Chapter 8

Managing Energy Demand in Buildings through Appropriate Equipment Specification and Use

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Additional information is available at the end of the chapter

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Abstract

The high demand for electrical energy in virtually all human endeavour has engendered the continuous rapid growth of electricity production, transmission and distribution worldwide. Every habitable building structure usually requires electrical appliances and mechanical systems such that the cost of electrical and mechanical installation in a building is generally between 10% and 35% of the total construction cost. This chapter examines the equipment used for electrical, mechanical and lighting systems in contemporary buildings in Cape Town, South Africa, towards determining those materials and equipment aiding energy efficiency in these buildings. The research employs a multiple case study approach, consisting of recently completed buildings. The study established that the equipment used in these contemporary buildings to effect a reduction in energy consumption are compliant with the main specifications and policies guiding energy efficiency in buildings in South Africa and that owners of the Case Study buildings obtained a significant reduction in power consumption as a result of the installation of the identified equipment. Based on these findings, the study concludes that a building that is compliant with energy efficient systems installation standards will experience a significant reduction in utility bills, and savings for commercial buildings and private property owners.

Keywords: efficiency, energy consumption, energy demand

1. Introduction

Globally, the demand for energy-powered services (energy efficiency and embedded generation) is growing [1]. Modern technology favours the use of electrical energy due to its numerous technical and economic benefits when compared to other forms of energy. The cost of electrical and mechanical installations in buildings is usually in the range of 10–35% of the total new building construction cost [2, 3]. Electrical and mechanical installation consists of electrical services, fire protection, plumbing, vertical transport and heating, ventilating and air-conditioning (HVAC) [3]. The cost of electricity in commercial buildings is very high due to high energy utilisation factor. According to Mobley [4], commercial building owners spend 22.4% of their operating costs on utilities (energy and water). Electricity prices are expected to rise in South Africa until they reflect the costs of the new infrastructure built to generate electricity to deal with the country's energy gap. According to GreenCape [1], the global market for energy services is driven by growing awareness of the impact of carbon emissions, rising electricity costs and increased financial returns arising from energy investments. This chapter examines the equipment used for electrical, mechanical and lighting systems in selected contemporary buildings in Cape Town; how these are specified; power demand and energy consumption in buildings and its relationship to energy bills; and steps for determining equipment that aid energy efficiency. Four case studies consisting of commercial buildings (offices and hotels) located in Cape Town were used as sources of primary data. The method of data collection used in the study include interviews, with building owners, on-site inspections and records (architectural, mechanical, electrical and plumbing drawings) that show how certain equipment and system have been used to advance energy efficiency (generation and conservation) in the buildings.

2. Outline of buildings used in the study

The buildings used in the study are contemporary buildings located in Cape Town. The justification for the use of these buildings are that the building must have been completed within the last 5 years and were designed based on 'green' building principles with the anticipation of attaining a 'green' building rating score. Three of the buildings used in the study were awarded green star ratings on completion. A description of the buildings used in the study is outlined below.

2.1. Case study A

Case study A is a 11,624 m^2 six storey hotel with a seemingly simplex layout, designed in an L-shape. The hotel owner strives to minimise the hotel's carbon footprint and decrease energy utilisation. As a result, this building has many highly advanced innovative systems including 3 kW wind turbines, photovoltaic panels, vegetated green roof, geothermal loops, occupancy sensors and regenerative lifts, imported from all over the world and installed to minimise the day-to-day running costs of the hotel.

2.2. Case study B

Case study B is the new Head Office building for an oil and gas company. The building situated in Cape Town, achieved the first 'green' certification in the industry category of refiners and marketers of petroleum products in South Africa. The building is a 9000 m^2 five levels (1 basement, ground, mezzanine, 1st and 2nd floor) in a square form. The building is a framed structure comprising of a large central courtyard. The project team sought to achieve energy conservation through the reduction of reliance on nonrenewable energy sources and the necessary criteria of the Green Building Council of South Africa. A fully integrated DALI lighting system, complete mechanical ventilation to all usable areas and the basement and a sub-metering system are equipment used in the building to enable a reduction in energy consumption.

