the requirement of 9% set for the program (Chirarattananon & Taweekun, 2003).

In China, the DSM program began to pay great attention to energy conservation in the late 1970s in the context of domestic energy shortages and international oil crises. Under a centrally planned economy at that time, the government mainly adopted a top down approach through administrative measures to promote energy conservation. The main characteristics of energy conservation management by the government were through a fixed energy supply and energy quota management system. From 1986 to the early 1990s, enterprises in China generally practiced the energy conservation bonus system. Enterprises could allocate certain amount of funds in proportion to an energy conservation volume and award energy conservation operating and management staff. This practice greatly motivated the initiatives of the enterprises and employees increasing their awareness and strengthening energy conservation management. Up to 1998 China achieved a cumulative energy saving volume of 834 million tce. Based on the 1997 end-use energy price of 945 Yuan/ tce, energy saving generated an economic benefit of 788.4 billion Yuan. Average annual energy conservation volume in China reached 46.3 Mtce from 1981-1998. In 1997, investment required for new supply capacity was 5702 Yuan / tce. Based on this, reduction in energy supply investment amounted to 264.2 billion Yuan ($US 34 billion) (Zhihong, W. 2004).

Research by (Kirsch et al., 1996) into the reasons for rejection of energy conservation opportunities by 3612 small and medium manufacturing plant in the USA from 1984 to 1993, were for the following reasons; 43% was due to unacceptable financial risk (unsuitable investment return, high initial cost and insufficient cash flow); 25% was due to postponement (still considering after two years) and 11,5% was due to unacceptable plant/person risk (personnel safety, production rate or quality jeopardized, or unacceptable inconvenience).

A program in the USA described by (Kirsch et al., 1996) provided technical assistance (energy assessments) from university engineering faculties to 3612 small and medium sized industrial (in the USA) from 1984 to 1993. Annual recommended energy conservation as a percentage of consumption averaged from 9.97% to 5.24% over the period. Disappointingly, implemented savings averaged from 5.4% to 2.1% over the period. The reasons for this resistance are discussed in the section on barriers.

In 1980, the United Kingdom (UK) Department of Energy initiated a program that aimed to install effective energy management systems at a quarter of all UK industrial sites that used more than 26 000 GJ/year. By 1987, overall annual savings of $120 million had been achieved and were forecasted to rise to annual savings of $640 million by 1995. By the end of the program in 1991, 700 energy information systems had been installed in 22 sectors. Some of the average percentage energy cost savings for the sectors were 9% (paper and board), 12% (non-ferrous metals), 13% (food) and 17% (textile finishing) (Fawkes, 2005).

A project to gather and package information on energy efficiency in South Africa, using three case studies in different industries, was undertaken by the Energy Research Institute (ERI) at the University of Cape Town. The results show that leading players in South African industry have found room for efficiency improvement. Energy cost savings for the South African Breweries Prospection plant were R1 370 000/annum (8% of annual energy costs) with a required investment of R1 180 000 giving a payback period of ten months (ERI, 2000). Energy cost savings for AngloGold's Elandsrand gold mine were R1 990 000/annum with a required investment of R1 293 000 and a payback period of eight months (ERI 2000). Sappi's Mandini plant was able to save R5 550 000/annum in energy costs (5% of annual energy costs) from an investment of R3 220 000, giving a payback period within seven months (ERI, 2000).

DSM programmes have been in operation in several developing countries for more then 28 years. Pacific Gas & Electric and Tennessee Valley in the US had initiated DSM programmes in the late 1970s. Electric Power Research Institute (EPRI) conducts regular survey of DSM programmes of the utilities in US. The surveys was conducted for DSM programmes for residential, commercial and industrial sectors. According to an EPRI report, the DSM programmes reached 40 million customers in the US between 1977 and in 1983; it lowered the peak demand by 13000 MW. The total of 85% of utilities implemented the DSM programmes and the total expenditure by utilities in 1990 where establish to be more then US $2 billion.

The national electricity utility of the South Africa had experienced some serious power outage during the year 2005 due to the non-service of the power service and the generators that were running at their maximum demand. By the end of 2007 and in the beginning of 2008, global financial markets were dominated by liquidity concerns as a result of the United States housing market credit crunch this has lead to an increase in electricity prices in South Africa and caused the power demand to becoming less, which could lead to fewer power outages. The target of the final energy demand reduction of 15% by 2015 has been calculated (South Africa. Department of Mineral and Energy, 2005).

The 1990 survey of the industrial sectored 417 industrial sector DSM programmes conducted by 154 electric utilities and involved 49738 industrial customers (EPRI, 1990).
The EPRI commercial DSM survey indicated 343 programmes by 168 utilities involving 228.927 participants, and residential DSM survey indicated 1022 programmes by 485 utilities involving 12.940.736 participants. In 1996, more than 1300 programmes for commercial sector have been initiated involving about 500 utilities. DSM budgets offer sample of 14 utilities increased from 1,6% of their operating revenues in 1989 to 2,3% in 1991. Peak load imports impacts on a sample of 9 utilities was observed to go up from 1,34% in 1989 to 2.43% in 1991, and expected to reach 8,16% by 2000 (Gelling & Chamberling, 1993b).

DSM programmes of three majors' utilities in US alone had commitments close to $1 billion. In 1987 there was a DSM program that initiated by New England Electric of the US had achieved 170MW of peak demand reduction by 1989. By 2008, DSM and load control programmes will account for more than 1100 MW, about one third of utility's resources. With the similar programmes being initiated by other utilities, the DSM programmes in the US since 1977 have eliminated need for 20GW of generating capacity, a cost saving of US $21 billion. By 2000 these programmes were expected to reduce energy use by 3% and summer peak demand by 6,7%. This amounts to a reduction of 45GW in generating capacity, reduction in annual energy consumption by 106.000 GWh and avoided cost of about US $45billion (Gelling & Chamberling, 1993a).

In the last 30 years, the global energy system was about 34% efficient. This number equates to a third of the world's energy input being converted into useful energy (Nakicenovic et al., 1998). Sanchez et al...(2008), further demonstrated that as a result of the growing population around the world, there is a movement to reduce green house gasses (GHGs) as they contribute to climate change. Due to this, it is important for both domestic use and the hospitality industry to conserve energy or to use more renewable energy sources.

During 1993 to 1996 in the Pacific Island Countries (PICs), Nine cost effective DSM programmes were identified with a total peak demand saving potential of 21 MW across the ten utilities with an equivalent energy savings of 90 GWh / year by 2000. Under that project, a DSM analysis manual for those countries utilities was published and distributed to all utilities to assist them in programme development. The International Institute of Energy conservation (IIEC) initiated the second phase of the DSM project in 2003 with funding from United Nations Department of Economic and Social Affairs (UNDESA) and implemented by South Pacific Applied Geosciences Commission (SOPAC) and the International Institute for Energy Conservation (IIEC). This programme was focused on implementing pilot DSM programmes in selected PICs with the aims to be a practical exercise in the review, design and application of appropriate DSM technologies through the development of replicable demonstration projects (IIEC, 2006).

In 2005, the United States (US) attributed 85% of its total energy consumption to fossil fuel sources (EIA, 2007a). This amount of CO_2 rich energy makes up about 19% of the whole world's total energy consumption (EIA, 2007b). Tragic impacts on the environment and world population will continue if major consumers of fossil fuels, such as the United States and China do not address the growing GHG problem (EIA, 2007b; Merz, 2001). Carbon sequestration technologies can be part of the solution to help stem climate change damage (Merz, 2007). This leads to the considerable benefit of reducing carbon emissions that stem from using less energy. This in turn leads to health benefits for the wider community. According to Herzog & Golomb (2004), carbon capture and sequestration (CCS) consists of collecting carbon emissions, transporting the carbon waste material, and finally storing the carbon waste in various reservoirs, preventing future emission into the atmosphere.

In 2005, the Thailand Energy Policy Act (EP Act) announced a pattern of more than 75% of the savings from equipment efficiency standards and efficiency tax incentives. Most of these savings were coming from a few provisions, and the majority of provisions proved to be more show than substance. However, federal energy policy over the past twenty years has failed to address two of the core energy challenges in our economy: surging electricity demand and rapidly rising motor fuel usage. These two sectors were key elements to solving our energy security and climate problems.

In Massachusetts, a 1999 evaluation of DSM programs found that in addition to direct energy savings and reduced customer bills, DSM programs resulted in increased customer awareness of energy efficiency opportunities, greater local availability of efficient products, better product reliability and lower prices for efficient products, improved design and engineering specification, changes to customer purchasing requirements and local economic development through direct jobs in energy efficiency (Nadel, 2000). The study also determined that "large-scale energy efficiency programs operate…at an average cost of US$0.03 per kWh, well below the cost of supplying electricity" (p. 10).

The European countries and more specially in Kyoto, the system was put into place to manage the energy and has required the investment in new technologies and has lead to some substantial savings. The system was based on the intelligent low-cost control element named power management switch (PMS). The switching element was to control and monitor electric devices through the existing power wiring by means of communication technology named Narrow-band Power Line Communication (NPLC) and in that way, the need of new wiring for the partially distributed power consumer was avoided and making the technology suitable for monitoring and controlling of extended installation such as street lighting, office building and etc… (Dagoumas, Pagagiannis & Dokopoulos, 2006)

In the Vietnam which has a significant potential for tourism development, study have proven that the tourist arrivals have increased from 250,000 in 1990 to 1.4 million in 1994, and to 2.5 million in 2001. The number of visitors was expected to grow by 30–40% up to the current year 2010. To meet the growth of inbound foreign and local tourists, various hotels and resorts, rated from

2-star to 5-star, have been built in recent years. The occupancy rate has not shown much, but the increases in rooms' number have been by about 3.75% every year. With increasing demands for hotel services, the Vietnamese hotel industry has become a great consumer of energy, water and other resources. (Trung and Kumar, 2005) South Africa hotel industry is currently facing the same scenario with lead to increasing the energy management in that industry too.

In 1992, the national electricity utility of south Africa, Eskom, recognised the Demand Side Management (DSM) programme (Eskom, n.d.). The Integrated Electricity Planning (IEP) was also introduced that year. The DSM plan was only produced in 1994.
In that plan, the role of the DSM was established and the wide range of DSM opportunities and alternatives available to Eskom were identified. These alternatives had the following benefits:

- Monitor electricity demand in ways that would increase customer's satisfaction.
- Co-incidentally produce desire changes in the utilities load shape (National electricity utility of South Africa (Eskom).

As a result of Eskom electrification and the development in the commercial and industrial sector, the current peaking generation capacity would not be enough to supply electricity in South Africa beyond 2007 (Britz & Delport, 2002). This situation has shifted Eskom's focus toward Demand Side Management (DSM). Due to the power generating plants that have been running at their maximum, and in order to protect and balance what is available for everybody to use, Eskom has introduced what is called load-shedding, which refers to planned interruptions of energy (Gellings & Chamberlin, 1993a).

The national electricity utility of South Africa (Eskom), has experienced in the past few years some serious problems with power outages. Some of these outages were due to non-servicing of power plants. The equipment was running at almost full capacity, therefore it was difficult to service them. With this in mind, Eskom has decided to invest in the installation of load management and energy conservation technology. In most commercial sectors, (government building, shopping malls, commercial trades etc.) lights has been replaced by energy-saving Compact Fluorescent Lights (CFL) in order to minimise the energy outage. The commercial sector of South Africa spends up to 35% of their total operating expenses on the energy consumption (Greyvenstein et al., 2000).

2.13 DSM makes use of efficient equipment to promote the green environment

Energy and environment are very closely related. An increase in demand of electricity due to growth puts pressure on environment. In case electricity is generated through use of fossil fuels (such as coal oil and gas), it creates local as well as global pollution on account of emissions associated with use of such fuels. Besides, these are exhaustible resources and hence need careful planning before committing increased use. In case of hydro electricity, local ecology gets adversely affected. These are several movements to oppose construction of hydro power plants to preserve the forests, land mass and ecology. By reducing the electricity requirement DSM reduces environmental pollution and associated health impacts (Greenhalgh, 1990).

Human activities have added 925 billion tons of CO_2 to the atmosphere as well as other greenhouse gasses (GHG's) such as methane and nitrous oxide. These additional gasses intensify the greenhouse effect of the Earth's atmosphere, and the IIEC (1996) report that this may cause predicted global warming of 1°C by 2025 and 3°C by 2100, more severe weather conditions and rising sea level 0.65m by 2100 (Flavin,1998).

In the European union (EU), the directive on the CO_2 emission trading that entered into effect from the beginning of 2005, had an important effect on energy efficiency in energy-intensive of industrial sectors and was expressing the saving goal as the amount of energy that should be saved as a consequence of energy efficiency measures for final consumers in the domestic and tertiary sectors, industry and transport. The annual amount of the targeted savings was in the increasement of 1% (cumulated each year, and relative to GDP) of the energy efficiency of these final users and that amount is fixed for a period of six years (Farinellia, Johanssona, McCormicka, Mundaca, Oikonomoub, Ortenvik, Patel & Santi, 2005).The same concerns apply that each installation pertaining to these industrial sectors is assigned a permit for the emission of a certain quantity of carbon dioxide, which will generally decrease with time according to the general targets of the EU. The high carbon tax has been considered to do comparison especially in order to be able to compare its effects and its costs with the effects of the instruments based on tradable certificates. These ideas should also be adapted to the South African industries to promote the use of efficient equipments that generate less emission and lead to the green environment

In 1998, South Africa produced 1.7% of the world's carbon emissions and his economy is structured around large-scale, energy-intensive mining and primary minerals beneficiation industries, pushing its "energy intensity" to above average with only 10 other countries having higher commercial primary energy intensities. Its major indigenous energy resource is coal, to generate most of its electricity and a significant proportion of its liquid fuels. Because of that, South Africa is the 14th highest emitter of greenhouse gases. Further, the country is committed to reducing emissions, and is a signatory to the United Nation (UN) Framework Convention on Climate Change and the Kyoto Protocol. In this regard, Eskom said that he is committed to reducing coal's current 88% share of South Africa's primary energy mix to 78% by 2012 and to 70% by 2025. However, the power supply crisis has accelerated the need to diversify Eskom's energy mix and its move towards alternative energy sources such as nuclear power and natural gas, as well as various forms of renewable energy. Acccording to Grobler & Heijer(2001), the whole of Africa produced approximately 4% of CO_2 and the USA approximately 24%. However, the Contributions in 1994 for South Africa CO_2 emissions by sector were studied as shown in Figure 2.1 below.

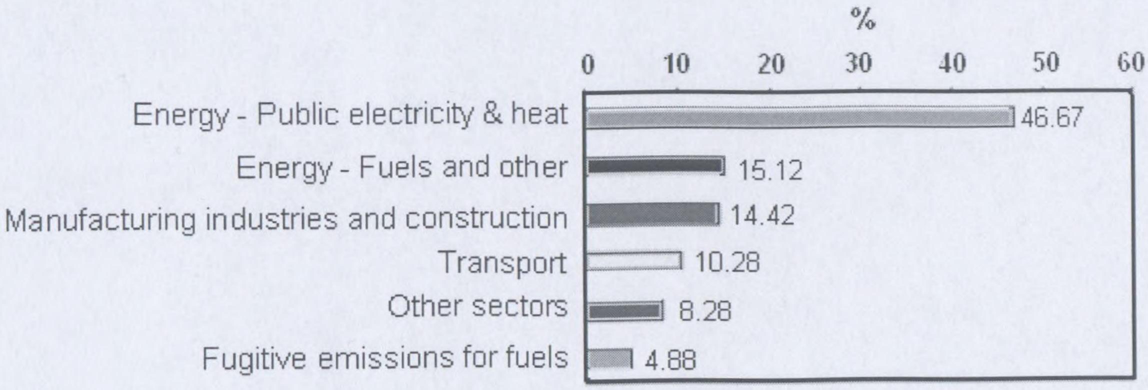

Figure 2.1: % CO_2 emission for South Africa by sector

(Howells and Solomon, 2000)

From Figure 2.1, notably the three largest sources of CO_2 emissions are 'Energy – public electricity and heat production' (46.67%), 'Energy – fuels and other' (15.12%) and 'Manufacturing industries and construction' (14.42%). Together, these three sectors of South African industry contributed 76.21% of CO_2 emissions in 1994. Grobler and Heijer' (2001) state that "The sector that holds the greatest potential for emission reductions and energy efficiency improvements is the industrial sector ... (being) responsible for almost 63% of carbon emissions". All these impact into reducing green house gasses (GHGs) as they contribute to climate change. Due to this, it is important for both domestic use and the hospitality industry to conserve energy or to use more renewable energy sources (Sanchez et al., 2008). Today, David et *al* (2007) indicates that "The Bureau of Energy of the Ministry of Economic Affairs has taken substantial measures and established an energy audit group to assist energy users in enhancing energy efficiency, reducing CO_2 emission and promoting energy savings by all industrial sectors".

2.14 Chapter Summary

This chapter reviewed literature on energy conservation and demand Side management in the hotel industry. The literature review indicates that companies' energy initiatives are driven by various motivational factors including economic benefits and ethical concerns. The main area of energy initiatives in the hotel industry was identified to be the Demand Side Management in the fight against energy conservation. The literature on environmental management in the hotel industry serves as secondary data for designing and to identify currently implemented green practices and underlying motivations of going green.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

In this study of energy conservation / DSM for the hotels, it is noted that an increase awareness of barriers in the conservation and institutional mechanism is needed to ensure that hotels consider implementation of energy conservation measures. The benefits of efficient lighting and the energy conserving systems and their potential for hotels are explored. This chapter examined the possibility of reducing energy consumption for the hotels. It is also indicated how the hotels can evaluate various options with the examples of lighting and air conditioning options. Some of the housekeeping measures have also been identified. Steps already taken by some hotels have also been investigated. A detailed exercise to evaluate other options with involvement of the utility and manufacturers of the equipment can be considered based on result of the study. This chapter is divided into six sections namely introduction, methodology and design, different phases of the study, interviews, data analysis and summary.

3.2 Methodology and design

According to Oliver (2004), the methodology describes the practical way in which the whole research project has been organized. According to Walliman (2005), a plan of action must be developed that shows how the problems will be investigated, what information will be collected using which methods, and how this information will be analysed in order to arrive at conclusions and develop recommendations. Fellows & Liu, (1997) said "research projects synthesise and analyse existing theory, ideas, and findings of other research, in seeking to answer a particular question or to provide new insights". Once the problem statement has been formulated, it should become evident what kind of data will be required to study the problem, and also what kind of analysis would be most appropriate to analyse the data (Walliman, 2005). The problem investigated in this study is energy management for the hotel industry. It is anticipated that the identification of the causes of high energy use in hotels may lead to the price reduction, possible improvement on the utility countrywide. In this study, both the quantitative and qualitative methods will be used.

Hotels in South Africa have been classified in categories from one star to five stars. Most of the hotels in a particular star category could be required to have a certain level of standard of services and facilities such as air conditioning, refrigerators in the guest room, laundry facilities etc. The energy using equipments and their consumption patterns are expected to be similar across a particular category of hotels. Therefore, thorough energy audit of even one hotel in a specific category can give some broad idea of potential saving for that category.

The big hotels refer to hotels with 200 rooms and above. The hotels with 100 – 199 rooms are referred as medium size, and those with less than 100 rooms are referred as small sized hotels. There may be differences in term of sizing of equipments, hotel layout, and efficiencies of individual equipment, monitoring and control of energy consumption. The same applies to expertise of the hotel engineering / maintenance staff, occupancy in rooms, hotels practices etc. Therefore, to account for differences across hotels, several hotels may need to be studied.

Despite the fact that potential for energy savings exist in all hotels, energy consumption is a major item of expense in big and medium sized hotels on account of variety of energy consuming services offered. Big hotels normally have engineering / maintenance departments with qualified personnel to deal with energy services. Since the study sought to identify awareness, barriers and policy measures preferred by the hotels, it was decided to conduct a survey of many hotels as possible. Although hotels did not want to participate, one small hotel was also included in the study to get some perspective on these issues.

To study the energy consumption in the hospitality industry, an interview was arranged with the management of the different star hotels in Cape Town. The study has explored the perception of these hotels regarding the installation of load management systems or energy conserving technology.

3.2.1 Different phases of the study

The study was divided into two phases:

Phase I: Energy preservation awareness, barriers and policy measure survey

Phase II: Walk through energy audits of a selected hotel.

3.2.1.1 Phase I: Energy preservation awareness, barriers and policy measure survey

The phase in research is important as it is necessary for the project to arrive at a common understanding of the term. According to Kolltveit & Gronhaug (2004), the early phase is defined as "The process and activities that lead to, and immediately follow, the decision to undertake feasibility studies and to execute the main project"

Phase I was designed to investigate the awareness of hotels on energy conservation / Demand Side Management measures, barriers faced by them in the energy conservation and their preferences for financial mechanisms, institutional mechanism and other policy measures for facilitating energy conservation.

A two part questionnaire was developed from energy conservation reference and management: Guide for churches (Vries, 2002) and DSM options for hotel industry in Malaysia (Painuly & Hamid, 1996) and was personally hand-delivered to the participating hotels for this purpose. The first part was to obtain general information about the hotels, such as, number of rooms, facilities offered etc. The second part was divided in four Sections; A to D. the first section A was to get information on general awareness on energy conservation, such as: decision making authority for investment in energy appliances, energy conservation measures and reviewing level, energy consumption monitoring and audits. Section B was designed to obtain awareness on specific measures such as efficient lighting, air conditioning and other appliances, automation control, alternate energy systems, demand shift and control, heat control and heat recovery, retrofitting of pumps and motors and house-keeping measures. See Appendix A for the questionnaire.

In this section, the following options were offered to the respondents to measure degree of awareness. These are demonstrated or reflected in the table below:

Figure 3.1: Options offered to the respondents to measure degree of awareness

Options	Representation
(a) The hotel is not aware of the operation	NAw
(b) The hotel is aware of the benefits and technology option but has not initiated any action	Aw
(c) The hotel has floated decision and enquiries in the process	Decid
(d) The hotel has implemented the option	Implt

(e) It is not applicable to the hotel	NA
(f) The hotel did not find it suitable the option after evaluated	NSt

The respondents were also asked to indicate the importance of these measures for their hotels (with options of not important, important, very important and can not say). The options where given to measure degree of awareness and the responses were as follow: NAw for not aware; Aw for aware; Decid for deciding; Impl for implementation; NA for not aware and NSt for not suitable.

In section C, respondents were asked to indicate the importance of various energy conservation barriers on a four point scale (not applicable, not important, important and very important), and also ask to rank top five barriers. In section D, respondents were asked to indicate their preference and acceptable payback period for different methods of conservation such as retrofitting, replacement of equipments, adding new systems and demand shift. This section also included ranking of financial mechanisms, institutional mechanism and importance of their policy's measures (on four point scale) for energy conservation. See Appendix A for the questionnaire

Finally, the respondents were also asked to indicate whether they would be interested in a detailed study of energy conservation measures for the hotel or not. This was to pick up hotels for second part of the study, described below.

3.2.1.2 Phase II: Walk through energy audits

Phase II of the study, walk through energy audits were conducted and the questionnaire (labelled as part III) was administrated to obtain details of hotels energy consumption, and details of lighting and air conditioning appliances / system. From the response received previously, this part of the study was carried out for two medium size hotels. Big hotels did not have time to participate in the survey due to their busy schedule. The hotels participating in this part of the study were also required (through the questionnaire) to give detailed information on appliance ratings and consumption for these applications (lighting and air conditioning). The questionnaire for phase II of the study is attached as Appendix A.

A questionnaire enables a researcher to organize the questions and receive replies without actually having to talk to every respondent (Walliman, 2005). Personal visit were made to collect the questionnaires, and in most of the cases it required follow up visits. In some cases, inspite of several visits, no response could be obtained. Respondents were restricted in the way they answered the questions as they were required to select one answer from among the given ones. Closed-ended questions, as they provide 'ready made' categories within which respondents reply to the questions asked by the researcher, help to ensure that the information needed by the researcher is obtained (Kumar, 2005).

3.2.2 Interviews

According to Kumar (2005), any person-to-person interaction between two or more individuals with a specific purpose in mind is called an interview and the interviews may be conducted face-to-face or by telephone. The interviews involves questioning or discussing issues with people and it is viewed to be a very useful technique for collecting data which would probably not be accessible using techniques such as observations and questionnaires (Blaxter *et al.,* 2001). Because of its flexibility, an interview is a useful method of obtaining information and opinions from experts during the early stages of the research project (Walliman, 2005).

Three kinds of interviews are distinguished: unstructured, semi-structured and structured. According to Fontana and Frey (2005), structured interview is the interview that has a set of pre-defined questions and the questions would be asked in the same order for all respondents. Patton (1990) regarded unstructured interview as a natural extension of participant observation. He defined that the "unstructured interview relies entirely on the spontaneous generation of questions in the natural flow of an interaction, typically an interview that occurs as part of ongoing participant observation fieldwork". Further, he stated again that semi-structured interviews are conducted with a fairly open framework which allow for focused, conversational and two-way communication. They can be used both to give and receive information. Semi-structured interview were conducted with risk / maintenance manager personnel from hotels companies on issues pertaining to energy conservation in their companies. Interviewees were first informed of the focus of the interview prior to meeting. This helped the interviewees to prepare for the interview in advance. Interviews were conducted either in meeting rooms or in offices of the interviewees.

3.3 Data analysis

Data analysis encompasses the compilation and interpretation of the data collected. From the Wikipedia dictionary, compilation is a work formed by the collection and assembling of pre-existing materials or of data that are selected, coordinated, or arranged in such a way that the resulting work as a whole constitutes an original work of the author. The same dictionary explains that, interpretation is an explanation of something in order to communicate a specific understanding of the work.

Analysis will depend on the nature and form the data has been recorded. The data recorded and analysed will be done whether it is qualitative or quantitative. The main rule of any form of analysis is to move from raw data to meaningful understanding (O'Leary, 2004). Evaluation of various measures discussed in the next chapters and data collected will be compared and analysed to give an indication of the nature of energy consumption in the hotel or hospitality industry.

3.3.1 Qualitative analysis

The analysis of qualitative data consists of abstracting from the raw data all points that a researcher considers to be relevant to the topic under investigation. Qualitative data is analysed thematically. According to O'Leary (2004), thematic analysis can include analysis of words, concepts, literary devices, and or non-verbal cues. During the interview, especially a semi-structured one, interviewees are not always straight forward to the point. The researcher may have some few basic questions but often the conversation takes direction upon the response of the interviewee.

3.3.2 Quantitative analysis

Quantitative analysis uses the syntax of mathematical operations to investigate the properties of data (Walliman, 2005). Quantitative data is analysed statistically. Statistical analysis can be descriptive or inferential.

3.3.2.1 Descriptive

According to O'Leary (2004), descriptive statistics are used to describe and summarise the basic features of the data in a study, and are used to provide quantitative descriptions in a manageable and intelligible form. Descriptive statistics measure the central tendency (mode, median, mean) and the dispersion (standard variation) will be adopted.

3.3.2.2 Inferential

Inferential statistics draw conclusions that extend beyond the immediate data (O'Leary, 2004). Raw data from the closed-ended questions will be captured using Statistical Package for Social Sciences (SPSS) and subsequent calculations will be generated and then interpreted.

3.4 Chapter summary

In this chapter, methodology approaches including qualitative and quantitative methods investigating the outcomes of energy conservation were explained. In addition, the source of primary and secondary data was outlined. These included the literature review, exploratory study, interviews and data gathering. Methods for data analysis and appropriate test were discussed. Two are relevant in this study namely descriptive and inferential quantitative data analysis.

CHAPTER FOUR
ANALYSIS OF THE QUESTIONNAIRE

4.1 Introduction

This chapter analyses the data gathered at the first stage of the research using part one and part two of the questionnaire. According to O'Leary (2004), data analysis is defined as the process of transforming information with the aim of extracting useful information and facilitating conclusions. It comprises the investigation of the study in two different phases: Phase I (questionnaire) pertaining the energy conservation awareness, barriers and policy measure survey. Phase II (observation) explores the walk through energy audits. The study on energy conservation started with the exploration conducted from June 2009 until March 2010. A comparative analysis was done in two completed phases (phase I and II). The statistical or graphical methods use to present the data is the quantitative method.

4.1.1 Phase 1: Energy preservation awareness, barriers and policy measure survey

The following hotels in table 4.1 were identified and administrated part I and II of the questionnaire for the study based on the tourist brochures and visits to Cape Town during the initial part of the study, the big hotels, as mentioned early in this study, refer to hotels with 200 rooms and above.

The letters as indicated in the building description are as follow:

- MS indicates multi-story type, and
- SS indicates 2 - 3 stories but spread over large are / in blocks

Table 4.1: Hotels response to the questionnaires

Hotels name	Type	Numbers of room	Building description
Southern Sun V&A Waterfront	Big	546	MS
City Lodge V&A Waterfront	Big	207	SS
Protea Victoria Junction	Medium	197	MS

Southern Sun Newlands	Medium	162	MS
City Lodge Pinelands	Medium	133	SS
Protea Sea Point	Medium	124	MS
The Tulip and conference centre	Small	86	MS

Most of the hotels selected for the study were regrouped in Cape Town City, Green Point, Sea Point, Waterfront and Pineland. The result study covered few hotels from the list above because of the non availability of the concerned staff at the hotel. In addition to the response of the survey from hotels, findings reported are also based on observations made during visits to these and other hotels.

Responses received: It was observed during the distribution of questionnaire that most of the hotels in the Cape areas are multi-story type. Out of 12 hotels to which questionnaires were distributed based on the tourism brochure, responses were received from 7 and correspond to 58.33% of the total percentage. From those responses, four were chosen for walk-through audit but only one hotel could furnish more details for appliances rating and the rest did not have such information.

No response cases: With the FIFA World Cup around the corner and the preparation which is ongoing, the hotel did not have qualified person to respond to the question because all the employees where busy. Most of the hotels listed above returned the first part of the questionnaire, but could not reply most of the questions for a simple raison of unqualified personnel. All five-stars hotels did not respond and among the medium category due their busy schedule.

4.1.2 Phase 2: Walk through energy audits

Walk-through energy audits were conducted and a questionnaire (part III) was administrated to collect information on energy consumption and appliance rating. This was carried out for two big hotels, four medium hotels and one small hotel. Although the hotels could give overall electricity consumption data, none off them had time to respond to this part III of the study. The number of appliances could not be answered by some of them. Therefore the analysis carried out indicates some comparisons based on available data, potential areas for evaluation of the options, and method of evaluation with example.

4.2 Findings

4.2.1 General Observations

These are based on visits to various hotels in course of the study (limited to hotel lobbies in the majority of cases), and walk through energy audit for four hotels. Table 4.2 highlight the general observation measures for energy conservation to be taken into consideration.

Table 4.2: General observation consideration

No	
1	Energy audit
2	Energy conservation measure taken
3	Appliances
4	Use of compact fluorescent lamps (CFLs)
5	Open lobbies and restaurants

4.2.1.1 Energy audit

Although hotels monitor the energy use regularly, and some have even taken some energy conservation measures (use of CFLs for example), a majority of them appear not to be familiar with the concept of energy audit. Although most of the hotels mentioned that energy audits are carried out regularly, none of those visited for walk through energy audit had handy information on different types of energy consumption appliances, their numbers ratings hours of use, energy consumption etc. (the information would have been readily available if a thorough energy audit was carried out even once). No sub-metering was available in case of electricity to measure consumption of important appliances / systems. It appears that not knowing the concept of energy audit, energy monitoring was confused with energy audit.

4.2.1.2 Energy conservation measure taken

Maintenance / engineering executives in hotels were too busy in day to day operation to pay attention or scout for major energy conservation opportunities. However in some hotels, despite their busy schedule they have carried out some measures resulting in substantial savings. For example, the replacements of most of the incandescent lamps by CFLs were taken in by the hotels. Use of timers (for pump and lighting operations), proper sealing of freezer doors etc. some hotels also used efficient systems for hot water circulation and air conditioning.

4.2.1.3 Appliances

Since most of the hotels are more than ten years old, the hotels have old generation appliances. The appliances in most cases appear to be of old technologies. Therefore, hotels may feel need for retrofitting / replacement at this stage.

(a) Use of Compact Fluorescent Lamps (CFLs)

CFL use had been adapted by almost all medium hotels, although to different degrees. In some cases, it was limited to replacement of incandescent lamps in lobbies, guest rooms and other locations. The only exceptions were some small hotels where no CFLs appear to have been in use (as none could be seen even in the lobby). In one of the older hotels, CFL, had been in use for more than three years in lobby (been in use for more than 10,000 hrs already). However, a majority of hotels did not have any criterion to adopt CFLs.

(b) Open lobbies and restaurants

Several hotels took advantage of the fact that there was no space, therefore entrance to lobby and the restaurants could be with high ceiling and open from several sides with greenery in and around that area. This ensured good air circulation and day lighting, and eliminated the need for lighting and air conditioning in these areas. The temperature is not very high (ambient between 23 to 31°C in summers) and hence this strategy appears to have been successful to keep electricity consumption relatively low in these hotels.

4.2.2 Specific observation

Table 4.3 below describes the specific observation measures for energy conservation to be taken into consideration.

Table 4.3: specific observation consideration

No	
1	Awareness and conservation
2	Energy intensive systems and practices
3	Poor insulation

4.2.2.1 Awareness and conservation

In one small hotel that had several incandescent lamps in the lobby and adjoining areas and no CFL, all lamps and fans were found to be on during daytime. The areas that were away from lobby (guest corridor) also and open from two side (where there was sufficient day lighting), several lights and fans, were on with no guest or hotel personnel in sight in that area.

4.2.2.2 Energy intensive systems and practices

In another medium hotel, the guest rooms had too many light points, with few incandescent lamps. Even the toilet had several lighting points with incandescent and CFLs. A few lamps had common switches. Some hotels have a practice of leaving one lamp "ON" (and it was an incandescent lamp) at the guest entrance room for its convenience. It is difficult to say how much all these measures add value to the guest comfort and how much its superfluous. It is possible that a guest survey could indicate utility of such measures. However, practices such as separate switches for different lamps, replacing incandescent lamp with CFL or incorporating a limit switch (so that lamp at the entrance gets switched on as soon as guest enters, rather than leaving it all the time) can reduce energy waste without affecting the guest comfort.

In some small and medium hotels, gaps between window and door frame were observed. This was resulting in cool conditioned air escaping from the gaps and hence increasing the load on air conditioners. In case of multiple storied type hotels, the cool air escaped to corridors.

4.2.3 Energy conservation awareness, barriers and policy measure survey

As already mentioned, out of 12 hotels in the Cape Town area were questionnaires were dropped, filled questionnaires could be obtained only from 7 hotels. The part one of the questionnaires gives the general information of the participant hotels as show in table 4.4. Two of these were big size, four medium sizes and one small, the findings from the survey are discussed in sections that follow below.

4.2.3.1 General awareness on Energy Conservation / DSM

Table 4.5 summarizes the responses on items related to general awareness of energy conservation related issues.

Three most reported that investment decisions for major consuming appliances are taken by the top management, and frequency of review varied from half-yearly to yearly. From the response, only two hotels reported for energy consumption monitoring done on regular basis and energy audits carried out in all the hotels. This indicates high level of awareness on energy related issues among top management and concerned department. This is however some doubt on energy auditing; some hotels appear to have a confusion with and energy audit and energy monitoring. But it became very clear during the walk through energy audit of four hotels surveyed. All the hotels were walk through energy audit was conducted; had no sub-metering facilities for electric system / appliances, and could not furnish data appliance rating and consumption (that would have been handy in case energy audits are carried out)

Table 4.4: General information of the hotels surveyed

	Hotels name						
	Protea Victoria Junction	**Southern sun V&A waterfront**	**City Lodge V&A Waterfront**	**Southern sun Newlands**	**City Lodge Pineland**	**Protea Hotel See Point**	**The Tulip Hotel & Conference centre**
Year established	1996	1999	1993	1992	1992	2000	1999
Hotel category (star rating)	4	4	4	4	4	3	2
Total No of rooms	197	546	207	162	133	124	86
• Single	yes	193	-	yes	-	96	-
• Double	yes	321	133	yes	Yes	30	32
• Twin	-	-	74	-	-	-	22
• Triple	-	-	-	-	-	-	19
• Family	-	-	-	-	-	-	7
• Suites:	-	-	-	-	-	-	-
-Standard	-	24	-	-	Yes	-	-
-Deluxe	yes	3	-	-	-	-	-
Number of:							
• Restaurants	1	2	1	1	1	1	1
• Kitchens	1	2	2	2	1	1	1
• Guest corridors	5	13	4	yes	5		9
• Lobbies	1	1	1	1	1	1	1
Facilities offered:							
• Conferences halls	2	-	1	1	-	8	2
• Meeting rooms	-	1	1	1	1	-	-
• Gymnasium	-	1	1	-	1	1	-
• Swimming pool	1	1	1	1	1	1	-
• Business centre	-	1	-	-	-	-	-
• Office facilities	6	-	-	-	1	1	-
• Others	-	-	-	-	-	7 (store room)	1 (Bar)

Table 4.5: General awareness of energy conservation / DSM measures

General awareness	Response	Frequency of response	Percentage (%) of response
Investment decision for major energy consuming application are taking by:	• Top Management • Middle management • Concern manager	6 1 -	86 14 -
Energy conservation measures taken by the hotel:	• Yes • No	7 -	100 -
Frequency of review:	• Yearly • Half yearly • Quarterly • Monthly • Weekly	1 2 4 - -	14 29 57 - -
Energy consumption monitoring is done on regular basis:	• Yes • No	2 5	29 71
Person responsible for energy monitoring and management:	• Energy manager • Others	1 6	14 86
Energy audits carried out:	• Yes • No	7 -	100 -
Audits are done:	• Internally • By external agencies • Both	4 3 -	57 43 -

4.2.3.2 Awareness of Energy Preservation and DSM technologies Measures

This part of the questionnaires list out several states of the art technologies for energy end use. The summary of the response is given on to the table 4.6 below.

Table 4.6: Awareness of Energy conservation / DSM technologies

DSM Technology	Frequency of responses					
	N/Aw	Aw	Decid	Imp	N/A	NSt
(I) Use of energy efficiency equipment:						
(i) Efficient lighting system:						
(a) Compact fluorescent lamps in place of incandescent	-	1	-	6	-	-
(b) High pressure sodium lamps in place of mercury	-	1	-	-	6	-
(c) Replacement of magnetic ballast by electronics	3	4	-	-	-	-
(ii) Efficient Air conditioning and water heating system:						
(a) Use of heat pumps for water heating	-	-	-	1	6	-
(b) Use of heat pumps for space cooling	-	1	-	-	6	-
(c) Use of heat pumps for space cool and water heating	-	1	-	-	6	-
(d) Energy efficient motors to replace standard motors	-	-	-	5	-	2
(e) Proper sizing of pumps and replacement	-	-	-	5	-	2
(iii) Efficient appliances:	1	2	4	-	-	-
(a) Energy efficient refrigerators and freezers	-	2	1	4	-	-
(b) Energy efficient TVs	1	-	-	1	5	-
(c) Other EE appliances: fans, radios, washing machines	-	7	-	-	-	-
(II) Other innovative measures:						
(i) Automation and control:						
(a) Infrared activated guest room switching control	-	6	-	-	-	1
(b) Building energy management systems	2	1	4	-	-	-
(ii) Alternative energy systems:						
(a) Use of solar water heating systems	-	3	-	-	3	1
(b) Use of solar space heating systems	-	3	-	-	3	1
(iii) Demand shift and control:						
(a) Load control	-	5	-	-	2	-

(b) Thermal storage to use cheaper off-peak electricity	-	-	-	-	3	4
(c) Shifting operations from peak to off-peak time	-	1	-	-	2	4
(d) Improving power factor	-	2	-	2	3	-
(iv) Heat control and head recovery:						
(a) Fixing heat control film on windows	-	1	2	-	-	4
(b) Heat recovery from laundry waste water	-	2	3	-	-	2
(v) Retrofitting of equipment and systems:						
(a) Power sizing of pumps, motors and other equipments	-	2	3	2	-	-
(b) Provision of better insulation in the room	-	2	3	-	1	1
(III) Housekeeping and monitoring:						
(i) Awareness training and good practices:						
(a) Staff awareness training on energy conservation	1	-	2	4	-	-
(b) Minimizing waste of the hot water	2	1	1	3	-	-
(c) Switching off lights in the areas not needed	-	-	-	7	-	-
(ii) Monitoring and auditing:						
(a) Overall energy consumption monitoring regularly	-	2	3	2	-	-
(b) Sub-metering to monitor energy consumption	-	7	-	-	-	-
(c) Monitoring and control of air conditioning systems	-	-	1	6	-	-
(d) Monitoring air supply in different areas	-	3	-	4	-	-
(e) Checking air-Con temperature and raising if possible	-	3	-	4	-	-
(f) Energy audit of the hotel	-	-	-	7	-	-
(iii) Repairs and servicing:						
(a) Plugging leakages in hot water piping	1	1	-	5	-	-
(b) Repairing insulations in rooms, piping, etc.	-	1	-	5	-	1
(c) Regular servicing of steam boilers, freezer units etc.	-	1	1	5	-	-

Notes:

N/Aw: The hotel is not aware of the operation.

Aw: The hotel is aware of the benefits and technology / option but has not initiated any action.

Decid: The hotel has floated decisions and enquiries in the process.

Imp: The hotel has implemented the option.

N/A: It is not applicable to the hotel.

N/St: The hotel has evaluated the option and did not find it suitable.

4.2.3.3 Technology

The respondents were not aware in several cases of the option, they have not chosen the proper response; ie. "The hotel is not aware of the option". Instead, they have opted for response "it is not applicable for the hotel," or "option was evaluated and not found suitable." For example, the response in case of heat pumps. This is one of the potential technology for commercial users like hotels that can make substantial energy saving. The level of awareness remains low due to lack of marketing efforts by manufacturers and availability. Each of the technology / option is summarised in the table 4.7 and discussed below.

Table 4.7: Summary of the energy conservation

No	
1	Efficient lighting system
2	Efficient air conditioning system
3	Efficient appliances
4	Automation and control:
5	Alternate energy systems
6	Demand shift and control
7	Heat control and heat recovery
8	Retrofitting of equipments
9	Housekeeping and monitoring

(a) Efficient lighting system

A majority of hotels (6 hotels) corresponding to 85.710% of the total percentage had already implemented use of CFLs in place of incandescent lamps and one hotel (14.28%) is in process of implementation but have not taken any action yet. In the case of the sodium vapour lamps, it has been found in one hotel (14%) that they are aware of the option and did not yet implement it while in other (86%) it is not applicable for them. The response in case of the use of electronics ballast indicated that only four hotels (57.14%) is aware of the technology and have not yet implement the option. But surprisingly, three (42.85%) mentioned that this is not applicable, although during a visit to the hotel and data collected, it was observed that several fluorescent lamps were in operation at the hotel.

(b) Efficient air conditioning system

The questions in this category pertain to use of heat pumps for water heating, and space cooling purposes. Only one hotel (14.28%) mentioned that inquiries to this option have been floated. The rest 86% of the respondents mentioned that it is not applicable to the hotel; the reason appears to be non-awareness of this option or lack of expertise in the related field. Heat pump technology appearing not to be actively promoted by the manufacturers however, is well proven even for households. The other two questions related to replacement of standard motors by energy efficient motors and proper sizing of pumps were already been implemented in some hotels and other hotels did not find it applicable since they did not have such equipments.

(c) Efficient appliances

The question in this area related to the use of efficient refrigerators, freezers, TVs, radios, washing machines etc. 28.58 – 57.14% of the hotels mentioned that they had implemented this option. Others had mixed responses from non-awareness to non-applicability of the option. It was observed that since in most cases hotels are old, respondents consider whatever appliances they have, are non efficient. This perception may be true in the case of some hotels, if technologies available in South Africa only are not considered. But this may not be true for all because South Africa itself is a manufacturing base of some European companies. In most cases, appliances are therefore energy efficient.

(d) Automation and control

Most of the hotels (86.72%) mentioned that they are aware of the infrared activated guest room switching system, but have not initiated any action. Building energy management system may be difficult to consider for the city lodge and resorts due to their large spread. It may be considered for the multi-story hotels. Four hotels (57.14%) mentioned there have decided of the option and have not yet taken any action. The other two (28.57%) hotels were not aware or have not found it suitable.

(e) Alternate energy systems

This part enquired about use of solar systems for water heating and space heating. For the water and space heating, three hotels (42.85%) mentioned that they are aware of the option and benefits and did not take any initiatives.

(f) Demand shift and control

This section had questions on load control, thermal energy storage, shifting operations to off-peak time, and improving power factor. Many of the hotels had Low Voltage (LV) connections with no demand charges and fluctuation tariffs. Therefore, except power factor improvement, other options were not applicable to them. However, since one hotel was using timer to control energy consumption, they responded that they practice load control. Thermal storage was not aware by any of the hotels. Most hotels had implemented power factor improvement option. This may be due to high penalty by the utility in case power factor falls below 0.96 lagging

(g) Heat control and heat recovery

For the solar control film, three hotels (42.85%) mentioned that they are aware of the technology and have not yet implemented it and four (57.14%) said it was not applicable. In some case, it was observed that extension of the roofing or balcony ensures that windows are not exposed to the direct sun for long duration. In most of the chalets (lodge), this may be true. However, in case of multi-storied hotels, this problem remains. Exposure of windows to sun depends on hotel architecture and design.

On heat recovery from laundry wash water, most hotels felt it was not applicable because the laundry is done by outside companies and two did not take any action. In the case of the city lodge hotel, where walk through audit were carried out, potential for heat recovery from the laundry system (including driers) was observed. It could be used for boiler water preheating, which was close to the laundry room.

(h) Retrofitting of equipments

The first question pertains to proper sizing of pumps and motors, which has been covered (b) above. On provision for better insulation in the rooms (windows, door, etc), hotels mentioned that that is not applicable for them.

(i) Housekeeping and monitoring

This section included questions related to awareness training and good practices, monitoring and auditing, and repairs and servicing. The response from the hotels on good housekeeping indicated that most of the good practices had been implemented in a majority of the hotels. Following measures, switching off lights in areas not needed, energy consumption monitoring on regular basis, and checking conditioned air temperature drew 86% implemented response from the hotels. Staff awareness and training in more then 5 hotels was another highlight. One hotel mentioned that sub-metering to monitor electricity consumption exists, but this could not be found during the walk through energy audit. In case of other hotels, a walk through energy audit indicated no such sub metering. Similarly, contrary to the response in the first part that energy audits are carried out by all (4.3.1, table 4.5), only few hotels mentioned that energy audits are carried out, one was in process of taking a decision and another had taken no action. As mentioned earlier this may be due to non-familiarity of many with the concept of energy audit, and probably confusing it with energy monitoring.