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2.3. Case study C

Case study C is a newly developed office building located in Cape Town. The building is an 18,600 m^2 office building, with approximately 500 m^2 retail and 455 car parks extending over two basements levels. The building is a ground breaking project in the South African context as it is the only 6-Star Green Star SA-Design and as Built certified building in South Africa. The idea for the building came about and was driven by the unique combination of the developer and tenant. This chapter will discuss the initiatives such as a Sea Water Cooling System, an ICT system that monitors energy and water use, a lighting system that will ensure that lighting is only used when required and a green roof that contributes to thermal roof insulation, implemented in order to obtain Green Star points, as well as detail how they operate in order to mitigate the carbon footprint of the building.

2.4. Case study D

Case study D is a 124 m high, 34-floor multi-story office building located in a prime location on the Cape Town foreshore. The building has a footprint of 114,547 m^2 comprising of office space, seven parking levels, an atrium and a Sky plaza. The building was awarded a 5-Star Design rating under the Green Building Council of South Africa's Green Star rating system, making it the first 5-Star Green Star skyscraper in the country. A significant amount of engineering, planning and innovative forward thinking had to be carried out by the professional team. The professional team has focussed on energy reduction initiatives, through the adoption of an efficient air-conditioning system and application of LED lighting fittings throughout the office space.

3. Overview of equipment used for electrical, mechanical and lighting systems in the case study buildings

The public power generation company in South Africa Eskom is the main supplier of electricity to the buildings studied. South Africa is in the midst of an energy crisis that is resulting in rising energy prices, rolling blackouts (known as load shedding in South Africa) and changing energy policies and incentives [1]. Power outage/load shedding comes with significant costs to businesses that are unable to operate during periods of power outage shutting down production at companies [5], and causing inconveniences to residents [6]. As a result of this, end users in the commercial building sector (offices and hotels) have begun exploring alternative energy options through the use of appropriate equipment [1]. The case study buildings generated additional power from solar panels, wind turbines and a regenerative lift. Electrical appliances and mechanical systems are required in buildings to make the building habitable. Initiatives such as sea water cooling air-conditioning units, displacement ventilation units, geothermal loop systems, LED lighting, automated lightning and electronics that automatically turns off when rooms are unoccupied (occupancy sensors) were implemented to reduce operational costs. The power-generating equipment together with other energy saving techniques is said to reduce the consumption of electricity from the mains by 35–94% each year (field survey). In the event of a power outage, electrical energy from the batteries can be used to run buildings for at least 30 min (field survey–case study A), which gives the generator time to start.

3.1. Electricity generation equipment

The photovoltaic solar panels, wind turbine and regenerative lifts discussed in this section are used as alternative means of electricity generation in case study A (hotel building) to reduce the reliance of the hotel on public power supply. These equipment are examples of alternative forms of electricity generation, which make it possible to reduce energy demand in buildings and increase energy efficiency.

3.1.1. Photovoltaic solar panels

Case study A makes use of a number of solar panels to generate electricity. The 240 W photovoltaic solar panels, as shown in **Figure 1**, are produced locally in South Africa and have an anticipated production of 78,000 kWh/year. The panels are connected in series and positioned on the buildings to face the North-East in order to ensure that the panels maximise the sun energy. The system includes an Afrisum Karoo 70 KVA Grid tied inverter as shown in **Figure 2**, installed to serve as the core of the solar energy installation system, as it harvests the energy captured by the solar panels, and a battery bank for energy storage, and a charge controller that regulates the power flow into and out of the battery bank. Battery banks are typically sized in order to provide energy during days of no or limited sunshine.

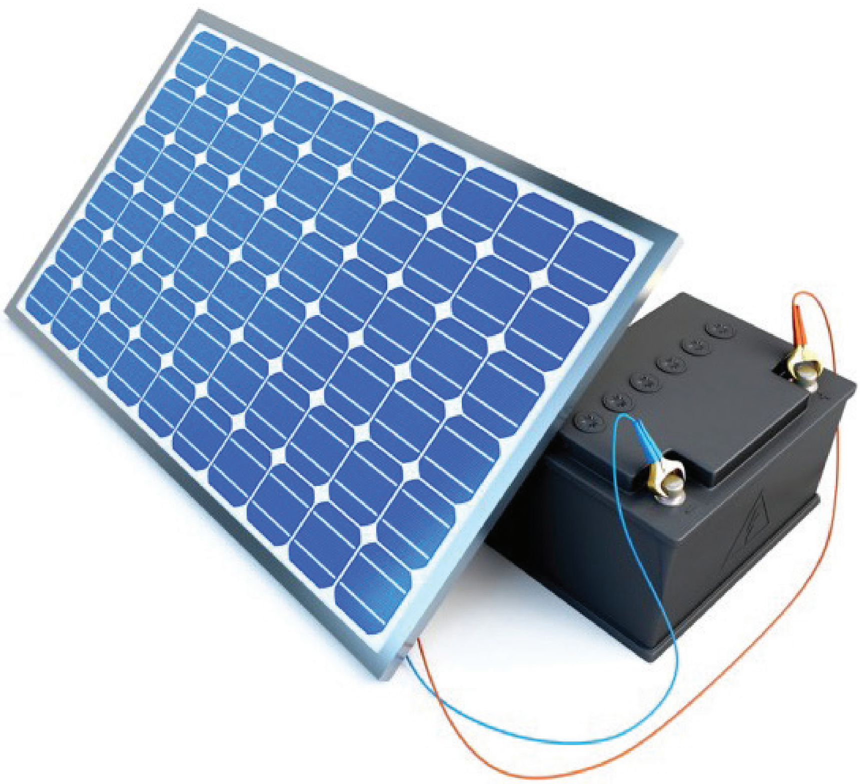

Figure 1. 240 W photovoltaic solar panel.

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Figure 2. Afrisum Karoo 70 KVA Grid Tied Inverter.

3.1.2. Huebner-Giessen 3 Kw wind turbine

Three vertical axis wind turbine that convert wind into electricity were installed in front of case study building A at a height of 17 m to maximise output as shown in **Figures 3** and **4**. Cape Town is well known for the high amount of wind that it generates. Therefore, using wind turbines as a power generating system generates power without using fossil fuels or producing gasses or toxic waste. Location is critical for the use of wind turbines since buildings can obstruct the wind flow. These turbines use the wind, a renewable energy source, to contribute 9 kWh to the hotel by converting wind energy into electrical energy. Although the wind turbine does not generate a lot of energy, it makes a small change and creates social awareness about alternative sources of energy.

Figure 3. Huebner-Giessen 3 kW wind turbine here.

Figure 4. Huebner-Giessen 3 kW wind turbines.

3.1.3. Regenerative elevators

An elevator can account for 5–10% of the energy consumption of a building. In case study A, there are regenerative energy drives on all elevators. Energy is saved by installing energy-efficient lifts fitted with regenerative drives and brake system which recapture 30% of the input energy and feed it back into the building. This follows the principles that in order to move an elevator, energy must be produced to accelerate the lift. Likewise, energy must be removed in order to decelerate the lift as shown in **Figure 5**. Twin Kone elevators fitted with a regenerative braking system were installed in case study A.

When using a mechanical brake, the removed energy is wasted in heat. A cooler will therefore be required for the machine room. By contrast, a regenerative motor will recover potential energy stored from an elevator's use and feed it back to the unit as electricity. The elevator utilises this surplus energy and transfers it back into the building's electrical system for use in other areas. More specifically, the regenerated energy is connected to a battery storage bank that houses large batteries and charges the batteries as the lift brakes.