4.2.4 Ranking of measures of energy conservation

Hotels were also asked to rate various conservation measures covered above (4.2.3.2/3) on the following scale; not important (N/Imp), important (Imp), very important (V/Imp), and can not say (CN/say). The results are given in table 4.8 below

Table 4.8: Ranking of energy conservation / DSM technology and measures

Technology / Measure	**Frequency of responses**			
	N/Imp	**Imp**	**V/Imp**	**CN/say**
(i) Use of energy efficiency equipment:				
(a) Efficient lighting systems	-	2	5	-
(b) Efficient air-conditioning systems	-	3	4	-
(c) Efficient appliances	1	2	4	-

(ii) Other innovative measures:				
(d) Automation and control	-	2	4	1
(e) Alternate Energy systems	3	3	-	1
(f) Demand shift and control	2	3	2	-
(g) Heat control and heat recovery	-	3	3	1
(h) Retrofitting equipments / systems	-	3	1	3
(iii) Housekeeping and monitoring:				
(i) Awareness training and good practice	1	4	2	-
(j) Monitored and auditing	1	3	3	-
(k) Repair and servicing	2	-	5	-

Notes:

N/Imp: Not much important

Imp: Important

V/Imp: Very important

CN/say: Cannot say / no idea

N/Real: Not relevant

Five hotels (71.42%) considered efficient lighting to be a very important measure and important for the rest of hotels. Lighting is a major item of cost in the hotels and hence considered important. Efficient air-conditioning was considered very important for four hotels and important for the rest (57.14%). This probably represents the highest consuming appliance in hotels. Automation and control was also considered important by more than 80% (four hotels), whereas alternative energy system (solar systems) had equalled number of important and very important rating (three hotels each) and the response cannot say by 14,28%. Demand shifting and control was considered not important by 28.57%; Non-applicability of this measure explains the response cannot say by 0%. Heat control and heat recovery also had somewhat similar response. Retrofitting was considered important by a majority (57.14%) and three respondents 42.85% were however not sure on this. However, no one rated as important, as appear to be current perception of the utility in South Africa. Most of the hotels felt that awareness training and good practices, and energy monitoring and auditing were either important or very important. Repair and servicing was considered very important by (71.42%) and surprisingly, not important by the rest 28.57%.

4.2.5 Rating of barriers to energy conservation

Several barriers were mentioned and respondents were asked to rate on the following scale; not applicable (N/A), not important (N/Imp), important (Imp), and very important (V/Imp). The results are summarised in the table 4.9 below.

Table 4.9: Ranking and barriers in energy conservation / DSM

Barriers	**Frequency of responses**			
	N/A	**N/Imp**	**Imp**	**V/Imp**
(a) High cost	-	-	2	4
(b) Maintenance problems	-	-	2	5
(c) Not enough saving potential	-	1	3	3
(d) High payback period	2	-	2	3
(e) Lack of technical expertise	1	-	3	3
(f) Experts / consultant not available	-	-	5	2
(g) Implementing agency not available	-	-	1	4
(h) Financing not available	1	5	-	-
(i) No application in hotel	1	5	-	-
(j) No barrier	5	-	-	-

Notes:

N/A: Not applicable

N/Imp: Not much important

Imp: Important

V/Imp: Very important

Maintenance problems emerged as a most important barrier, rated very important by 71.42% followed by high cost (rated by 57.14%). Not surprising, considering that the questionnaire was filled by the maintenance personnel, and cost may be very important to them, as they may have to justify every time they propose an energy efficient option. An important finding was that "Implementing agency non-availability" was considered equally important barrier as cost (57.14%), implying that the hotels would prefer if energy conservation / DSM measures could be carried out by some agency.

High payback period was next important concern with 50% considering it very important, followed by equal number of very important rating of not enough saving potential and lack of technical expertise.

4.2.6 Preference for method of conservation

Some experts feel that retrofitting of old equipments is a cumbersome task that customers do not like. This part of the questionnaire was designed to find willingness, acceptable payback period and preferences of the respondents among various methods of conservation such as replacement of equipments, adding new systems and demand shift measures. The findings are reported in table 4.10.

Table 4.10: Method of conservation

Method	Responses	Frequency	Percentage
Renovating:	• Yes	5	72
	• Not	2	28
Maximum payback period:	• One year or less	-	-
	• Up to five years	6	86
	• More than five years	1	14
Replacing equipments/ systems:	• Yes	4	57
	• Not	3	43
Maximum payback period:	• One year or less	5	72
	• Up to five years	-	-
	• More than five years	2	28
Adding new system:	• Yes	6	86
	• Not	1	14
Maximum payback period	• One year or less	-	-
	• Up to five years	2	28
	• More than five years	5	72
Demand shift:	• Yes	-	-
	• Not	-	-
	• Do not know	6	86
Peak to off-peak ratio of electricity rates required to shift operations:	• 1.5:1	-	-
	• 2:1	-	-
	• Above 2:1	-	-
	• Cannot say	7	100

It could be seen that retrofitting, replacement and adding new systems, all the methods were acceptable by an average of 71.42%, and demand shift they do not know. Acceptable payback periods were more than five years, a rather number for measures involving high investment. However acceptability of payback period in such cases may depend on top management.

Ratio of on-peak to off-peak price of electricity was very difficult to indicate unless relevant options are identified and evaluated. For the utility to promote demand shift from peak to off peak, some changes may create uncertainty for the customers, resulting in failure of any such programme.

Retrofitting and replacement were considered almost equally important, followed by adding new system and demand shift respectively. The second two are relatively low investment options with least uncertainty, and ranking reflects the low risk attitude of the respondents.

4.2.7 Policy measures for energy conservation

It is clear from the voluminous material on energy conservation efforts in developed countries that several policy measures such as awareness campaigns, demonstration programmes, financial and institutional mechanisms etc. are required for success of the programmes. In this part of survey, respondents were first asked to indicate their preferences for financial mechanisms and institutional mechanisms. Subsequently, the respondents were asked to indicate importance of the various policy measures on the following four point scales; not important (N/Imp), not much important (N/Rel), important (Imp) and very important (V/Imp). The results of the importance of policy measures are included in table 4.11.

Table 4.11: Policy measures for the energy conservation

Policy Measures	Frequency of response			
	NRel	NImp	Imp	VImp
(a) Energy audits	-	1	5	1
(b) Technical assistance	-	-	2	5

(c) Financial incentives	-	1	2	4
(d) Seminar and workshops on energy conservation / DSM	-	1	4	3
(e) Energy conservation literature availability	-	2	4	1
(f) Awareness campaigns through media	-	1	5	1
(g) Education / training programmes	-	-	5	2
(h) Availability of experts / consultants	-	1	3	3
(i) Availability of financial from banks / financial institutions	-	1	6	-
(j) Availability of institutional mechanism such as ESCOs	-	-	4	3

A majority of hotels preferred energy service companies (ESCO). ESCO is a novel concept in the area of energy conservation / DSM. ESCOs contract agreed to carried out the modification / replacement for energy conservation at their cost and recover the cost from the savings in the energy bill of the client over an agreed period of time. Three of the respondents had ESCO as first choice to carry out the job and take care of financial aspect of energy conservation. From other aspects too (such as technical; as follow from discussions below), ESCO appear to be preferred alternative. Own financing was second most preferred option. However, top management option on this aspect may be more important.

On institutional mechanism, expert / consultants was most the preferred option, followed by ESCO and utility at the same level of preference. This indicates that if the utility were to take initiative on this, hotels would welcome and participate enthusiastically. Government agencies and financial institutions were next in the list of preferred alternatives, followed by no need of any agency, at least preferred alternative. Industry associations in several countries have made powerful impact on such programmes (hotels association in Thailand for example). The advantage is that communication is easy and experience sharing can be an impact tool itself to assimilate the findings. The industry associations in South Africa may have to examine why members do not have adequate faith in them.

Among the various policy issues (see table 4.11), technical assistance was considered the most important requirement by 71.42% of the respondents. This is also in line with earlier findings on barriers where maintenance problem was cited the most important barrier and non-availability of implementing agency, second most important. Lack of technical expertise was also listed as one important barrier. Financial incentive was considered second most important measure (with 57.14% rating it very important), followed by availability of institutional mechanism such as energy service companies. Such mechanism takes care of technical expertise as well as financial problems, and can play an important role in energy conservation, if policies are properly pursued. Availability of experts / consultants was next in importance, which also point out to the same problem that the most important policy measure (technical assistance) seeks to address. The findings on this account are very consistent. Education and training programmes, and seminars and workshops on energy conservation / DSM were next in the importance rating. Both these measures are complimentary in nature to the technical assistance; the most important policy measure. Energy audits, pilot demonstration programmes and awareness campaigns through media follow after seminar in ratings, and all the three were considered equally important. Availability of finance from banks and financial institutions is last on agenda of policy measure, not difficult to understand as this problem belongs to the top management.

4.3 Chapter Summary

The analysis of energy conservation awareness, barriers and policy measure survey and the walk through energy audit find that investment decisions for major consuming appliances are taken by the top management. Maintenance problems emerged as a most important barrier and cost of implementation of energy efficient equipments since the retrofit have to be done in the old buildings. Not surprising and energy audit was not poorly done in those hotels and finally in policy measures education and training programmes appear do be the most important issue. The next chapter will be analysing the result of the energy consumption for those hotels as per identification of part three of the questionnaire.

CHAPTER FIVE

DATA ANALYSIS AND RESULTS

5.1 Introduction

This chapter analyses the data gathered using a part three of the questionnaire and it discusses the pilot study, analyses the questionnaire response and formulates the conclusion.

5.2 Profile of participants

Out of 12 targeted hotels based on the tourism brochure, 7 (58.33%) completed and returned the questionnaire. As depicted in figure 5.1 below, participant hotels included hotels 4-star (71.42%), 3-star (14.29%) and 2-star (14.29%) hotels.

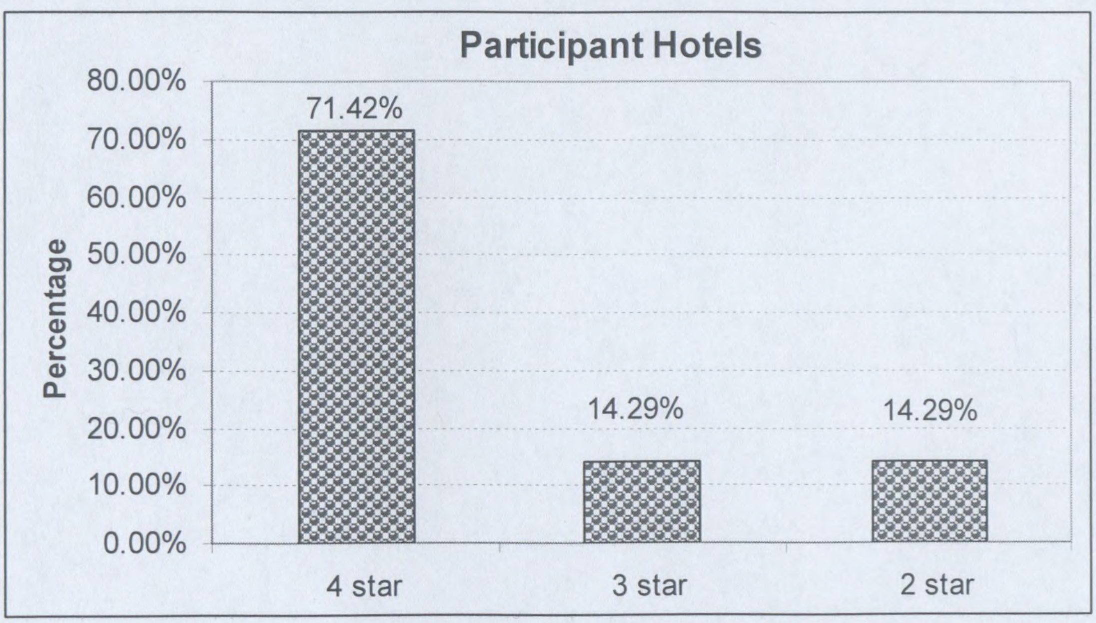

Figure 5.1: Category of hotel involvements

From figure 5.1, it is evident that the hotel with higher response rate is the 4 star hotels (71.42%) which could mean that the people responding to the questionnaire were more experienced as compared to the small hotels where the response rate was very low.

Table 5.1 below presents a demographic profile of the above participated hotels where the properties consist of two upscale and luxury hotels (28.57%), four mid-price hotels (57.14%) and one economic and budget hotel (14.29%).

Table 5.1: Demographic profile of sample hotels

	Frequency	Percent %
Hotel grade (N=7)[a]		
Luxury	2	28.57
Mid-price	4	57.14
Economy and budget	1	14.29
Ownership type (N=7)[a]		
Independent owner, self managed	1	14.29
Independently owned, managed by a franchise agreement	6	85.71
Hotel size (N=7)[a]		
Small (less than 100 rooms)	1	14.29
Medium-size (100 – 199 rooms)	4	57.14
Large (200 rooms or more)	2	28.57

[a] Total number of respondents varied due to missing values.

From the above table, it can be seen that 14 percent of the properties (*N*=1) was independently owned and self-managed. 86 percent (*N*=6) is independently owned and managed by a franchise agreement. With regard to the size of sample properties, small hotels (less than 100 rooms) and medium-size hotels accounted for 14 percent (*N*=1) and 57 percent (*N*=4) respectively, while large size properties (200 or more rooms) accounted for 29 percent (*N*=2). The table 5.2 bellow indicates the statistics of energy use in surveyed hotels.

Table 5.2: Statistics of energy use in surveyed hotels

Hotels star & No.	4-star hotel			3-star hotel			2-star hotel		
	5			1			1		
Resource	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**
Electricity(MWh/yr)	3211.7	1890	778	2054	1390	142.8	708	405.6	62.6
Fuel (MWh / yr)	738	104	61.5	356	3.1	30	33	6	2.2
Avg Occupancy	78.87			87.67			73.75		

Table 5.2 shows the use of energy by each hotel category based on the survey. Based on these rough data, assessment on energy performance was conducted. It is observed that, at the same occupancy rate, the electricity consumption increases by about two times for each hotel categories (the lowest is 2-star hotel). The 3-star and 4-star hotels consume much fuel (LPG) for running boiler, diesel generator and cooking.

5.3 Current state of energy consumption in surveyed hotels

The status of energy consumption in the South African hotel industry is described by analysing gathered quantitative data of energy consumption. The classification has been done depending on the hotel categories (4, 3 and 2-star) and location (Cape Town metropolitan area) because the energy use is significant. Complied from 3-year data of energy in typical 4 star hotels in the Cape Town metropolitan area, figure 5.2 below presents a difference in quantity and trend of yearly energy consumption.

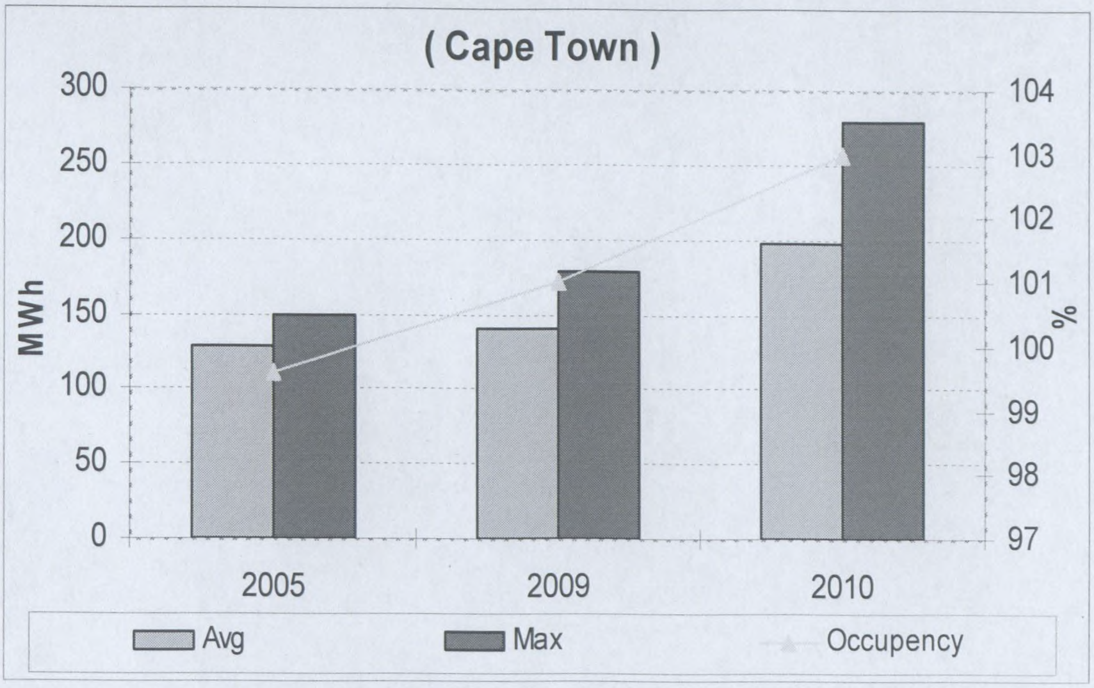

Figure 5.2: Trend of energy consumption in 4 star hotels.

It is observed that perhaps increase in occupancy rate during 2005 – 2010, energy consumption has increased as well. It is also noted that with the slight increase of 3.42% in occupancy, the energy consumption has dramatically increased by 86.33% from about 125mWh to 200MWh.

5.3.1 Electricity price in South African hotels

With the rapidly increasing electricity tariffs in South Africa set to continue for the next few years, it is becoming vital for hotels to become aware of their energy expenditures and take advantage (subsidies) of energy efficiency opportunities in their business. According to Harpur (2009), the days of South African companies relying on cheap electricity are over. Energy cost cutting becomes a major priority for business and the need for saving electricity drives for the energy efficiency measures. The measurement of energy use in business will be the fundamental starting point from which staff behaviour, energy efficiency initiatives and energy management all stem from. Figure 5.3 below shows the trend of electricity prices in the South African hotels.

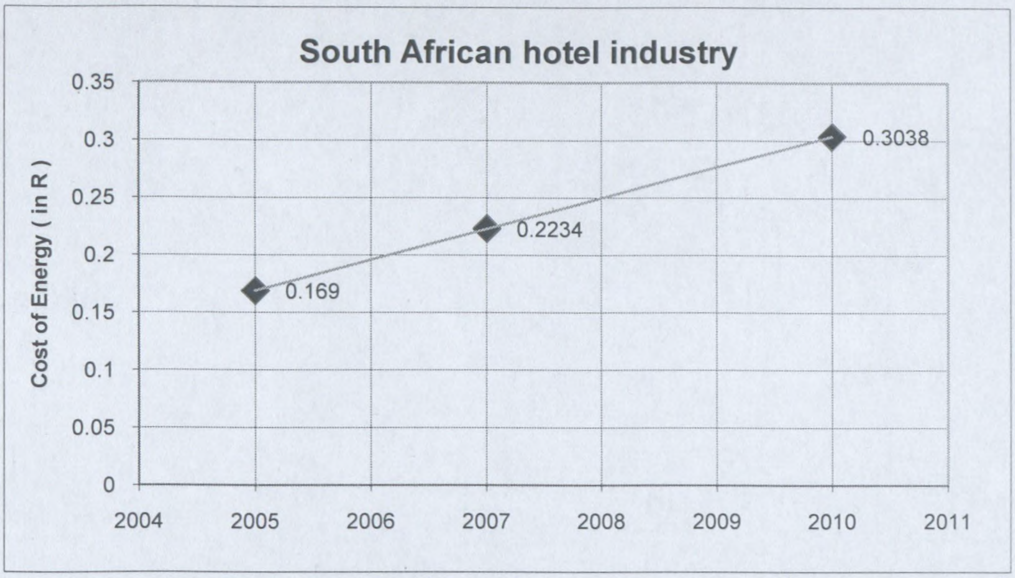

Figure 5.3: Trend of electricity price in the S.A. hotel industry

As the figure 5.3 illustrates, the analysis was done only for the years 2005, 2007 and 2010 and the electricity price grow exponentially.

5.4 Analysis of energy sources and consumption.

The major sources of energy used in hotels are electricity (for lighting, appliances, air conditioning, water heating and water pumping), Liquefied Petroleum Gas (LPG) (for cooking) and diesel oil (for diesel generator); electricity always dominates the total energy consumption. Fuel (gasoline) for transport is very small as compared to others and could be neglected. Figure 5.4 below shows the typical breakdown of energy use in the South African hotels.

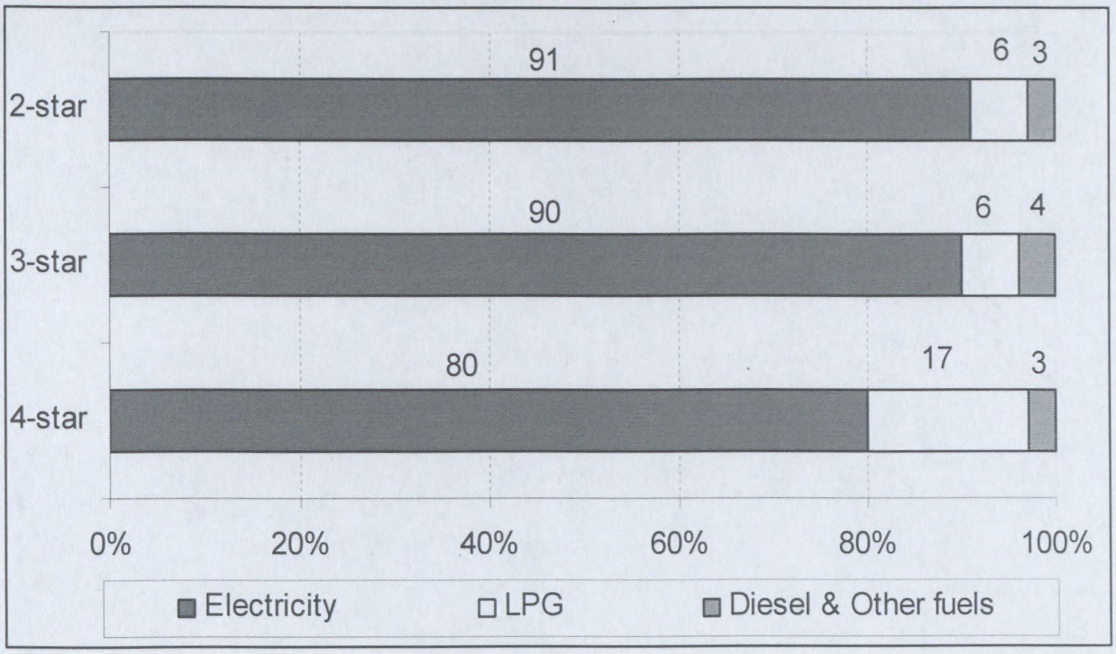

Figure 5.4: Breakdown of energy use in the S.A. hotels by category.

It is evident that the energy use patterns of 2-star and 3-star hotels, where electricity is used for around 90% of energy consuming activities, are nearly the same while LPG is the main fuel for cooking in 4-star hotel.

In 4-star hotel, fuel (LPG and charcoal) are used for power generator, boiler and cooking whereas some 3-star and 2-star hotels used electricity for almost all activities, and the amount of fuels used is very little.

Below is the figure 5.5 that summarises the approximation of electricity consumption in hotels surveyed based on analyzed data and calculation done for some equipments found in the hotels since there has no sub-metering.

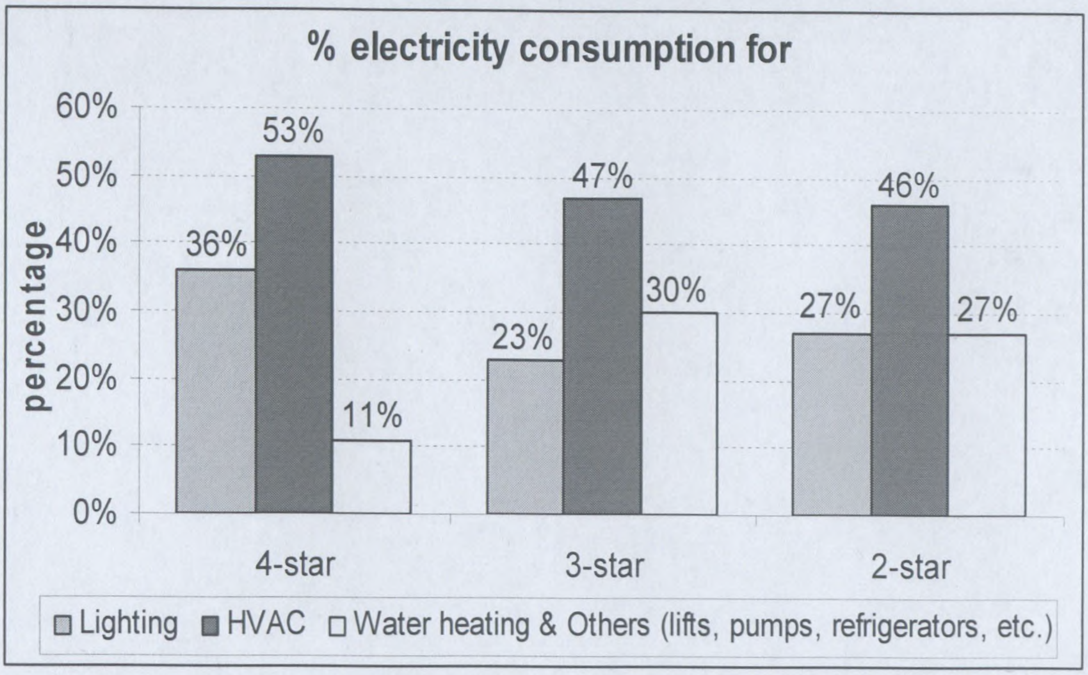

Figure 5.5: Percentage of energy use by sector in S.A. hotels by hotels category

It is indicated that the Heating Ventilation Air-Conditioning (HVAC) takes a significant portion of the total consumption (from 46% to 53% of the total depending on the category of hotel). The remaining is shared by the lighting (from 23% to 36%), electric water heater and other equipment (11% to 27%) such as elevator, refrigerators etc.

As mentioned that air-conditioning systems consume major fraction of commercial hotel industry energy, several measures could be taken to reduce their energy consumption. The usage of energy efficient air-conditioning can reduce financial cost of commercial sector such as the cost of filters maintenance. From the result of the survey it has been found that most of the hotels are still using the standard air conditioning in their premises even though some of them have knowledge of energy efficient air-conditioning system. This is due to several factors which are listed as follow:

- There is a tendency to follow the old development of using standard air conditioning systems
- The cost of efficient air-conditioning is high
- Lack of knowledge on efficient air conditioning system that provide the use of heat pump for water heating or for space cooling and heating purposes and or both combined.

- Not enough enforcement from the government to conscientise the hotels about energy saving.

The climate and season in South Africa are also factors affecting the energy consumption in hotels. Generally, the consumption varies seasonally following the change of seasons (winter, summer) and the yearly festivals. Figure 5.6, 5.7 and 5.8 predict the monthly electricity consumption against the outdoor temperature. Figure 5.9, 5.10 and 5.11 show the influence variations of electricity use versus occupancy rate in different hotels category in the Western Cape.

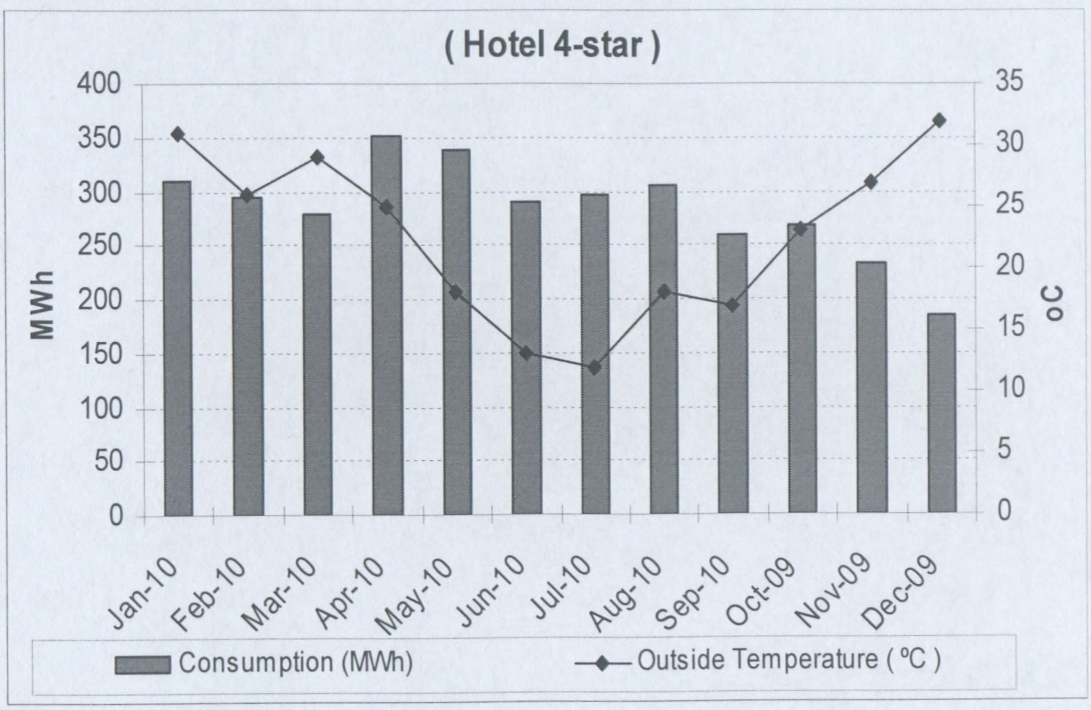

Figure 5.6: AvE_{use} & outdoor temperature for a 4-star hotel.

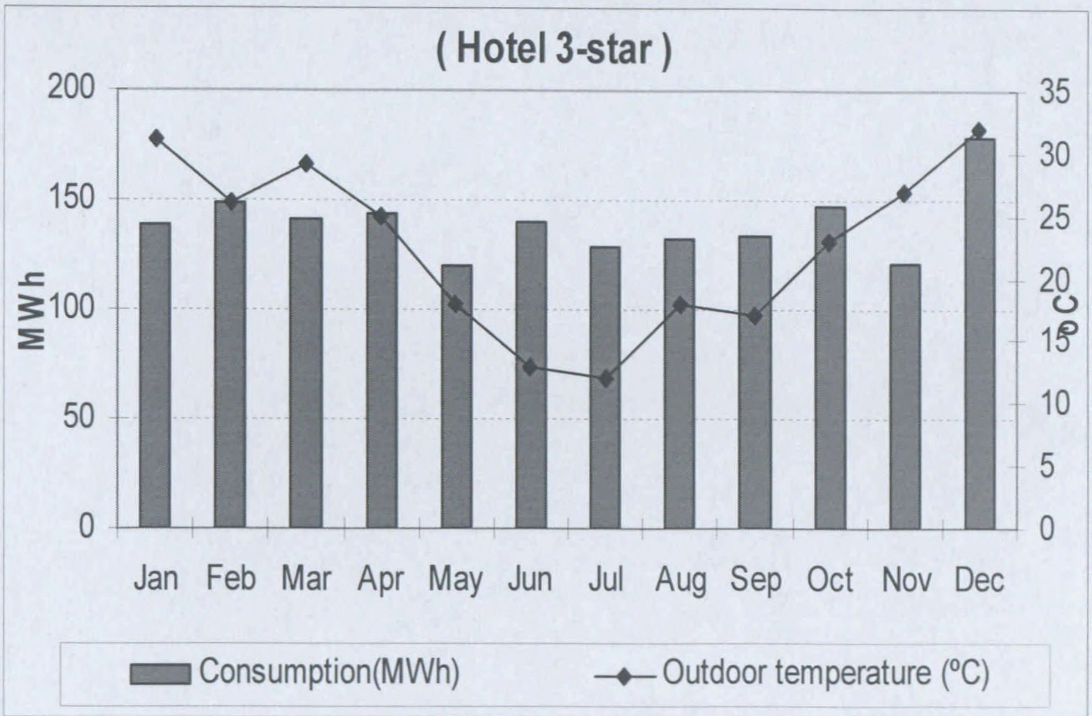

Figure 5.7: AvE_{use} & outdoor temperature for a 3-star hotel.

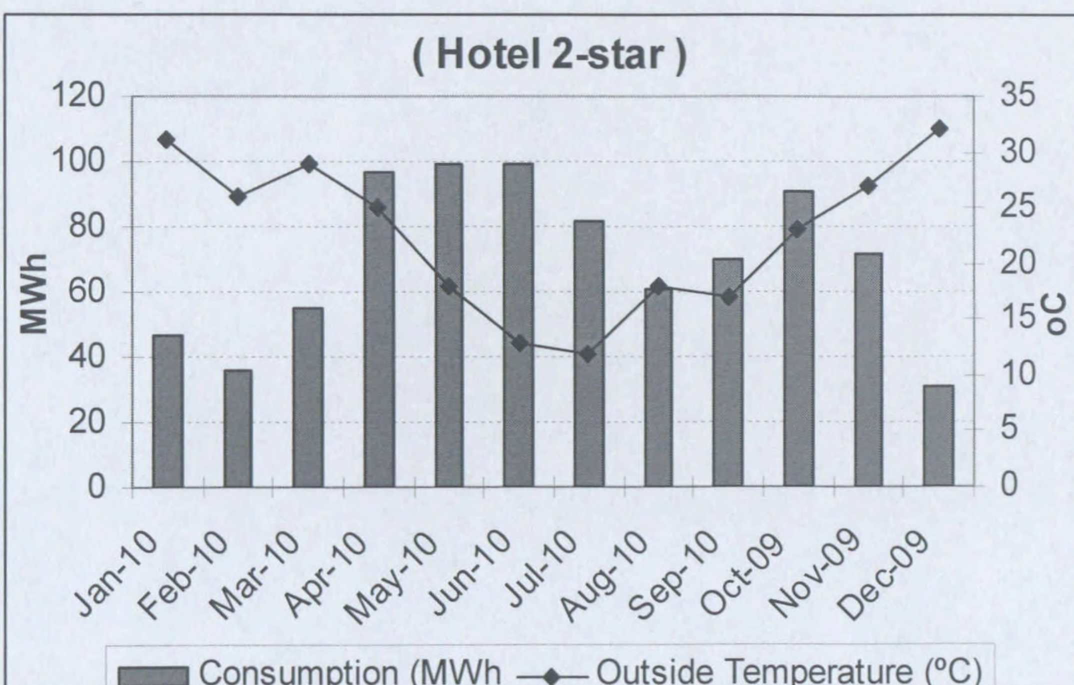

Figure 5.8: AvE_{use} & outdoor temperature for a 2-star hotel.

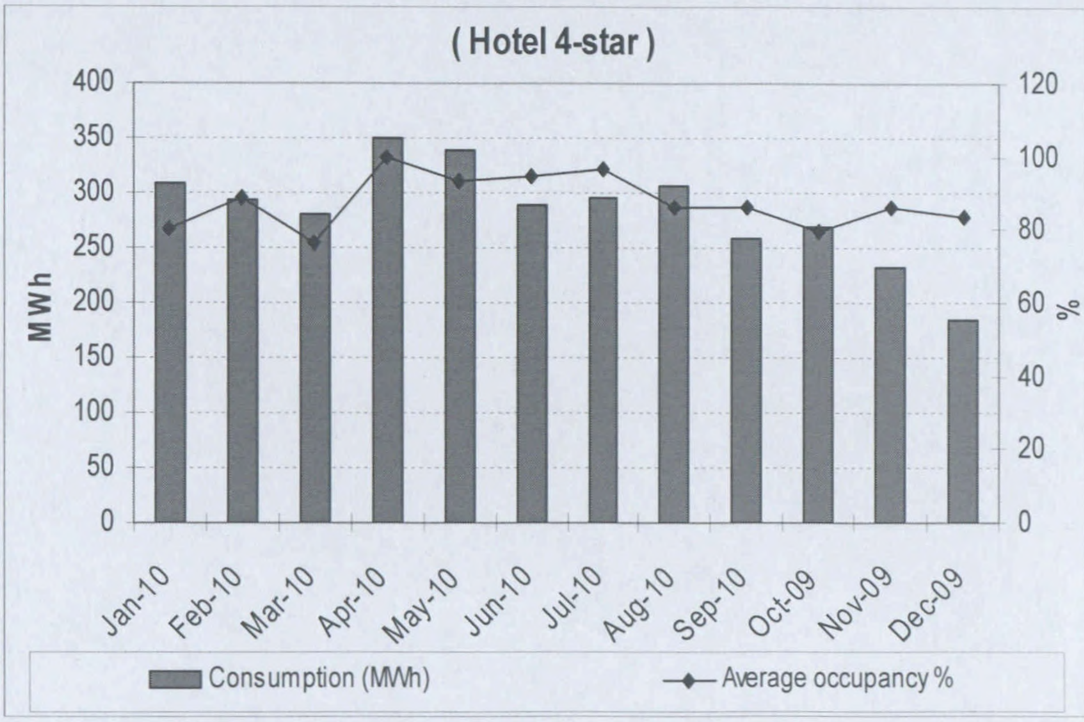

Figure 5.9: AvE_{use} & occupancy rate for a 4-star hotel.

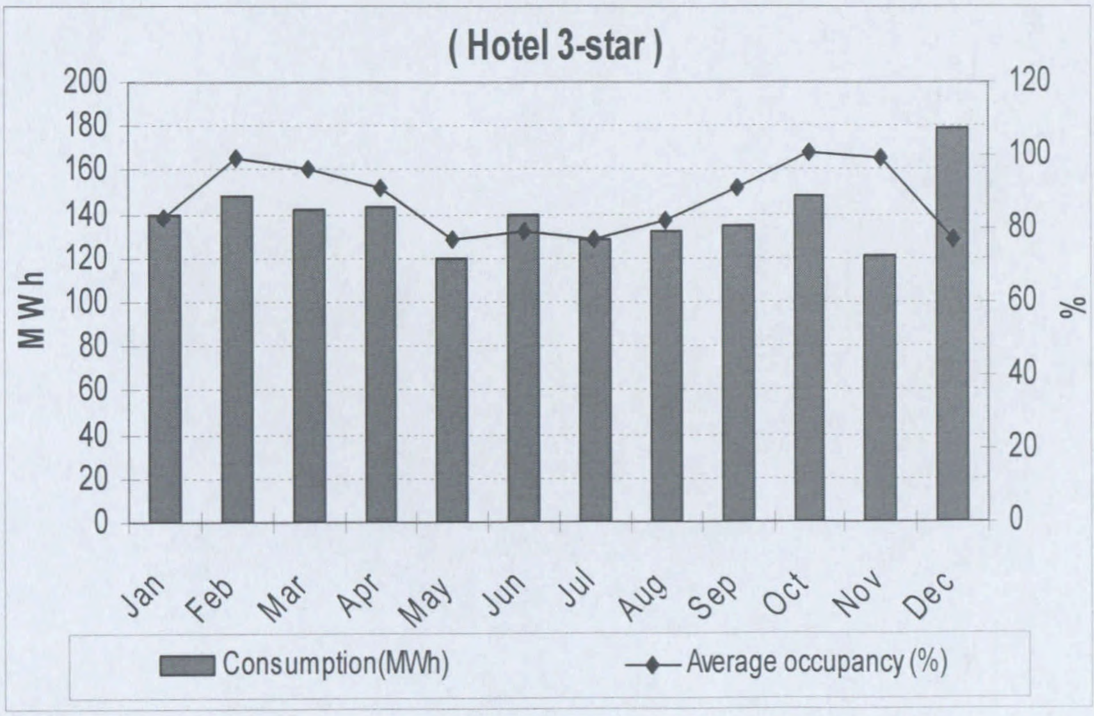

Figure 5.10: AvE_{use} & occupancy rate for a 3-star hotel.

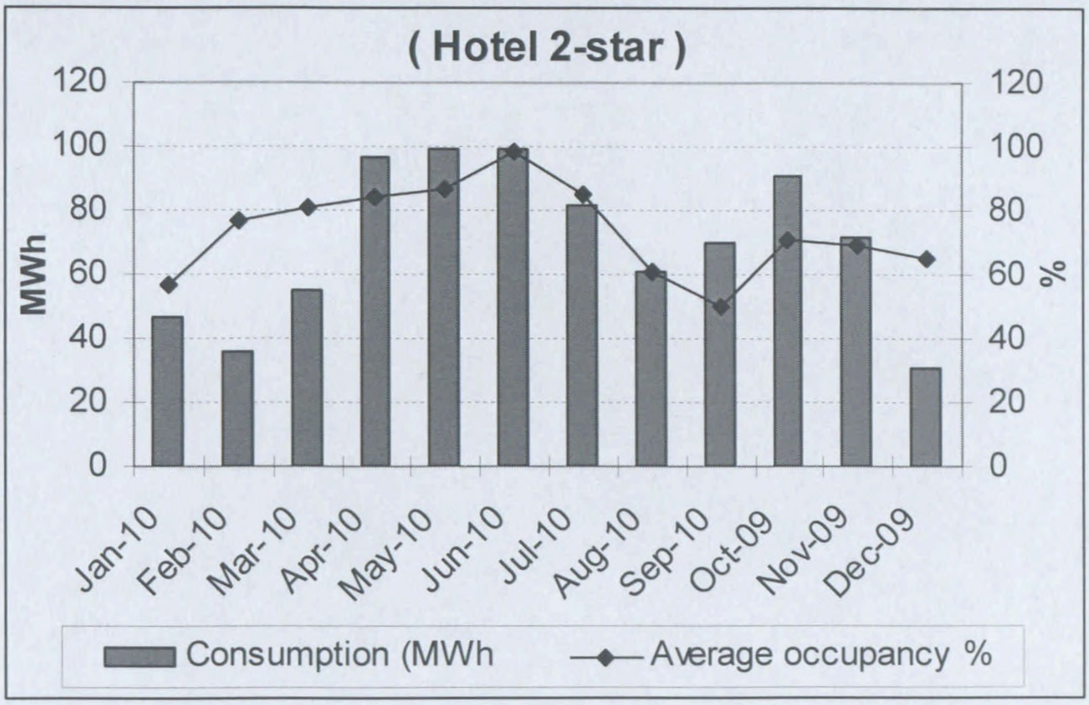

Figure 5.11: AvE_{use} & occupancy rate for a 2-star hotel.

As seen in different hotels, the occupancy rate has increased and the consumption is respectively following the increase too. It can be noted that the outdoor temperature has a veritable effect on the energy consumption.

The influence of occupancy is obvious in all hotels category where both occupancy and energy consumption are high. However, in the same energy consumption pattern, the influence of outdoor temperature is significant in all hotels where more energy is used much in winter than in summer. This is quite evident due to the FIFA World Cup which took place in South Africa. Most hotels were operating at their maximum occupancy as the players and visitors had to be accommodated, this in turn put a result to the huge amount of energy consumed by this industry.

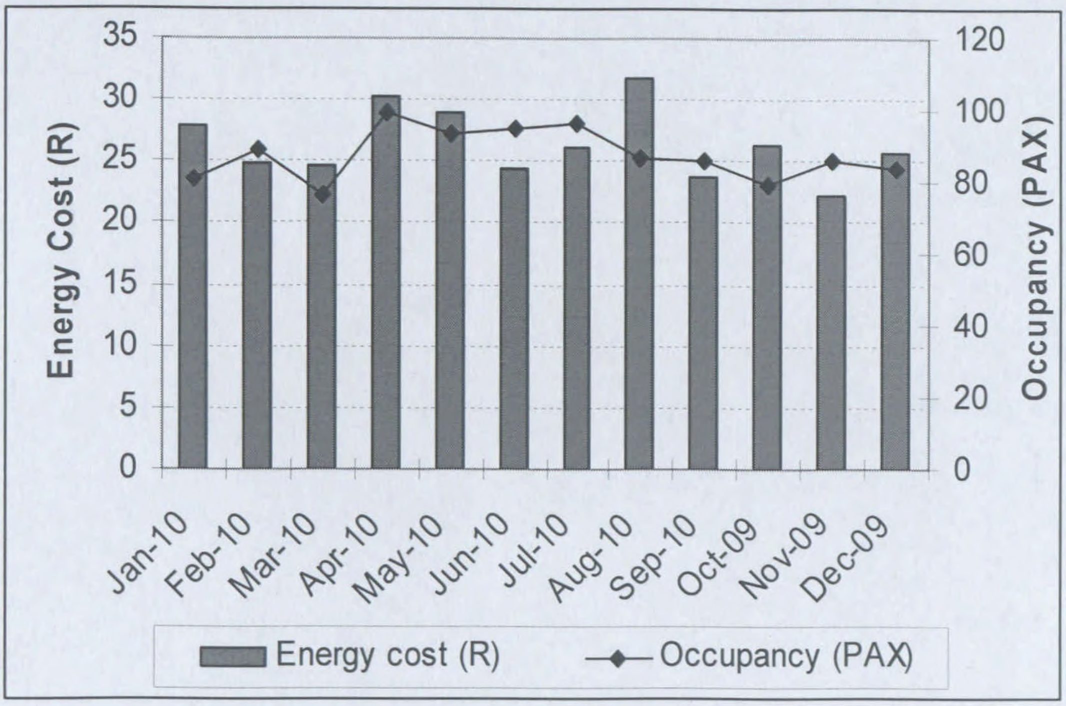

Figure 5.12: Energy cost versus occupancy in hotel.

Figure 5.12 above shows that there is a good relation between guest night and energy cost. Yet this relationship is linear as shown in figure 5.13 below, it is where the more the occupancy the more the energy consumption is. However, the energy cost does not go to zero when the occupancy is zero, this is due to the fact that the facility has a minimum base load energy consumption that is not related to guest nights, which is the energy needed by the different equipment / facilities that have to be operated regardless of the number of guests staying at the hotel. Such equipment / facilities are lighting, domestic water heating, ventilation and cooling of the Lobby, Restaurant, Kitchen etc. In addition to the climatic conditions that necessitate the use of high energy consuming cooling equipment during the hot summer season and even in winter in Cape Town region.