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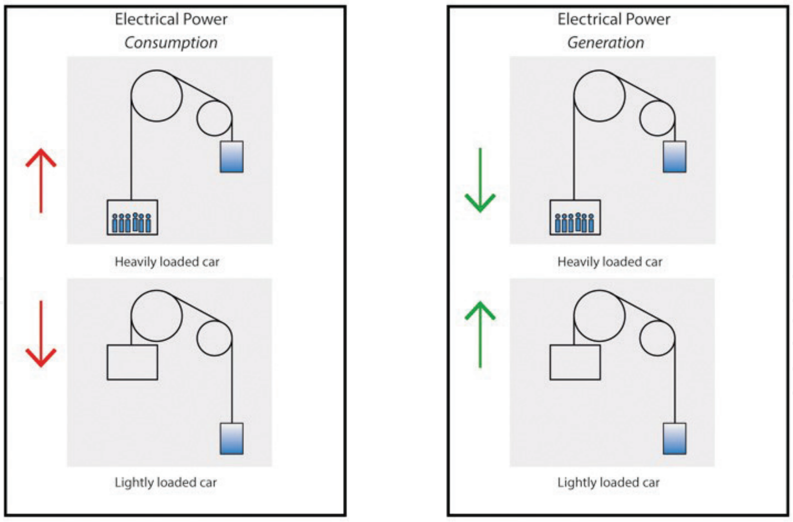

Figure 5. Electricity consumption versus generation.

The gearless traction machine, control panel and vector-controlled system are installed within the hoist pathway located on the side wall of the lift shaft as shown in **Figure 6**. This arrangement of equipment frees up space normally required for separate machine rooms. The use of regenerative lift technology targets significant savings in energy costs, financial and reduction in environmental impact.

Energy received from the mains, solar panel, wind turbines and regenerative drive lift installed in case study A is stored in a battery room as shown in **Figure 7**.

3.2. Typical mechanical equipment used in the selected buildings for energy conservation

Mechanical equipment used in the buildings, apart from the regenerative lift shown in **Figures 5** and **6**, include a sea water cooling system used in case study C and mechanical ventilation systems used in case studies B, C and D. These are further described in this section.

3.2.1. Sea water cooling system

A sea water cooling system in which cold sea water is used for cooling units of the air-conditioning plants as shown in **Figure 8** was installed in the basement of case study building C. Unlike ordinary water-cooled air-conditioning systems, which make use of cold potable water, this air-conditioning system makes use of cold Atlantic seawater drawn from the harbour, where the water is normally between 14 and 16°C through a titanium plate heat exchanger [7]. This cooled water is then used to cool down the chiller plant when it rejects heat from the building. The sea water cooling plant was a radical intervention used by members of the project team in solving the problem of energy conservation when cooling the building.