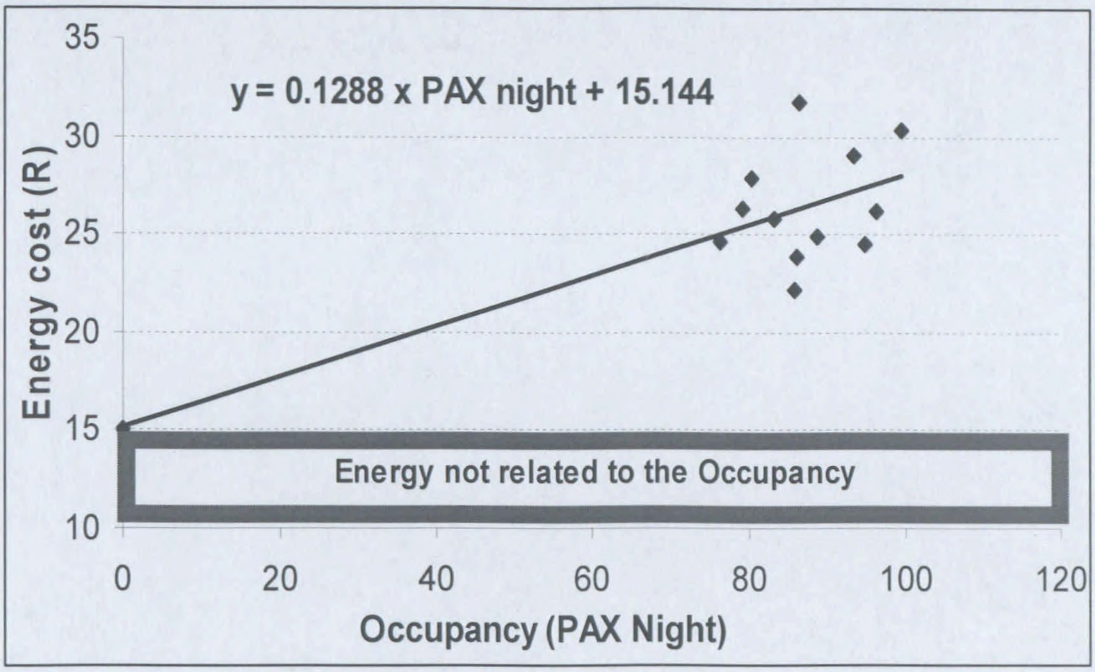

Figure 5.13: Energy cost (R) Vs Occupancy (Guest night)

In figure 5.13 above, this best-fit line is drawn through the data. Extrapolating this line to ZERO occupancy shows the theoretical amount of energy that the property consumes per guest room sold which is unrelated to guest use, or the energy "base-load" per room. In other words, all of the energy consumption in the shaded region of the graph goes to non-guest related activities such as:

- Lighting in corridors, public areas, etc.
- The air conditioning in public areas such as the lobby, halls, etc.
- The chilled water pumps for distribution, the domestic hot water pumps and fans in air handling units, etc.
- Energy loss through un-insulated pipes, walls and ceilings.
- Office equipment, etc. (Jordan, 2000).

This property's base load per room is R15.144 per month, as shown in the graph. In other words, the property spends R15.144/month/room on electricity and Diesel for non guest-related activities. This high value shows that there are significant opportunities for reducing the property's base load. Reducing the base load is important for hotel since the occupancy may get low during some months of the year.

The remaining energy is the energy directly related to guests' activities, such as guest room lighting and air-conditioning, water heating for showers, energy used to launder guests' linens and towels, etc. This indicates that air conditioning was an important factor in the net electricity usage.

The regression analysis plotting using Microsoft excels examine the h otel operational and climatic parameters that might influence the electrical energy used by the hotels: the monthly mean outdoor air temperature. It may be observed in figure 5.14 that the coefficient of correlation (R^2) for the linear regression equation for the 4-star hotels was the highest at 0.35, followed by 0.27 for the 3-star and finally 0.05 for the 2-star indicating that there is no correlation between all hotels for the total electrical energy use and the outdoor air temperature. This could be due to many activities happening at the same time in each hotel and since they have no separated meters for different equipments for energy measurement and the number displaying here are the monthly values.

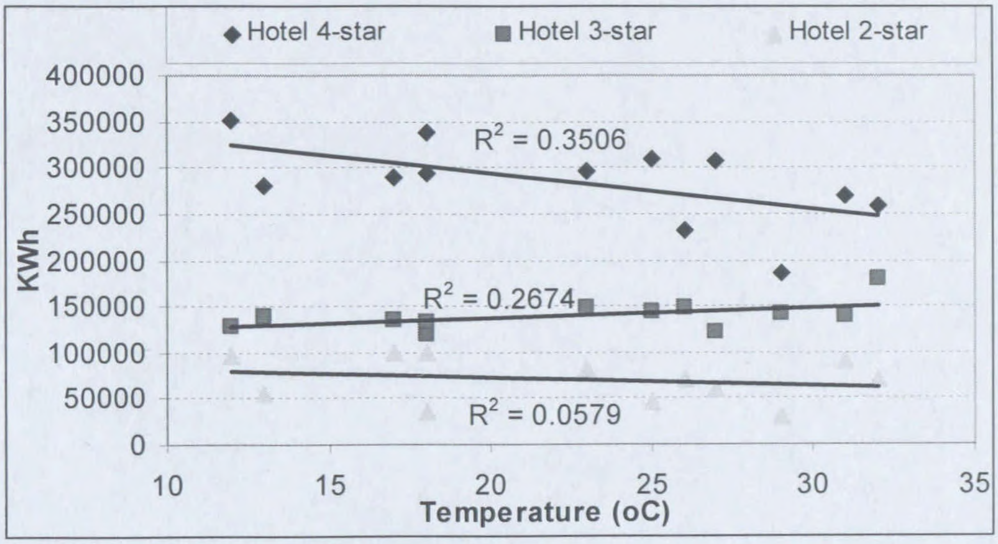

Figure 5.14: Trend relationships.

However, the same figure (5.14) shows good the trend relationships between for the 4-star hotels and 3-star hotel and finally the 2-star hotel.

Due to the trend relationships between electricity use and outdoor air temperature for each hotel category, the variation between summer and winter months were plotted. It is observed that the electricity consumption in summer is lower than in winter for the 4-star hotels; higher than in winter for the 3-star and 2-star hotels as shown in figure 5.15. This indicated the electricity use was dependent on the outdoor air temperature, hence confirming the air conditioning units and associated equipment directly influenced energy use.

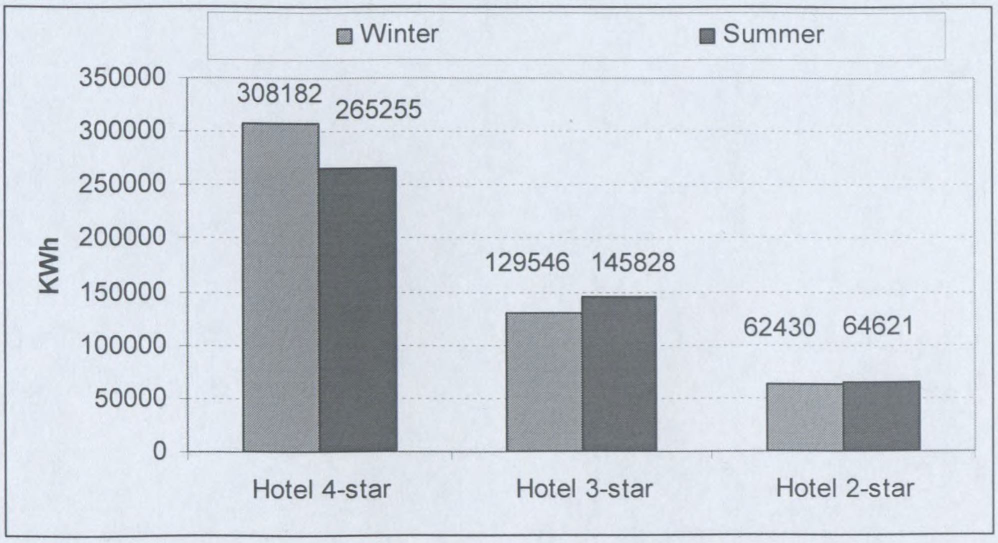

Figure 5.15: Comparison of electricity use between winter and summer.

The reason for the 3-star and 2-star hotels to behave differently from the 4-star hotels been the fact that the during winter, there is no mush tourist travelling in to the country but among the few who travels are upper class level people who normally prefers to stay in 4-star hotels. Hence the 4-star hotels use more energy than the 2 and 3-starts hotels.

5.5 Energy consumption between two hotels

The following questions can be posed:

How does energy consumption compared between similar hotels (in term of size, facilities offered and star ratings)? What account for the differences? Is the hotel with lower energy consumption more efficient? What is the scope of improvement?

To answer these questions, energy consumption data of two comparable hotels: A and B both, the four star hotels were analysed (see figure 5.18 below). The major energy sources used in these hotels were electricity, gas (LPG) petrol and diesel. From November 2009 to September 2010, monthly bills for these fuels and occupancy data cost per room sold for electricity, gas, petrol and diesel were determined. The total energy consumption and cost per room sold was worked out (see table 5.3 and 5.4)

Table 5.3: Hotel A energy consumption Oct. 2009 – Sept. 2010

Month	**Consumption (KWh)**	**Average occupancy %**	**Specific Energy consumption (KWh/guest.day)**
January 2010	309358	80.5	27.87
February 2010	294085	88.7	24.86
Mach 2010	279622	76.3	24.63
April 2010	350839	99.6	30.30
May 2010	339138	93.3	29.02
June 2010	289080	94.8	24.51
July 2010	296092	96.3	26.14
August 2010	306504	86.4	31.78
September 2010	258518	86.2	23.81
October 2009	268840	79.3	26.36
November 2009	232617	85.8	22.19
December 2009	184858	83.4	25.74
Average	288129.25	87.55	26.43417

Table 5.3 shows the monthly energy consumption, average occupancy and specific energy consumption per guest room for hotel A. The analysis of the data for hotel A as shown in figure 5.16 indicated that, as occupancy increases, the energy consumption for the hotel increases and the specific energy consumption or cost per room vary accordingly with the average of R26.43.

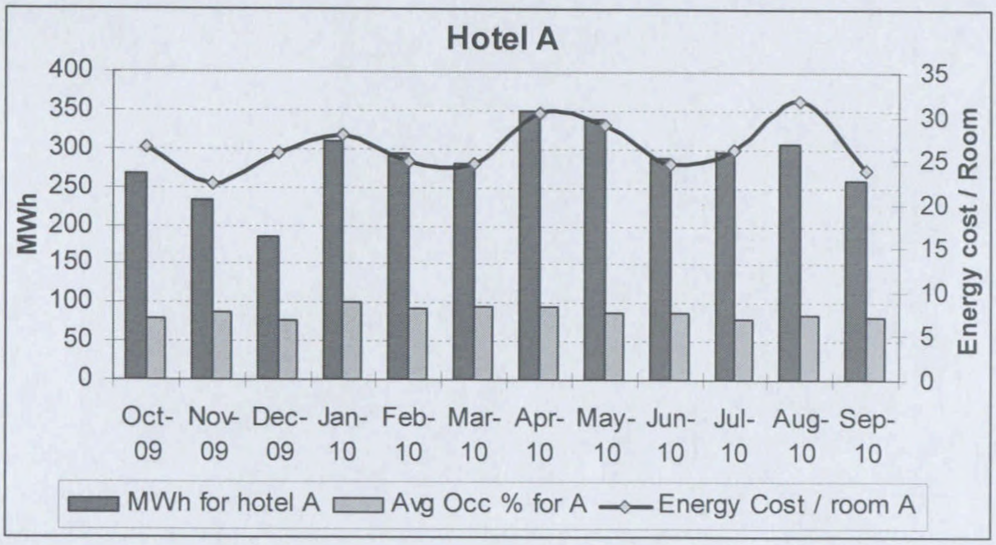

Figure 5.16: MWh & Avg occupancy Vs Energy cost / Room for Hotel A

Table 5.4: Hotel B energy consumption Oct. 2009 – Sept. 2010

Month	**Consumption (KWh)**	**Average occupancy %**	**Specific Energy consumption (KWh/guest.day)**
January 2010	164660	64.06	17.41
February 2010	178321	77.72	14.89
Mach 2010	184718	72.65	15.09
April 2010	217459	82.81	17.81
May 2010	246484	95.27	21.56
June 2010	279271	91.91	25.03
July 2010	149277	96.10	13.34
August 2010	180684	74.81	14.17
September 2010	216447	52.48	18.60
October 2009	223294	45.60	19.61
November 2009	165054	71.04	12.94
December 2009	168436	71.67	15.00
Average	197842.0833	74.67667	17.12083

Table 5.4 shows the monthly energy consumption, average occupancy and specific energy consumption per guest room for hotel B. The analysis of his data as shown in figure 5.17

indicated that, as occupancy increases, the energy consumption for the hotel increases and the specific energy consumption or cost per room vary accordingly with the average of R17.12.

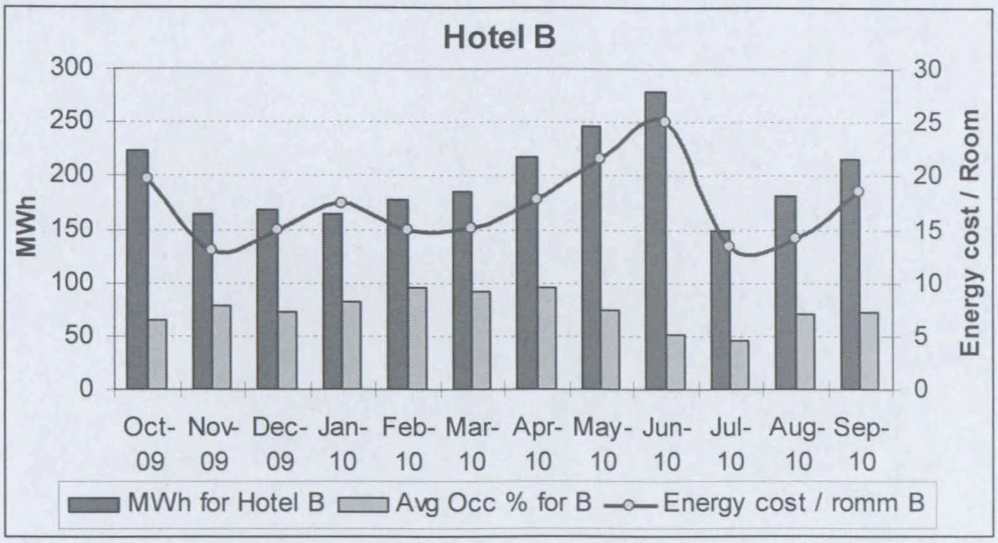

Figure 5.17: MWh & Avg occupancy Vs Energy cost / Room for Hotel B

Figure 5.18 below shows the relationship between consumption for hotel A and B versa the average occupancy for the two hotels respectively.

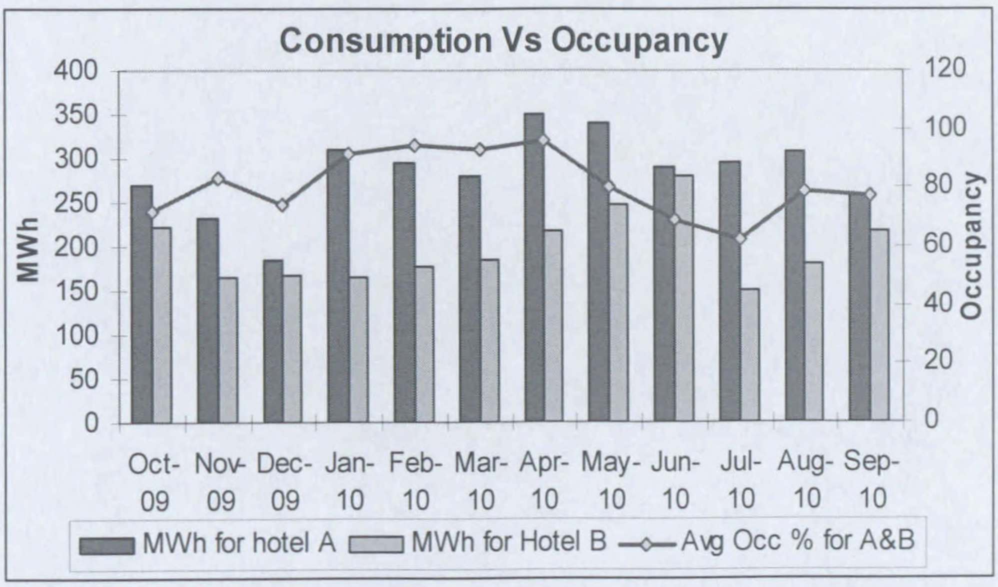

Figure 5.18: MWh Vs Avg occupancy for Hotel A & B

The different units of different fuels were converted to KWh to calculate total energy use. It was observed that hotel A average energy cost per room in Oct. 2009 – Sept. 2010 was R26.44 against R17.12 of hotel B, about 50% more than hotel B. Interestingly, average electricity costs were 68.66% higher for hotel A. On the other hand, an average occupancy during Oct. 2009 – Sept. 2010 was 87.55 in hotel A against 74.67% in hotel B.

Since the considerable amount of energy consumption does not vary with occupancy rate, (for example in lobby, offices and a large part in kitchen, restaurant and other hotel facilities), with higher occupancy rate, the energy cost per room sold should be less. If this factor is considered, compared to hotels B, Hotel A average electricity consumption per room sold was between 50 to 66% higher and energy consumption between 67 to 89% higher. Monthly variations in energy consumption are difficult to explain from the data.

Normally, such variations should be explained by climatic conditions and occupancy (and special events, if any). However, variations during different months were not in same direction in case of the above hotels. In both cases, maximum monthly variation in electricity and energy consumption respectively were of the order of 100% to 93% in the of hotel A and 96% to 83% in the case of hotel B, indicating need for investigation into possible causes.

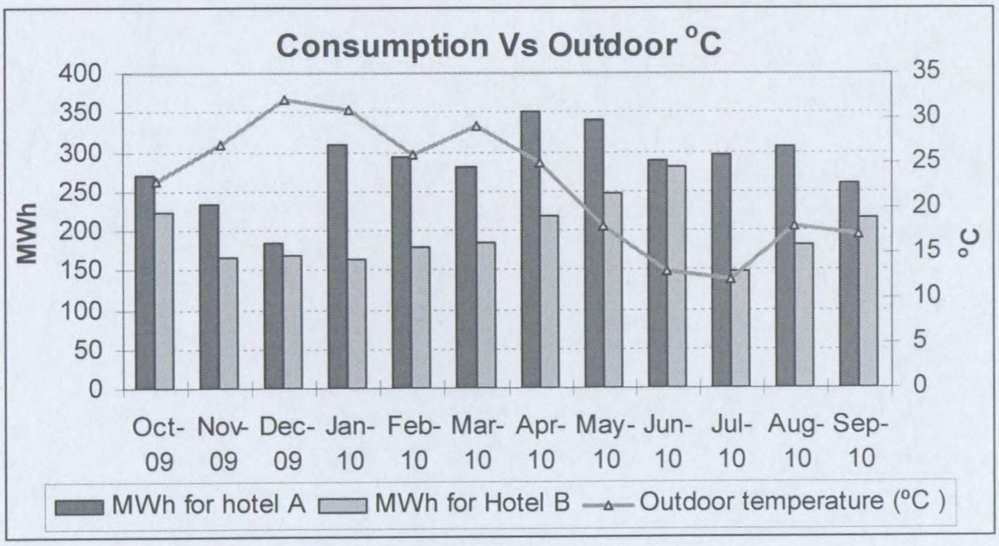

Figure 5.19: MWh Vs Outdoor temperature for Hotel A & B.

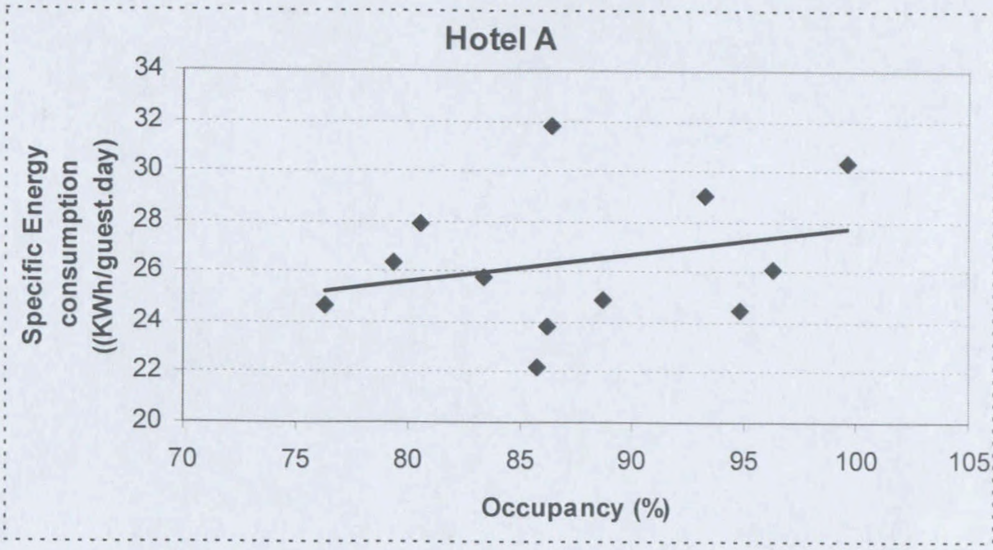

Figure 5.20: Specific energy consumption and occupancy in the hotel A.

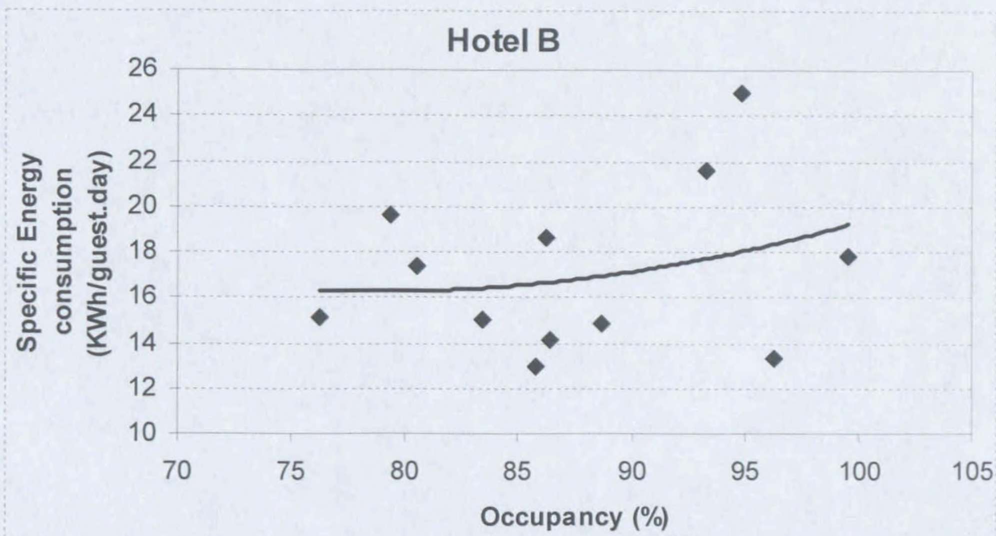

Figure 5.21: Specific energy consumption and occupancy in the hotel A.

The variation of specific energy consumption is quite large and different for each hotel (figures 5.20 and 5.21). As occupancy rate increases, it is observed that specific energy consumption trends increases slightly. This show that these hotels where using many energy consuming devices such as incandescent lamps, low efficiency air-conditioning and electric water heater, making the explanation difficult to explain from the data.