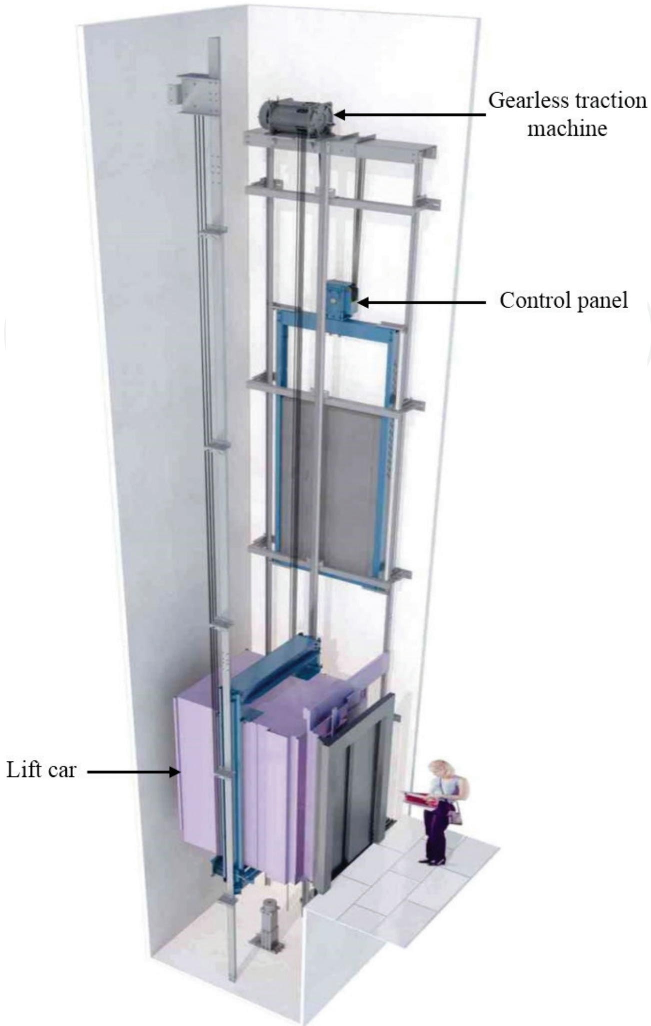

Figure 6. Traction less elevator shaft detail.

Figure 7. The batteries used to store generated energy.

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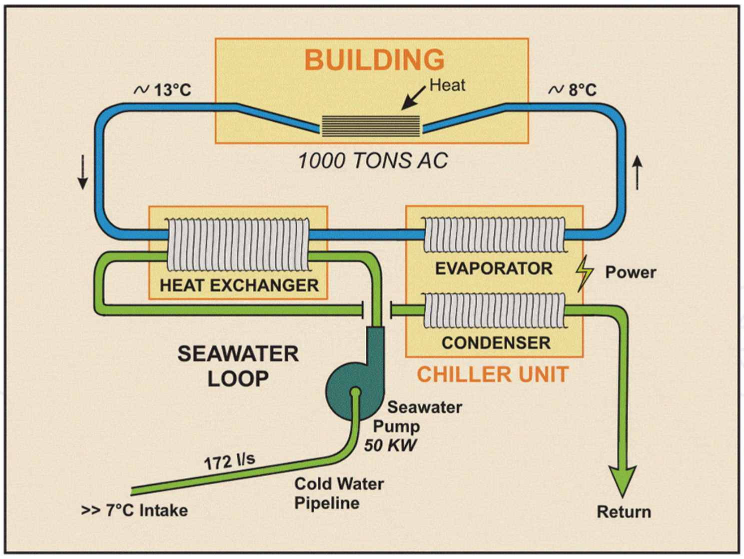

Figure 8. Diagram of sea water cooling system [8].

3.2.2. Displacement ventilation

Case study building C makes use of air handling equipment placed at intervals on the roofs as shown in **Figure 9**. A mechanical inlet and mechanical extract system that provides air at slow velocities as opposed to the usual high speed velocities are used to regulate and balance the supply and emission of air. The air in a room is circulated based on the following process—cool air is sent through a diffuser, the cool air is warmed by body heat and rises, creating an upward convection that draws fresh air across individuals, the warmer used air and pollutants are extracted at ceiling level, the air handling equipment recovers wasted energy, wrings out moisture and slightly cools fresh air, which is then delivered into the building through a diffuser. Due to this innovative ventilation system, it is found that the internal environmental air quality within these buildings is very good and reportedly 150% better than the legislated standard [9].