5.6 Development of the 'Self-help' guide on energy management for the South African Hotel industry

Base on the current state of the energy use in South African Cape Town hotels, the proposed strategy for efficient use of energy and development of 'self-help' guide can help a hotel to achieve both short and long term benefits

5.6.1 Strategy for energy management

The strategy for energy management in hotel industry could be use in the following hierarchy (figure 5.22):

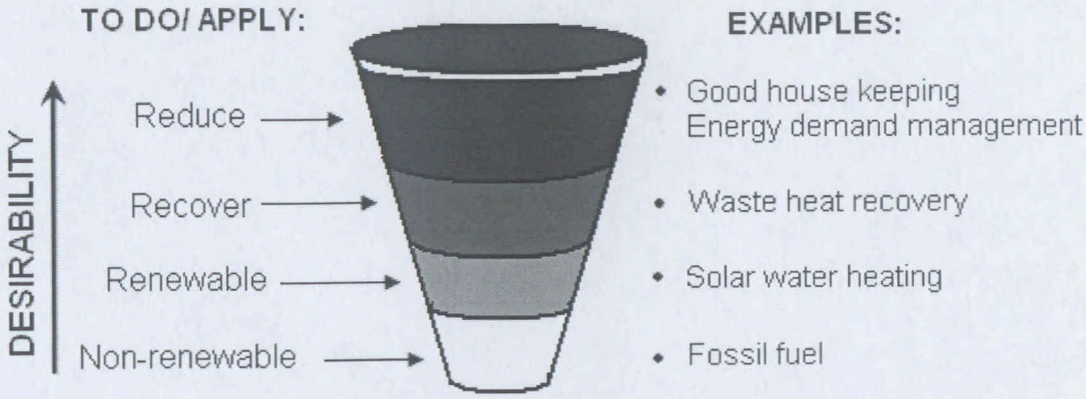

Figure 5.22: Energy management hierarchy

(HKPolyU, 1996).

In South Africa, it was noted during the survey that most hotels have set their own energy saving policy with targets for reducing electricity consumption by 10 – 15%.

5.6.1.1 Reduce energy consumption

(a) Good housekeeping

Good housekeeping is the first measure to be considered to reduce wastage of energy when not required, or where it is oversupplied. For example, light and air conditioning being switched off when a room is not in use, turning off equipment when not needed, etc. The key to successful good housekeeping is by monitoring the staff response for operating and maintaining equipment in the laundry, kitchens, guest floors (lighting, air conditioning, and water heating system) and other areas, such as building envelopes, office equipment, etc. This approach does not require major capital investment and specialist knowledge, but significant reduction in energy and hereby, operational cost can be obtained. For example it is estimated that up to 10% reduction in energy consumption is achievable through good housekeeping (Parasnis, 1998).

(b) Energy demand management

Energy demand management aims to reduce consumption while not affecting the quality of the service. In South African hotels, the reduction focuses on electricity (for lighting, air conditioning and appliances). The magnitude of these demands is determined by the following load sources: lighting, occupants, equipment and building envelopes etc. The energy demand can be significantly reduced if the load sources are well controlled. Lighting control systems can save a considerable amount of lighting energy that, for example, has a share of about 10 – 30% in a typical hotel (Thermie, 1998).

In the South African hotels, Liquefied Petroleum Gas (LPG) is mostly used for cooking, but now the hoteliers could think of using LPG instead of electricity for water heating. Through good housekeeping, a hotel has reduced its electricity consumption up to 10,000 to 15,000 KWh/month (survey 2010). These measures are replacing incandescent lamps by Compact Fluorescent Lamps (CFL), re-setting air and hot water temperature at comfort levels in guest rooms.

5.6.1.2 Energy recovery

The energy efficiency can be increasing by recovering waste heat. For example, waste heat from refrigeration or air conditioning equipment may be used to heat water. In the case of the one city hotel, where walk through audit was carried out, potential for heat recovery from the laundry system (including driers) was observed. It could be used for boiler water preheating, which was close to the laundry room.

5.6.1.3 Renewable energy application

(a) Solar water heating

Solar water heating can produce and can provide a cost-effective and reliable choice for hot water in the hotels. Solar water heating system has a higher initial investment than electric or gas water heaters. However, when all cost are considered for heating water, the life-cycle cost of solar water heating system could be lower because the system runs on a renewable energy source. For example in the Cape Town South African, some hotels are considering to install solar water heating system for their laundry hot water service.

5.6.2 Proposed 'self-help' guide

An analysis of the energy management in the South African Cape Town hotel industry shows that guidelines which allows hotelier to manage their energy better and save costs as to quality services guests is not available. A check list or 'self-help' guide will be useful to the hoteliers to achieve energy saving, rather than relying solely on consultant and contractors. The training received by the hotel's own staff is a valuable source.

This section present 'self-help' guide from general point of view and highlights of main items. The possible items in each section are discussed. However, this can be modified and adopted according to actual practice and requirements. The complete details of proposed 'self-help' guide are shown in Appendix B

5.6.2.1 Organization of the guide

The 'self-help' guide is organized into three main parts:

- Getting started
- 'Self-help' guide
- Approaches for a long term benefit.

This guide follows a 'bottom-up' approach (see figure 5.23) and covers of energy management such as energy. The chart shows the guide's structure from the basic concept to achieving long-term benefit and provides steps of each level.

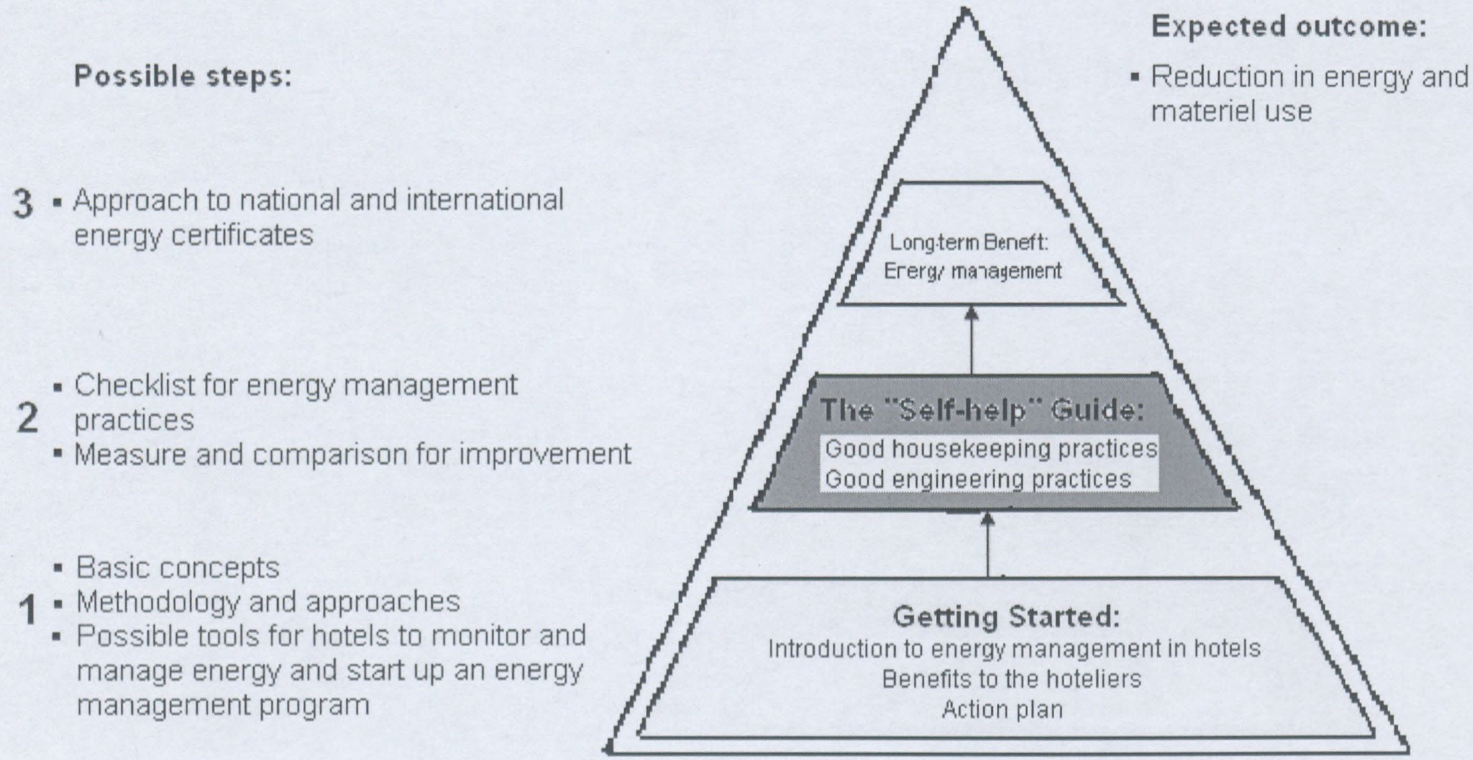

Figure 5.23: Organisational of the 'self-help' guide

5.6.2.1.1 *Part I: Getting Started*

This section aims to provide basic information of energy management to increase awareness of hoteliers, and provide the management tools and action for energy management activities. The structure is as follows:

a) Introduction to energy management in the hotel industry

In the hotel industry, energy management aims to effectively manage the usage of energy. The major purpose of energy management is to reduce operation cost and reduce energy consumption without affecting the quality of the hotel's services.

b) Benefits to the hoteliers

A well organized energy management program can give significant results for a hotel. Benefits can come directly or indirectly and in both short and long-term. Some of these are:

- Saving energy resources,
- Reducing operational cost,
- Increase reputation and competitive advantage, and
- Improving moral for employees and satisfaction to guests

c) Action plan, measurement and consolidating energy management performance

These are many actions that the hotels can take to save energy resources. The problem is knowing where to start, how to define the best areas for action which may bring real benefit to the business. However, the action plans that could be undertaken, and the measure to be taken and considering to good energy performance are the issues described in this section. An action for setting up an energy management program in the South African hotels is suggested in figure 5.24:

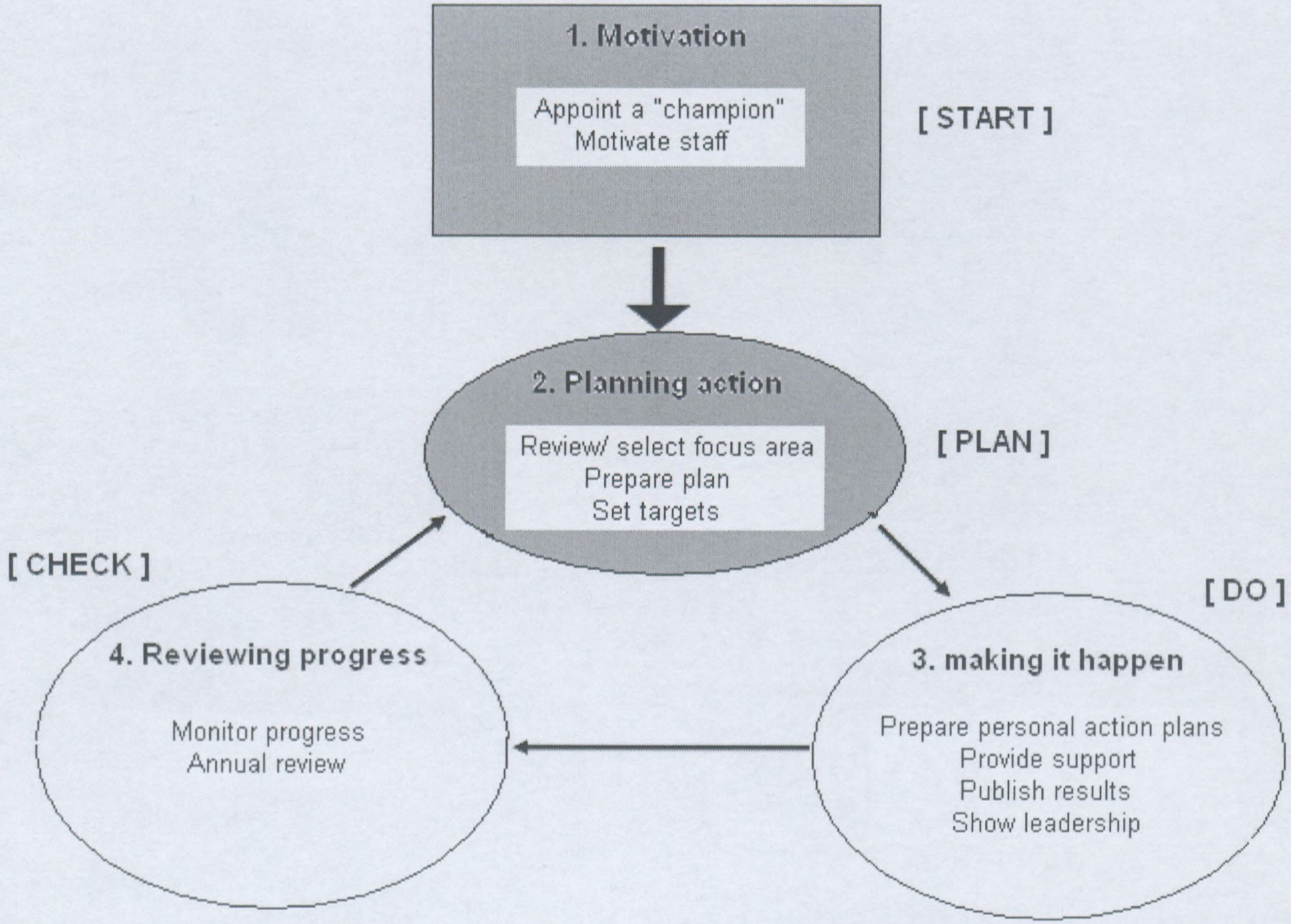

Figure 5.24: Yearly action for energy management in hotel.

(UNEP/ IHA/ IHEI, 1995)

- <u>Step 1</u>: The program is started by appointing a person, a "Champion", to take responsibility for coordination and implementation. The objectives of initiative program are also communicated to all staff for involvement.
- <u>Step 2</u>: Detailed review is carried out to select a priorities areas for action. Suitable measures, action plan and targets are also identified for implementation.
- <u>Step 3</u>: Proposed measures and action plan are implemented with commitment from staff.
- <u>Step 4</u>: Progress is monitored against set targets and objectives. Success and failure assessment are also conducted.

These steps form a yearly energy management cycle with **"Plan – Do – Check"** sequence. Each year the hotel can go back through this cycle again, starting up with review targets (step 4) to learn from the previous year's successes and failures for setting new targets.

Another implementation issue which the hotel should know before conducting the program is how to measure the energy performance, which may be used at step 2 and step 4 (see figure 5.25), so that the hotels can know their current status and how far they have improved. The following are the common tools:

i. <u>Audit</u>. To valuate the energy performance, department by department, highlight achievements and those areas that need to be paid attention

The audit could be divided into two phases:

- Preliminary audit – including walk through survey for equipment which can be done trimester; and
- Detailed audit – including detailed on-side investigations and measurement focusing on major consumption areas identified in preliminary audit, but other areas should not be ignored.

The steps to be followed in conducting the audit is presented below (figure 5.25):

ii. Continuous monitoring and control: To let the hotel managers (maintenance or risk manager) track the use of energy, identified problems and compare implementation.

This will support them in making decisions and modifying strategies of energy management as to compare against best-in-class hotels with similar operations or categories and for setting targets of improvement.

In order to facilitate these tools, a good communication / interaction among departments should be facilitated so that the energy data flow can be well managed and communicated throughout the hotel.

Training of hotel staff can greatly assist hotels to achieve their energy targets. Initially, it would be used to create awareness of energy aspects and secondly, to initiate specific programs, for example, training to switch off equipment when not needed, etc. unless awareness of staff is increased, the program cannot run smoothly.

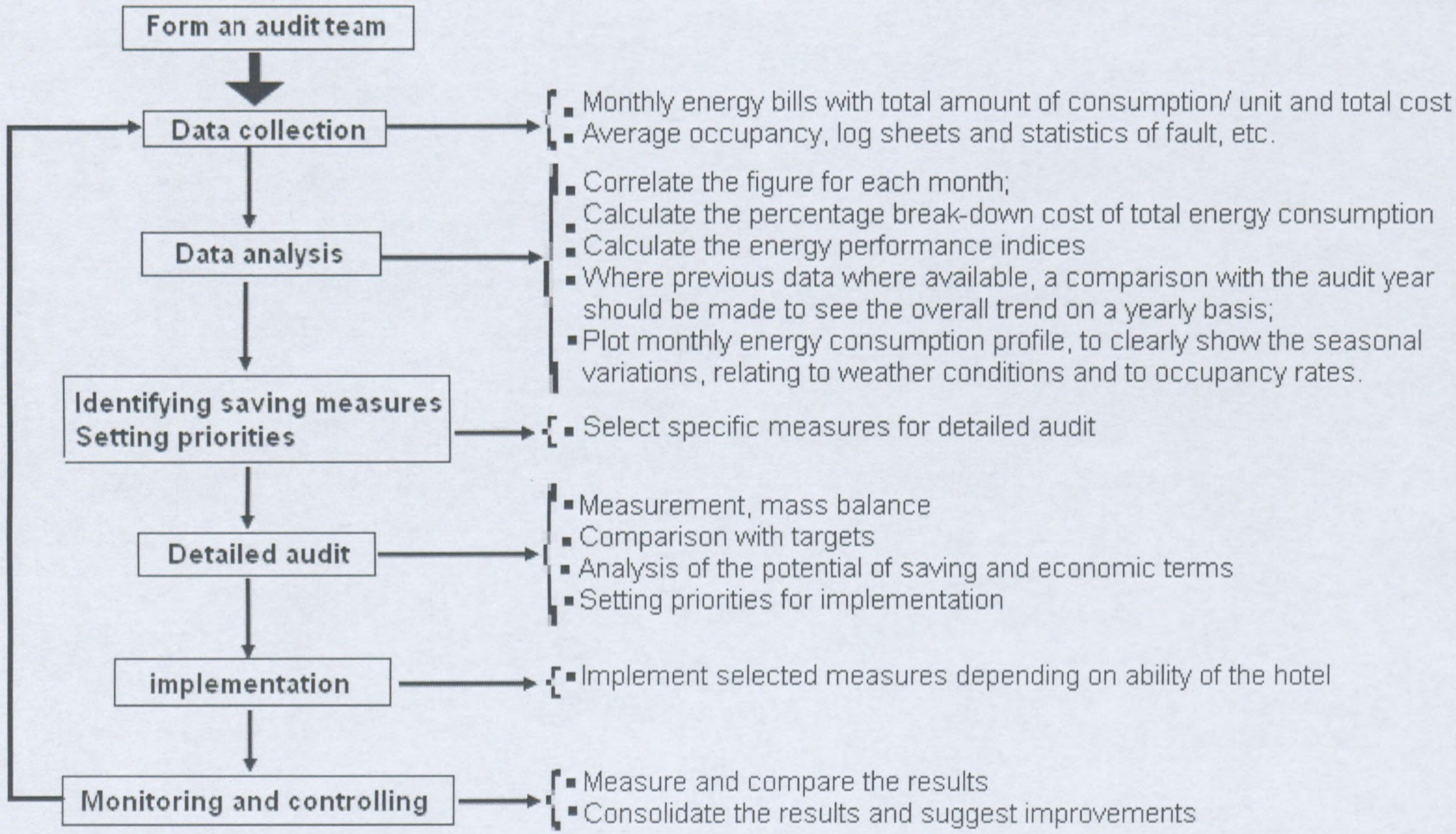

Figure 5.25: Audit steps and description

5.6.2.1.2 Part II: The 'Self-help' Guide

This section aims to provide energy saving checklists and good practice of the hotel and mainly focusing on no-cost and /or low-cost measures. The suggested checklist is presented in Appendix B.

a) Good house-keeping practices:

This part is intended for staff working in a hotel to guide them in their routine work in implementing "good house-keeping" practices, which can reduce use. It is by no means exhaustive and hotel management, and department or section heads might design their own list, appropriate to the work activities in their respective sections. The adoption of "good house-keeping" practices can considerably enhance the competitiveness of hotels by reducing the cost of production, thus protecting the financial resources of a company. Many hotels have already noticed that they can achieve significant reductions in energy and costs by paying attention to energy management and environmental issues (Nafti, 1998).

The use of checklists and suggested measures contained within this guide (Appendix B) are intended to enable hoteliers to establish an initiate steps for taking a step-by-step and more systematic approach for improving both energy uses efficiently and environmental sustainability. Applying good housekeeping practices allows hotels to start with easy-to-implement actions related to improving management procedures.

The good housekeeping practices are set up in form of checklists (details are in Appendix B) covering energy area. The energy management here focuses on good maintenance, monitoring energy use and recovering and reuse energy. A generic energy management scheme for use in hotels is given below (Nafti, 1998):

Table 5.5: energy management check list for saving energy

Objectives: Conserve, reuse, and reduce energy
Maintain good insulation for hot and cold water pipes • Periodically check the state of insulation to avoid heat losses and repair when needed • Ensure cooling and air conditioning systems do not heat unnecessarily
Maintain compressed air pressure pipes • Avoid the loss of pressure • Periodically check the leakages and repair when needed
Maintain energy using equipment (eg. Heaters, boilers) • Optimise combustion efficiently through regular maintenance • Avoid unnecessary cold / heat losses from open doors, exhausts, etc.
Use air conditioning systems efficiently • Check whether air conditioning can be avoided • Ensure there is a good insulation of air conditioned rooms • Switch off air conditioning systems when not needed (eg. at night) • Regular adjust the air conditioning to an adequate temperature level
Regulate the energy input according to the needed energy level • For example, if an energy input of 50°C is needed, do not provide an input at 70°C
Use the temperature thermostat in processes that involve heating water (eg. in rinse baths) • Ensure the temperature does not become too hot or too cold, requiring further energy to moderate
Control the dimension of electric compensation equipment at source • Install a condensation battery at the transfer level
Check where alternative or renewable energy sources could be used and substitute these for non-renewable energy inputs

Detailed of actions that could be taken depending on the area, such as building envelope, lighting, air conditioning, water heating, etc. are listed in Appendix B. These checklist / choice could be directly used by the hotels to implement energy management option described above.

b) Good engineering practices

This part is intended specially for engineering staff in a hotel to be included as part of their responsibilities. In South African hotels, the engineering department is responsible for operation and maintenance of all resource consuming systems, such as HVAC, lighting, water supply and drainage, lifts, etc. therefore, engineering staff should first understand that conservation is part of their responsibility.

First of all, it is suggested that engineering staff should regularly conduct hotel audit to identify current state and provide top management with information to assist in decision making, for example,

- Establish where energy is being used in a hotel and at what cost;
- Help determine the priorities for more detailed investigation of energy use;
- Justify investment in energy saving measures; and raise the awareness of all staff by providing facts on energy use.

The main issue discussed here is energy with checklist in Appendix B. The object is to understand how energy is used in the hotel, and where the best opportunities for saving exist. It is required for:

- Collect usage data, cost and hotel occupancy statistics.
- Estimate how must of the total each department takes, ultimately the only way to do this accurately is through the installation of sub-meters.
- Identify the main opportunities for saving energy and estimate the cost and savings

5.6.2.1.3 Part III: Approaches for long-term benefit

This section is designed to provide a methodology to hoteliers to improve awareness of energy issues, to get long-term benefits from implementing energy management and to have opportunities of going forward to obtain Green label (as national certificate) and or energy management ISO 50001 (as international certificate). They are affective tools for marketing, enhancing benefits and sustainable development.

The following flow chart (see figure 5.26) illustrates a scheme of an integrated energy management system, in which the links between the 'self-help' guide and energy management are presented to form a suitable approach for the hotel industry of South

Africa to benefits in long-term. The development of the guide and the approach can be described as follows:

- Starting from assessment of current practices and preliminary programs on energy management in typical hotels, benchmarks and checklist of good practices can be found to form the "self-help" guide, which can be applied for the whole hotel industry.

- Then, the "self-help" guide could have an effective tool for implementing energy management in hotels, which could result in reduction of cost, increment of awareness and knowledge of staff with low cost of implementation. The benefit gained from the first initiative will be a driving force for hotel for being more concerned energy management, which may give them long term benefits.

- With initiatives benefits and knowledge build upon energy management practices, hotels can then move toward establishing energy management through energy labeling and ISO 50001 achievements.

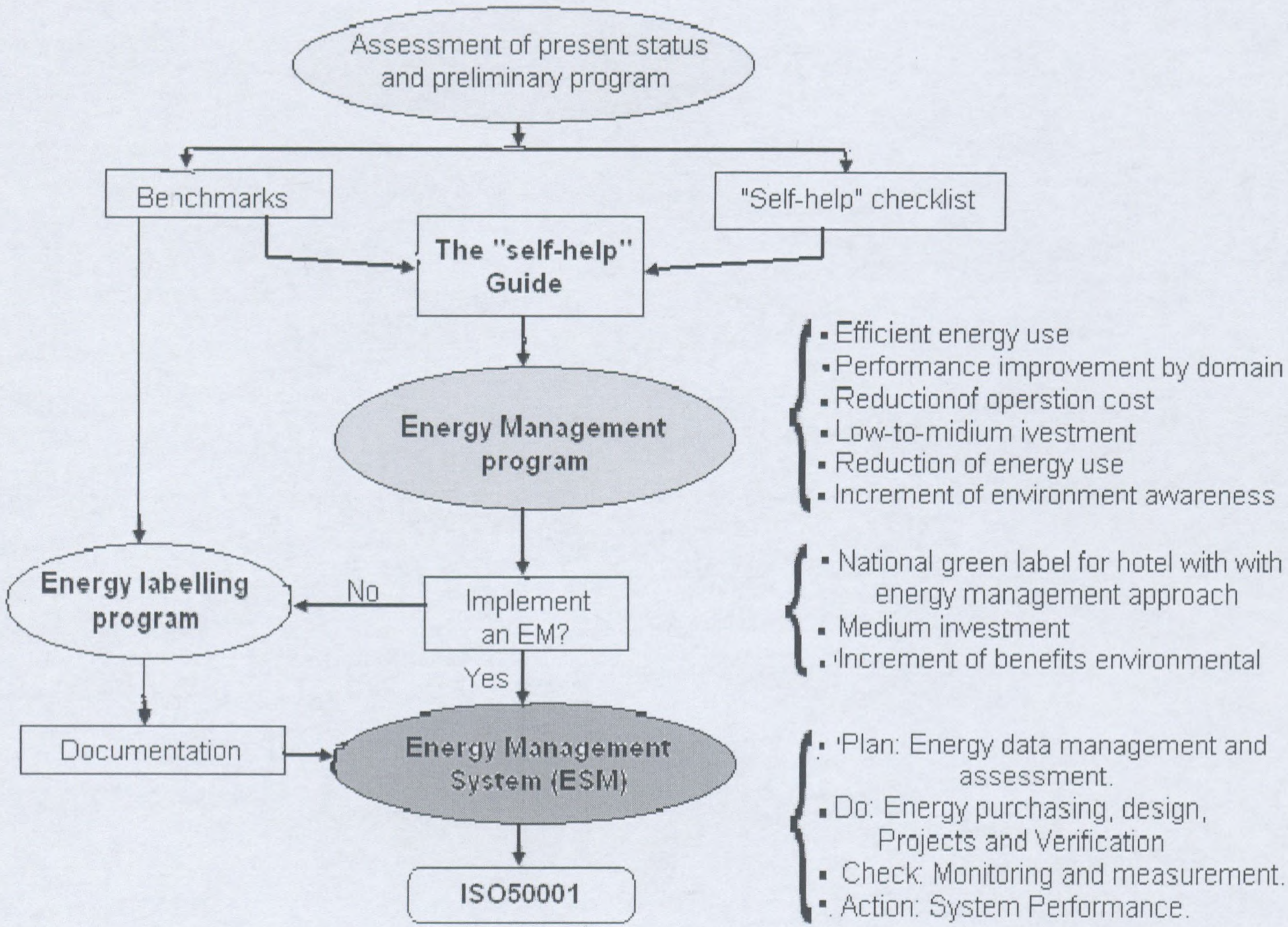

Figure 5.26: The development of the 'self-help' guide with its linked approach

5.7 Chapter summary

The data analysed the findings from the research instrument and the empirical audit of site instruction. Open-ended questions where summarised. The audit of energy was done on four hotels and the subsequent comparative of two hotels was done. The findings were discussed of both research instrument and the site instruction audit linking them to the literature review.
The good management practice presented in the guide (Appendix B) need to be revised through actual implementation in a number of hotels in South Africa. Most of these practices require little or no capital cost investment, mainly a change of approach by staff. The potential benefits are significant, and are recurrent if operational practices are maintained. Part of the money saved could be invested in further measures to improve efficiency.

It is noted that not every hotels has the same energy consumption pattern and situation, and therefore no single solution will meet the need of all hotels. The suggestion and proposal listed in the guide are general in nature, and individual hotels should plan an energy management program that is suitable for their particular circumstances.

It is obvious that almost all hotel managers are interested in efficient energy management and improvement of performance in their hotels. Awareness of staff and well defined good housekeeping and engineering practices would help in achieving better energy performance.

It is important to establish a complete energy management system for the South African hotel industry to get long-term benefits, starting from the development of 'Self-help' guide and implementation of energy management. This Energy Management system can only be achieved through the combination of technical implementation for continual improvement (fulfilled by efficient energy management) and documentation (fulfilled by adoption of ISO 50001 standards).

CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The purpose of the study was to assess and determine the current state of energy management in hotel companies operating in South Africa. Energy conservation was studied through on-site surveys in 7 hotels in Cape Town. The study focus on energy management was in line with determining the major outputs of the energy consumption and conservation strategies used in the hotels. This chapter addresses the research questions posed in chapter one and explores the suggestions made in respect of energy conservation measures, development of the self-help guide on energy management in South African hotels and recommendations are made.

6.2 Conclusion

This section puts the discussion of findings of the study into perspective. In other words, the research questions are addressed here one by one. Data analysis of energy consumption is based on the following three research questions:

(a) Research question 1

Can the energy management programs in the hospitality sector contribute to minimising energy consumption?

The energy management programs in the hospitality sector can indeed contribute to minimising energy consumption however energy management practices need to be effectively controlled and monitored by management. Management is of essential importance due to the fact that electricity is a major energy form used in the South African hotels which approximately accounts for 80% of total energy consumed by this industry. Moreover, electricity for air-conditioning takes the biggest share (about 50%) of total electricity use in hotels. However, savings in terms of costs are the main concern for the hotels, but the first approach, as outlined in the previous section, is to try to pay less for the same amount of energy. This approach is the easiest as it does not require any radical change to behavior or installations.

The next step of the approach requires that a smaller quantity of energy be used to achieve the same result. Reducing consumption is strongly encouraged by the regulatory authority and involves technical modifications to the design of future or existing hotel buildings. The design and implementation of improvements, the adaptation of new systems, and even changes to the procedures and behavior of users are very crucial. The power consumed by the functional systems in the building must be reduced (while maintaining output and comfort).

It should however be stressed that this approach contributes to the improvement and modernization of equipment (providing new solutions in terms of both performance and quality): it thus also satisfies a professional requirement and contribute to minimizing the energy consumption in the hospitality industry. Generally, for a building containing an industrial process, the main area for savings lies in the cooking equipment, which must therefore be studied with specialists in the relevant application area.

(b) Research question 2

Are there any energy conservation measures in place in the hotel sector in South Africa?

The study found that most hotels participating in the study were implementing some type of energy management practices, even though the magnitude of organizational involvement in energy management practices varied. Of the 7 organizational involvement in this study, the overall mean score (M= 2.33, SD= 2.31) in energy management practices demonstrates a fairly large extent in energy management practices. The majority (71%) of the sample hotels also reported that they had been involved in energy management for less than or equal to three years. The findings show that energy management has recently been attracting much attention from hoteliers, and been becoming common practice in the South African hotel industry.

The study investigated energy conservation measure in hotels, barriers in the conservation, institutional mechanism the hotels would prefer and policy measures needed to implement energy conservation. The consumption was high in all hotels due to the FIFA 2010 World Cup and potential for efficient lighting and installation of sun control film was also discovered.

There are a variety of energy conservation measures are available in hotels. These include the use of energy efficient equipment for lighting, air-conditioning, water heating and improvement of power factor correction. Recent practices in this area include building envelope programmes and advances such as modern computer and communication technology based building energy management systems. The good housekeeping practices including regular monitoring of energy consumption, and other innovative measures such as fixing sun control film on glass windows and doors to prevent solar heat gain in the rooms.

The survey conducted at hotels indicated a high level of awareness on issues related to energy consumption. In the case of lighting, a majority of hotels were using Compact Fluorescent Lamps (CFL). Most of the hotels were however not aware of the heat pumps that offer substantial potential for savings. One hotel had key-tag system to save energy when the guest leaves the room. However, implementation of the system was not adequate. Some hotels are considering solar energy system for water heating for their alternative energy source. This will play a part in increasing the supply.

Demand shift and control (shifting operations from peak to off peak time) was not applicable to all the hotels due to the LT connections. A device such as timer is designed to monitor the load and to conscientise the user about energy consumption. The installation of capacitors to improve power factor were taken by the hotels to avoid penalty and the installation of sun control film and recovery of heat from laundry waste water were areas where no action has been taken. Most of the hotels (irrespective of the class or category) believed that their housekeeping practices were sound. This was however not supported by the observation during visits. Substantial scope for improvement on this count remains.

All the hotels have considered efficient air conditioning and lighting to be the very important measures for the hotels to save energy. Automation and control and solar systems were also considered important by some of the respondents. Training and good practices, including repairs and servicing, energy monitoring and auditing were also rated important by some hotels. As a matter of fact, maintenance problem emerged as the most important barrier and followed by high cost of efficient appliances. An important finding was that "implementation agency not availability" was considered equally important barrier as cost, implying that hotels would prefer if energy conservation could be carried out by some agency.

High payback period in case of maintenance by the outside company, product unreliability, lack of technical expertise, disruption in changeover and non-availability of money followed in importance in that order as barriers. Uncertain benefits, problem of availability, lack of information on energy efficiency products and non-availability of consultants, uncertain delivery were other barriers at lower ranking levels.

As a method of conservation, retrofitting, replacement and adding new systems, all the three were acceptable to a majority of the hotels. Acceptable payback periods were up to five years in most cases. On financing mechanism for energy preservation, a majority of the hotels preferred Energy Service Companies (ESCO) to carry out the job to take care of financing aspect of energy conservation. On institutional mechanism, expert / consultants was most preferred option, followed by ESCO and utility at some of the level of preference. This indicates that if the utility were to take initiative on this, hotels would welcome and participate enthusiastically. The financial institutions, governmental agencies and industry association were other preferred alternatives in that other.

Technical assistance was considered important requirement among the various policy issues, followed by financial incentive, availability of constitutional mechanism such as energy service companies. Availability of experts / consultants was next in importance, followed by need for education and training programmes, and seminars and workshops on energy conservation. Other policy measures in decreasing order of importance ratings were energy audits, pilot demonstration programmes, awareness campaigns through media, energy conservation literature and availability of finance from banks and financial institutions

Implementing energy saving practices, it is found that some of the energy management measures are associated with relatively large scale renovation and investment. As a result, it appears that energy management measures are restricted to some practices that require a low level of resource deployment. The majority (71%) of the hotels were not involved in any type of renewable energy programs at all although they are considering solar energy for their next way to go. Not surprisingly, small hotels in this study showed less involvement in such programs than large hotels because renewable energy programs may offer some of the best environmental practices that need a relatively high level of financial investment. In a similar vein, occupancy sensors and a key-card control system in guest rooms are energy saving practices that are highly recommended by related organizations, but were not well established in the sample hotels in this study. The majority (86%) of the sample hotels reported that they did not implement occupancy sensor or a key-card control system to save energy in guestrooms at all.

These findings suggest that, despite the significant attention placed on the need for implementing energy management measures to reduce operating costs, hotels' resources are available to invest and enough information on investment and return can play a deciding role in adopting such advanced energy management practices. Consistent with these findings, according to hotels visited, the first two challenges or barriers facing South Africa's hotels in greening their practices are a lack of capital to invest and a question on achieving return on investment.

(c) Research question 3

How does the increase in cost of electricity impact the hospitality industry in South Africa?

It can be seeing from figure 5.3 that the increase in electricity tariffs in South Africa has put the hotels industry to become aware of the energy expenditures and take advantage of energy efficiency opportunities in their business. Utility rate is an important consideration in deciding an energy conservation measure. It is designed an important component of major energy conservation programmes. The measures have been proposed for the hotel managers with a long-term view to have suitable plan of development for their hotels. Through housekeeping practices in South African hotels, it is about 10 – 15%. Identification of measures for energy management have been proposed. Development of the "Self-help" guide on energy management with tools and approaches for achieving both short and long-term benefits. In a form of checklists on energy, the "self-help" guide may provide a guideline for hotels, from short-term (through good housekeeping practices) to medium-term (though energy management) and long-term achievements (as ESM and ISO 50001).

6.3 Recommendations

The survey was conducted in seven hotels in Cape Town South Africa which may not necessarily provide a comprehensive depiction of the Cape Town hotels. To obtain a clear picture on energy use, the survey should be conducted in large number for each category of hotels to generate a significant result. Such a survey could also be conducted during the off peak season.

To further promote the participation of South African hotels in energy management activities, the following recommendations are made:

- Hotels should sustain the good practices on energy conservation measures that are already in place at the hotels such as:
    - Switch off air-conditioning in guest rooms while it is not occupied
    - Turn off light in areas not in use such as conference rooms

- Benchmarking should be conducted inside the hotels to determine benchmarks for efficient use of energy in each department. Hotels should focus and analyse the energy use and its management in each department, this provide more effective results.

- Further study should focus on other aspects such as water and waste management, environment friendly product purchasing, in-door air control, air emission management, noise pollution and community concerns.

- The proposed 'self-help' guide with efficient resource of this study could be applied and gradually improved based on actual cases and / or in further studies. The "self-help" energy management guide could be further developed to obtain the Energy Management System approach (See appendix B).

- While applying this guideline, the hotel will both gain benefit from their actual improvement and approach ISO 50001 standards which can be effectively marketing tool for hotels.

- The hotels should implement the principles and rules stipulated in the 'self-help' guide and the questionnaire for energy conservation survey in the hotel could also be improved by including information on eco-labelling program and environment management system. This would be useful to assess the status of energy management (before and after implementation).

- The issue of hotels staff education and guest involvement in energy management should be addressed. To increase the awareness / knowledge of hotel managers, assistance training in term of disseminating, promotion, green labelling, pilot projects and training courses as well as regular meeting of hotel managers for sharing their experience of good energy performance should be provided by the concerned government agency and the installation of sub-metering mechanisms to be taken into account.

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APPENDICES

APPENDIX O: REQUEST FOR PARTICIPATION

Cape Peninsula
University of Technology
P.O. Box 1906 • Bellville • 7535 • Electrical Engineering, Symphony Way (off Modder dam Road)
Tel +27 21 959 6244/6208/6488 • Fax +27 21 959 6870
Website: http://www.cput.ac.za

ENERGY MANAGEMENT IN THE SOUTH AFRICAN HOTEL INDUSTRY

Dear Sir or Madam,

Thank you for taking time to participate in the Cape Peninsula University of Technology Masters student academic project. Providing the information below will assist the student to complete his Masters degree. If you have any questions, please contact Brice Tsobze at 072 220 3852, tsobzeb@cput.ca.za / ftsobze@gmail.com or fax 0866605613.

We would greatly appreciate your assistance through furnishing us with all or some of the following information

1. Electricity consumption, 2009-2010
2. Other fuel consumption, 2009-2010
3. If sub-metering exists, monthly consumption of air conditioning plant
4. Utility rates for electricity supply
5. Average occupancy percentage for 2009-2010 (monthly, for different types of accommodation)
6. Number of lighting points and ratings (incandescent and fluorescent fixtures in lobby, guest rooms, corridors etc.)
7. Details of air conditioning plant equipment and loading
8. Details of boiler and hot water consumption
9. Sun/solar exposure of building (in m^2), to examine need for solar control film
10. Barriers in implementation of these measures

The data requested will be used to investigate and evaluate possible measures to use energy more efficiently in these areas and reduce cost. The subsequent research findings will be communicated to you, and we are sure you will find these useful.

Please Note:

1. The information provided will be used for academic purposes only.
2. All the information given will be treated with confidentiality and sensitivity

Please respond to this request for participation before or by the 06/12/2009
Yours sincerely

Prof. MTE Kahn

APPENDIX A: QUESTIONNAIRE

PART I: GENERAL INFORMATION.

1) Name of the Hotel

2) Address

Tel:

Fax:

3) Contact person (for the study)

4) Hotel category (star rating)

5) Year of establishment:

6) Number of rooms:

(i) Single

(ii) Double

(iii) Suites (category wise; write against applicable)

-Standard -Deluxe -Other types (please specify)

7) Number of:

(i) Restaurants

(ii) Kitchens

(iii) Guest corridors

(iv) Lobbies

8) Facilities offered: please tick mark if offered and specify numbers, wherever applicable

(i) Conference halls (Nos)

(ii) Meeting rooms (Nos)

(iii) Gymnasium

(iv) Swimming pool

(v) Office facilities room

(vi) Games and sport facilities

(vii) Others (please specify)

PART II: ENERGY CONSERVATION/ DSM AWARENESS, BARRIERS AND POLICY MEASURES.

A. General awareness: Please circle appropriate responses

1) The investment decisions for major energy consuming appliance are taken by

(i) Top management (ii) Middle management (iii) Concerned manager

2) Energy conservation measure are taken by the hotel.

Yes / No

If yes:

(a) Who is responsible for that?

(b) Are the energy conservation measure reviewed by the management?

Yes / No

If yes, frequency of review;

(i) Yearly (ii) half yearly (iii) quarterly (iv) monthly (v) weekly

3) Energy consumption monitoring is done on regular basis

Yes / No

If yes who is responsible for energy monitoring and management?

(i) Energy manager (ii) no one in particular iii) others (please specify)

4) Are the energy audits carried out?

Yes / No

If yes,

(a) Are the energy audits done?

(i) Internally (ii) by external agencies (iii) both

(b) Frequency of energy audits

B. Awareness of energy conservation / DSM measures: Please circle appropriate responses

Following is the list of possible energy conservation and demand side management (DSM) measures for hotels. (DSM refers to the programmes normally designed by utilities to manage electricity demand at the consumer end). Please circle one of the following responses against each measure/ option:

(A) The hotel is not aware of the operation **(NAw)**.

(B) The hotel is aware and has not initiated any action for the benefits of the technology (**Aw)**.

(C) The hotel has floated deciding and enquiries in process **(Decid)**.

(D) The hotel has implemented the option (**Implt**).

(E) It is not applicable to the hotel **(NA**).

(F) The hotel did not find it suitable an evaluated of the option **(NSt)**.

(i) Use of Energy Efficient equipments: this refers to the technological option for various end uses or energy services required by the electricity consumers.

NAw Aw Decid Implt NA NSt

Efficient lighting system

(a) Compact fluorescent lamps are used (CFL) in place of incandescent lamps. A, B, C, D, E, F.

(b) High pressure sodium vapours lamps in place of high pressure mercury lamps. A, B, C, D, E, F.

(c) Replacement of magnetic ballast by electronics ballast. A, B, C, D, E, F.

Efficient Air conditioning system

(d) Use of heat pumps for water heating purposes. A, B, C, D, E, F.

(e) Use of heat pumps for space cooling purposes. A, B, C, D, E, F.

(f) Use of heat pumps for cooling and heating combined. A, B, C, D, E, F.

(<u>Note</u>: Heat water pumps can save 40 to 60% of the energy compared to conventional resistance water heater systems. Heat pumps can be used to reduce air conditioning load by extracting the heat from the space (that is required to be air conditioned), and using it for water heating).

(g) Energy efficient motors to replace standard motors. A, B, C, D, E, F.

(h) Proper sizing of pumps and motors, and replacing wherever oversized. A, B, C, D, E, F.

Efficient appliances

(i) Energy efficient refrigerators and freezers. A, B, C, D, E, F.

(j) Energy efficient TVs. A, B, C, D, E, F.

(k) Other energy efficient appliances such as washing machines, fans, radio etc. A, B, C, D, E, F.

(ii) Other innovative measures:

Automation and control

(a) Infra Red activated guest room switching system. A, B, C, D, E, F.

(Note: An Occupancy sensor tracks the movement in the room and if undetected for a pre-specified time, switches off the lights and other appliances automatically).

(b) Building automation systems. A, B, C, D, E, F.

(Note: Building automation systems are computer based building Energy Management Systems that regulate air conditioning, heating, lighting and other energy consuming functions).

Alternative energy systems

(c) Use of solar systems for water heating. A, B, C, D, E, F.

(d) Use of solar systems for space heating. A, B, C, D, E, F.

Demand shifting and control

(e) load control. A, B, C, D, E, F.

(Note: This is accomplished using control devices (such as time clocks, thermostats etc.) that may alter the operation of an end-user equipment to change the maximum demand).

(f) Thermal energy storage to use cheaper "off-peak" electricity. A, B, C, D, E, F.

(Note: energy for space conditioning can be stored and it is referred as thermal energy storage. The energy is stored during "off-peak hour" (time of the day when the utility rates for electricity use are low), and used up during "peak hour" (when utility rates are high). The storage can be for the purpose of heating as well as cooling).

(g) Shifting operations from peak to off peak time (wherever possible). A, B, C, D, E, F.

(h) Improve power factor to reduce maximum demand, A, B, C, D, E, F.

(Note: this requires installation of the capacitors).

Heat control and heat recovery

(i) Fixing heat control films on the windows exposes to sun. A, B, C, D, E, F.

(j) heat recovery from the laundry wash water. A, B, C, D, E, F.

Retrofitting of other equipments / systems

(k) Proper sizing of pumps, motors, and other equipments in various systems and replacing wherever necessary. A, B, C, D, E, F.

(l) Provision of better insulation (on windows and doors) to avoid energy losses. A, B, C, D, E, F.

(iii) Housekeeping and monitoring:

Awareness training and good practice

(a) Staff awareness and energy conservation training programs. A, B, C, D, E, F.

(b) Wastage of hot water must be minimised (used for utensil cleaning, laundry etc). A, B, C, D, E, F.

(c) Switching off lights in areas not needed. A, B, C, D, E, F.

Monitoring and auditing

(d) Overall energy consumption monitoring on regular basis. A, B, C, D, E, F.

(e) Sub-metering to monitor energy consumption closely. A, B, C, D, E, F.

(f) Monitoring and control of air conditioning system. A, B, C, D, E, F.

(g) Air supply in different areas must be monitored as per requirement. A, B, C, D, E, F.

(h) Air temperature conditioned must be checked in different areas and raising if possible. A, B, C, D, E, F.

(i) Energy auditing of hotel. A, B, C, D, E, F.

Repair and servicing

(j) Plugging leakage in hot water / steam piping

(k) Repairing insulations (in rooms, piping etc). A, B, C, D, E, F.

(l) Servicing of steam boilers regularly, freezer units and other such equipments. A, B, C, D, E, F.

Other measures (please specify).

Ranking of measures

Rank importance of these measures for your hotel in term of potential for saving and cost effectiveness.

The ranking scale details are:

Not important (NImp)

Important (Imp)

Very important (VImp)

Can not say / no idea (CNsay)

(i) Use of energy efficient equipment

Efficient lighting system NImp, Imp, VImp, CNsay

Efficient air conditioning system NImp, Imp, VImp, CNsay

Efficient Appliance NImp, Imp, VImp, CNsay

(ii) Other innovative measures

Automation and control NImp, Imp, VImp, CNsay

Alternative energy systems NImp, Imp, VImp, CNsay

Demand shifting and control NImp, Imp, VImp, CNsay

Heat control and heat recovery NImp, Imp, VImp, CNsay

Retrofitting of other equipments / systems NImp, Imp, VImp, CNsay

(iii) Housekeeping and monitoring

Awareness training and good practice NImp, Imp, VImp, CNsay

Monitoring and auditing NImp, Imp, VImp, CNsay

Repair and servicing NImp, Imp, VImp, CNsay

C. Barriers to energy conservation /DSM

Here we are try to identify barriers to energy conservation on a broad and general basis. Although barriers may be different for different type of energy conservation measures (for example high cost may not be the barrier for efficient lighting system, but may a barrier for thermal storage system for air conditioning), we are not considering barriers to individual measures here. Please indicate your opinion on overall basis.

Circle importance of each barrier for each energy conservation / DSM measure as per following scale:

Not applicable (NA)

Not important (NImp)

Important (Imp)

Very important (VImp)

Also rank top five barriers in your opinion (1 most important, 2 less then 1, and so on up to five ranks)

(a) High cost NA NImp Imp VImp Rank________

(b) Maintenance problems. NA NImp Imp VImp Rank_______

(c) Not enough saving potential. NA NImp Imp VImp Rank_______

(d) High payback period. NA NImp Imp VImp Rank_______

(e) Lack of technical expertise. NA NImp Imp VImp Rank_______

(f) Experts / consultant not available. NA NImp Imp VImp Rank_______

(g) Implementing agency not available NA NImp Imp VImp Rank_______

(h) Financing not available. NA NImp Imp VImp Rank_______

(i) No application in hotel. NA NImp Imp VImp Rank_______

(j) No barrier. NA NImp Imp VImp Rank_______

(k) Others (please specify)

D. Preferences and policy measures

(1). Method of conservation:

Retrofitting: It refers to up-gradation of exiting equipments by replacing only few components or part of the system (for example chiller pumps in an air conditioning system) to improve the energy use efficiency. The energy savings over a period of time as a result of retrofitting pay for the cost of the component / replaced.

(i) Are you willing to get your equipment (such as boilers, air conditioning systems) retrofitted to improve their energy efficiency?
Yes / No

(ii) If your answer is yes, what maximum payback period (the time in which your investment gets recovered from savings in energy consumption) is acceptable for you?
(a) One year or less (b) Up to five years (c) More then five years also acceptable

Replacing equipment / systems: if refers to switching over to more efficient equipments / systems. For example changing the complete air conditioning system, boiler etc. Economics analysis is carried out to find out pay back period of the efficient system.

(i) Are you willing to get your equipment (such as boilers, air conditioning systems) replaced to improve their energy efficiency?
Yes / No

(ii) If your answer is yes, what maximum payback period (the time in which your investment gets recovered from savings in energy consumption) is acceptable for you?

(a) One year or less (b) Up to five years (c) More then five years also acceptable

Adding new systems: this refers to addition of new systems or equipment that helps achieve reduced energy consumption. For example, occupancy sensors in guest rooms to switch off lights and other appliances automatically when room is not in use, building automation system etc. Building automating systems are computer based building energy management systems that regulate air conditioning, heating, lighting and other energy consuming functions. Such systems also payback the investment through savings in energy consumption.

(i) Are you willing to add new systems such as building automation system, occupancy sensor systems to improve energy use efficiency?

Yes / No

(ii) If your answer is yes, what maximum payback period (the time in which your investment gets recovered from savings in energy consumption) is acceptable for you?

(a) One year or less (b) Up to five years (c) More then five years also acceptable

Demand shift:

(a) In case difference in “peak” and “off peak” rate of electricity increases, will you be able to shift some of you energy consuming activities to “off peak” hours? (For example laundry, thermal energy storage for air conditioning etc.).

(i) Yes (ii) No (iii) Do not know

(b) If your answer is yes, what activities do you have in mind?

(c) Approximately what “peak” to “off peak” ratio of electricity rates will be required to shift these operations?

(i) 1.5 : 1 (ii) 2 : 1 (iii) above 2 : 1 (iv) Can not say

Ranking you preferences

Rank your preference (1 to 4; 1 most preferred, 4 least)

	Rank
Retrofitting	______
Replacing	______

Adding new systems ______

Demand shift ______

(2). Policy measures

(i) Financing:

Please indicate order of preference (1 most preferred, 2 second most and so on)

Rank

1. You will arrange your own financing ________
2. You will require financial arrangement (such as banks, financial institutions etc.)_____
3. You will prefer ESCOs to do the job________
4. any other method (please specify)_______

(ESCOs refers to Energy Service Companies. It is a novel concept in which an ESCO will contract to carry out the modification / replacement for you at their cost. The ESCO will recover the cost from the savings in your energy bill over an agreed period of time.)

(ii) Institutional mechanism:

Ranks your preference for the agency to implement energy conservation / DSM measures (1 most preferred, 2 second most and so on)

Utility __________

Energy service companies _________

Governmental agency ________

Experts / Consultants _________

Financial institution ________

No need of any agency _______

Others (please specify and rank) _____

(iii) Other policy measures for energy conservation: Circle importance of the measures for implementation of energy conservation / DSM measure as per following scale:

Not Relevant (NRel)

Not mush important (NImp)

Important (Imp)

Very important (VImp)

Also rank top five measures that are most important in your opinion (1 most important, 2 less then 1, and so on up to five ranks)

(a) Energy audits NRel NImp Imp VImp Rank_______

(b) Technical assistance NRel NImp Imp VImp Rank_______

(c) Financial incentives NRel NImp Imp VImp Rank_______

(d) Seminar and workshops on energy conservation / DSM NRel NImp Imp VImp Rank___

(e) Energy conservation literature availability NRel NImp Imp VImp Rank_______

(f) Awareness campaigns through media NRel NImp Imp VImp Rank_______

(g) Education / training programmes NRel NImp Imp VImp Rank_______

(h) Availability of experts / consultants NRel NImp Imp VImp Rank_______

(i) Availability of financial from banks / financial institutions NRel NImp Imp VImp Rank_

(j) Availability of institutional mechanism such as ESCOs NRel NImp Imp VImp Rank___

Are you willing to participate in the PART III of the survey?

This involves some data collection as per enclosed questionnaire to evaluate a few specific measures for energy conservation / DSM?

A sample sheet of the part III of the questionnaire indicating type of data needed for detailed analysis of options is enclosed.

Yes / No

If yes, we will get in touch with you

PART III: ENERGY CONSUMPTION DATA.

1. Electricity consumption 20xx

	No of units	Cost	Demand charges	Total cost
January				
February				
Mach				
April				
May				
June				
July				
August				
September				
October				
November				
December				

2. Fuels consumption 20xx (if any, such as diesel etc.)

	Quantity in litres	Cost
January		
February		
Mach		
April		
May		
June		
July		
August		
September		
October		
November		
December		

3. if sub metering exists, consumption of air conditioning plant:

	Number of units
January	
February	
Mach	
April	
May	
June	
July	
August	
September	
October	
November	
December	

4. Utility rates for electricity

Demand rates	
Energy rates	

5. Average occupancy percentage for 20xx

	Single	Double	Suites
January			
February			
Mach			
April			
May			
June			
July			
August			
September			
October			

November			
December			

Air conditioning load of the hotel (and month)

Peak load:______________TR; months:____________

Description	Chiller pumps	
	Chilled water pumps	**Condenser water pumps**
No in operation and Standby		
Flow rate(GPM)		
Head		
Electrical rating (HP)		
Make and year of installation		
Approximate efficiency (if data avail)		
Chiller supply water temperature		
Chiller return water temperature		

Method of air conditioning of guest rooms:	
Through air ducts with cool air	
Through chilled water supply to fan coils units in the rooms	

Temperature and humidity that is normally maintained:

Typical temperature readings for:			
	°C / K (degree Celsius)		°C/K (degree Celsius)
lobby		Corridors	
Business centre		Club bar	
Health centre		Club library	
Hair-dressing saloon		Guest room	
Coffee shop		restaurants	
Shopping centre			

Details of other air conditioning in the hotel:

Are there other air conditioning units other than central unit? Yes / No

If Yes give following details:

Type of unit		rating	
Capacity electric		Hour of use	
Make and year of installation		Area served	

Details of boiler and hot water consumption:

Make and year of installation of the boiler					
Fuel used					
Specifications (please tick appropriate box)					
Steam pressure		Flue gas temperature		Feed water temperature	
Typical steam generation rates(on low and high fire both)					
Current efficiency (in case figure is available)					
Blow down steam / day (kg)					
Daily hot water consumption in the hotel (liters / day)					
Guest room		Laundry			
kitchens		Other (pl specify)			
Total					
Laundry data					
Total load of linen garments processes					
Laundry wash cycles and water temperature in each cycle					
Distance between boiler room and laundry					
Type of shower fittings in guest rooms and water supply rate					

APPENDIX B: PROPOSED 'SELF HELP' GUIDE FOR THE SOUTH AFICAN HOTELS

Introduction

The aims of this guide is to help hotel introduce energy or environment management as an extension to the daily running of hotel which does not need considerable additional time or money.

This guide seeks to help hotels star planning and take simple practice actions. It suggests a straight forward approach with good planning and regular monitoring and contains a range of checklist and benchmarks. There are simple for hotels to set and achieved their own objectives and targets.

The guide is organized into three parts:

Part1: getting started shows how a hotel can start an energy management (EM) program and provides the basis concept and plan of action.

Part 2: 'Self-help' guide provides checklists which are in two parts, one for general good housekeeping practices and the other for good engineering practices. These checklists are also needed for energy management and ISO 50001 requirement. As tools for champion and setting targets, benchmarks for energy management are also provided.

Part 3: Approaches for long-term benefits are provided which can help hotels to achieve EM and ISO 50001 through energy management.

Part 1 and part 3 have been introduced and elaborated in chapter 5. In this appendix, the checklists for energy management practices in hotel are presented as part 2 of the guide.

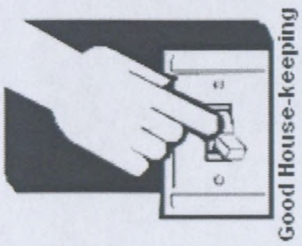
PART I: GETTING STARTED

Refers to chapter five (section 5.6.2.1.1)

PART II: "SELF-HELP" GUIDE

1 Good Housekeeping Practices

This section is intended for staff working in a hotel to guide them in their routine work in implementing 'good housekeeping' practices, which can reduce resource uses and costs. This section is set up in the form of checklists covering Energy Management issues only.

	Energy Management Checklist
Items	***Action to be taken***
General	• Use key tag or key card to switch off guestroom power, except mini-bar
Building Envelope	• Ensure that roof, ceiling and glazing are free from leaks. Otherwise seal the holes and cracks to prevent heat coming into the hotel building • Use screening to reduce sunlight into the building • Ensure that drapes and/or blinds are closed when a room is not occupied
Lighting System	• Regularly clean lamps, luminaries and surrounding surfaces in order to achieve the maximum exploitation at any time • Switch off lights when not in use in case of no automatic control system • Regularly replace the starter of florescent fixture for every two times of lamp changing • Reduce lighting levels to meet actual needs in locations where levels are more than required (during late night and daylight hours) • Use natural light where possible, but avoid heat again • Use efficient lighting fixtures (reflectors, louvers, housings) • Replace incandescent lamps with high quality compact fluorescent lamps(CFL) • Use high-frequency energy-efficient electronic ballast (about 20% less electricity use than conventional magnetic ballast) • Replace 36 mm diameter fluorescent tubes (40 W) with 28 mm tubes (36 W) to save 4W of power but provide the same lighting output • Request guests to participate in energy saving programmes, e.g., switching off lights when they go out

	• Use energy saving light bulbs (CFL) and fluorescent lights in areas which require many lighting hour (>8) a day • Use lamp shades which allow light to pass through
Air-Conditioning System	**General:** • Reset guest-room temperature during housekeeping, and close curtains to reduce solar gain • In consultation with engineering staff, ensure that temperature and fan speed settings for room thermostats are correctly adjusted • Place air-conditioning at low temperature when the room is not in use • Close the room windows, doors when the air-conditioner is on • Regularly lean the evaporator and condenser tubes (monthly) • Close all windows and doors to stop air leakage • Clean or replace air handling unit filters monthly and cooling coils every 6 months • Clean supply air and return grills at least every 6 months • Avoid placing objects in front of grills since it restricts air flow • Notify Engineering Department of all leaks immediately **For Chillers:** • Ensure that all chillers are in good working order through regular maintenance. • Check for any leakage of refrigerant (in chiller) and water (in condenser) • Stop all associated water pumps when a chiller is shut off. **For Air-Side Equipment:** • Never cool to an unnecessary low level: For summer air conditioning, the recommended comfort temperature and humidity are 25 - 26 C and 50 % respectively. • Turn off air conditioning, lights and equipment when the room is not in use. • Assign a person responsibility for turning off air conditioner, lights and equipment at each shift. • Close all windows and doors to prevent loss of air conditioning. • Clean HVAC systems regularly to reduce electricity consumption
Water Heating System	• Do not operate boilers below 30-50% of the designed capacity to avoid low efficiency • Maintain feed-water quality to the boiler • Reduce the temperature of the heater that supplies hot water to the guestroom to 50-60 'C • Maintain hot water temperature at 60-70°C in laundry
Kitchen	**General:** • Turn off or turn down kitchen equipment, lighting and ventilation, when not in use

	• Adjust water flow and temperature to different requirements • Keep kitchen clean at all times to reduce the water needed for cleaning at the end of the day • Clean daily and check frequently all kitchen equipment to maintain efficiency • Turn heat to lower levels once boiling point has been reached • Use hot water for sanitation only when necessary • Avoid storing items in front of evaporator coils and fans which restricts air circulation **For stove:** • Cover pots with lids to prevent heat from escaping (two-thirds energy savings are possible) • Use a pressure cooker when appropriate (50-75% energy saving) • Keep metal grease plates under burners clean, or line them with aluminum foil, to reflect heat more effectively up to the cookware • Keep heating equipment together and away from cooling equipment **For electric oven:** • Cook several dishes at the same time, or cook larger portions and reheat for another meal • Turn the oven off a few minutes before the food is ready, the oven will remain hot enough to finish cooking the food • Bake with ceramic or glass pans which will allow to lower the oven temperature • Preheat large ovens (10-15 minutes) and fryers (5 minutes) in minimum time before they are to be used **For microwave oven:** • Microwave ovens use up to two-thirds less electricity than conventional electric ovens, and are particularly effective for reheating meals • Keep inside surfaces clean so the microwave radiation can reach food effectively • Avoid defrosting food in the oven for food refrigeration: • Locate refrigerators and freezers away from heat sources • reduce the time and number of times refrigerator/freezer doors are open • Never put hot food in refrigerator • Regularly defrost the refrigerators and freezers • Defrost food in refrigerators or cold rooms with positive temperatures to thaw food more easily and help reduce power demand for the refrigerator • Consolidate food storage in refrigerators and walk-ins • Turn off the lights in cold storage rooms • Make sure all doors close properly and gaskets are tight
<u>Laundry</u>	• Dry at full load, but do not overfill the machine • Ensure the outside dryer vent close tightly to prevent outside from leaking in which will increase cooling load • Use solar energy for drying(directly exposing clothes under sunlight)

Office Equipment	• Use e-mail and Internet: E-mail and Internet offer great potential to eliminate much of the hard copy production and duplication of information(i.e. documents, bulletins, books etc) • Switch off all equipment (TV, Lights) when it is not in use. • Use Energy Star labeled equipment such as computer[3], photocopier[4], printers and fax machines[5], scanner[6] to automatically enter a low power sleep mode after a period of inactivity. **For Computers, Monitors and Printers** • Switch off Computers and Monitors when not in use (for example lunch time) • Do not leave printers switched on when not needed **For Photocopiers** • Install them outside of air-conditioned area if possible. • Reduce the amount of photocopying by circulating documents using notice boards or e-mail

2 Good Engineering practices

This section, which is intended specifically for engineering staff in a hotel to be included as part of their responsibilities, is set up in form of checklists covering 2 issues:

a) Documentation and Control
b) Energy Management

 Good Engineering	Energy Management Checklist
Documentation and control	
Items	*Actions to be taken*
	• Post stickers and posters on staff notice boards to draw attention on the significance of energy, water and materials savings • Adopt continuous commission to maintain operational requirements and system efficiency • Conduct hotel audits annually, to indicate the resource use of profiles and show significant changes in key areas

 Good Engineering	Energy Management Checklist
<u>General</u>	• Whenever budgets permit, install electricity meters for monitoring the energy used by major loads • Calibrate measurement and control devices, e.g., thermostats, flow meters, regularly as per manufacturer's instruction. • Carry out preventive maintenance work regularly (in accordance with the hotel preventative maintenance programme) in order to improve operating efficiency and reduce equipment failure rate. • Use key room control to switch off power and guest room lightning, to ensure that energy is not wasted in rooms when they are not occupied

Building Envelope	• improve the insulation to reduce heat transfer to the hotel building
Lightning System	• Replace the lamps when their output has depreciated by around 30% (use a flux meter to check luminance levels) • Introduce dimmer switches • Consider installing infrared sensor controls to switch off power when the space is unoccupied
Air-Conditioning System	• Properly insulate the pipes and ducts carrying the cold fluids to avoid heat gains from the surrounding • Use as high a proportion of recirculated air as possible For Chillers: • Ensure that chilled water flow rate through each chiller is as specified by the manufacturer (lower flow rate and improper setting valve lead to lower efficiency) • Ensure that the chilled water bypass valves are fully closed when pressure difference does not exceed the pre-set value. • Do not set chilled water supply temperature too low (at least 7˚C) and maintain a minimum temperature rise of 5˚C between the supply and the return line. • Always use the chillers with higher COP first in case there are many chillers in operation • Avoid the operation of chillers as part loads to the fullest extent as compression chillers have very low efficiencies as part loads. For Air-side Equipment • Ensure a positive internal pressure in the building relative to atmosphere pressure to minimize infiltration of untreated outdoor air. • Look for reducing fresh air supply in partially occupied ballrooms as the air supply is designed for maximum occupancy. • Fine tune the control of all air handling and fan coil units to ensure proper distribution of cooling air needs[3]
Water Heating System	• Adjust air-fuel ratio through fuel rate and a air damper opening to achieve optimum combustion, minimum CO concentration in flue gas, and high efficiency • Use condensing gas boilers which are the most efficient type of boiler with thermal efficiencies of 90% or more and the incremental cost can be recovered in around two years
Kitchen	• Use thermometers or timers to avoid over-cooking • Do not cover oven racks with foil - this reduces heat flow and increases cooking time
Laundry	• Avoid over-drying clothes. Use moisture sensor if there is one on the machine.
Office Equipment	For Photocopies:

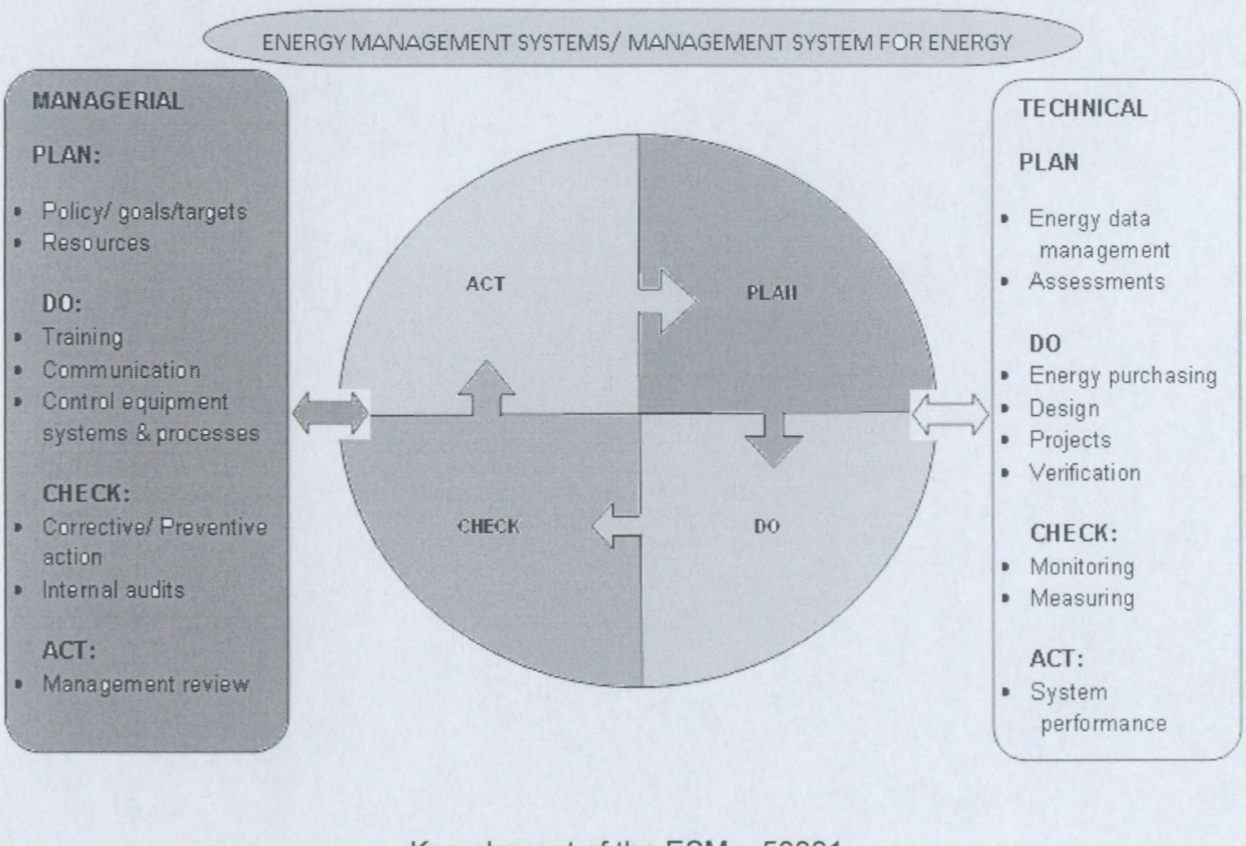
	• Fit a timer to prevent photocopies being left on overnight
Toilet	• Install automatic controls on hand dryers / urinals • Install occupancy sensors to lights and fans
Facts to consider: **In Energy Management: 'You can't manage what you don't measure'**	

Source: P3U-GTZ, 1998; UNEP/ IHA/ IHEI, 1995, HKPolyU, 1996, IHRA and UNEP, 1995.

PART III: APPROACH FOR LONG-TERM BENEFITS

This part is designed to introduce long-term benefit from implementing energy management system and ISO 50001 (as international certificate)

Normally, the hotel are interested in ISO 50001 standard as providing an international certificate for continual improvement of energy performance. In fact, ISO 50001 describes the basis requirements of an Energy Management System (ESM) which is the standard that the hotels will implement and the standard to which they will either self-declare conformance or seek third-parti registration. The basic model for this ESM or MSE –ISO 50001 includes a two- step process with sequence of "Plan – Do –Check – Act":



Key element of the ESM – 50001

Source: Risser, (2009)

It is observed that the ESM – 50001 standards is not so difficult for hotels to achieve because it does not require the actual implementation for improvement, but require well documenting of procedures, records and evidences for commitments of continual improvement of energy performance. Therefore, ESM standards are process –not performance – standards. They do not impose any energy performance to be achieves. Instead, the standards describe a system that will help the hotel to achieve its own objectives and targets. The basic assumption is that *better energy management* will lead directly to a *better energy performance*.