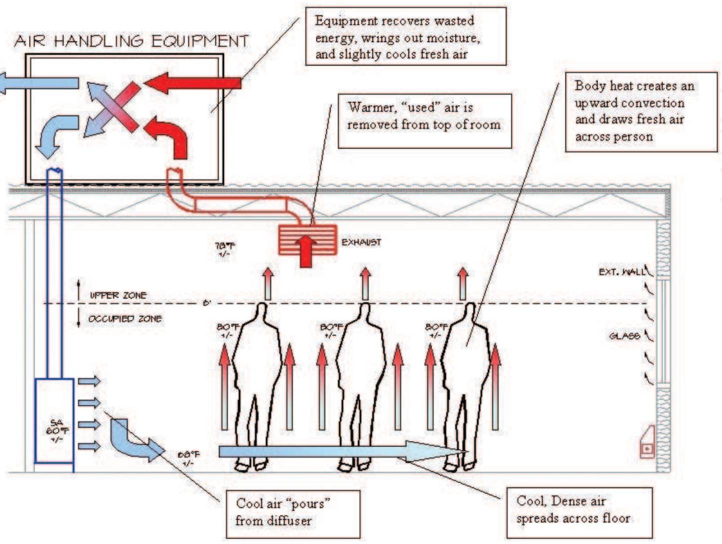

Figure 9. Displacement ventilation [10].

The use of a ventilation system that ensures sufficient supply of fresh air is used in case study B. Economy cycle technology is used for the air-conditioning fans, which determines the quantity of fresh air required and then also recycles a quantity of cooler return air, which reduces the energy used in cooling the air. Variable speed fans are used in delivering air to the building at the rate needed to circulate the conditioned air. Since case study B is long both on the East and West side, at certain times during the day, the building experiences both heat loss and gain at the same time in different areas. The HVAC system will be notified of this through the Building Management System (BMS) and adjusted through building heat produced by chillers acting as heat pumps, thereby eliminating the need for less energy-efficient electric heating.

3.2.3. Geothermal loop system

The geothermal loop system installed under the foundation of case study A, comprise of four Alpha–Innotec ground source heat pumps, coupled to 100 boreholes each 76 m deep, into which high density polyethylene (HDPE) U-bend pipes are installed. Subsequently heating or cooling water would be circulated through these pipes. These pipes would be connected together using headers and linked to the ground source heat pumps which are the central system of case study A's heating ventilating and air-conditioning (HVAC) system. The geothermal loop system was imported from Germany since it is not available locally. Air-conditioning is a huge energy consumer for hotels and the geothermal system is alleged to reduce the energy consumption of case study A by about 25%. This system uses water to keep the ground temperature below case study A at a constant 19°C throughout the year and significantly reduce the energy used for heating and cooling water and also the energy consumed by air-conditioning equipment. The 100 holes and all the high density piping used for the geothermal loop installation were positioned with protective foam to prevent any damage to the pipes. The piping and holes are covered by the basement concrete surface bed which keeps all the piping protected and out of sight. The only visible equipment as shown in **Figure 10** is the 14 sub-header pipes that penetrate through the concrete surface bed and connected to the heat pumps which feed the HVAC system.

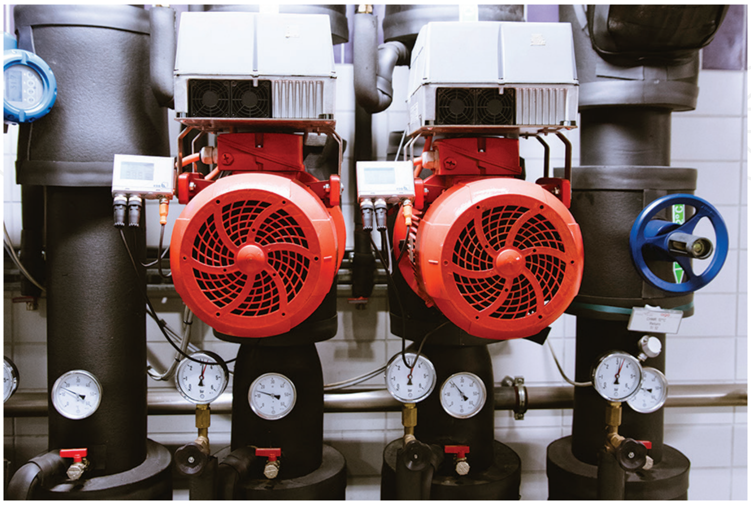

Figure 10. Geothermal loop system hole connections with valves.

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3.3. Common lighting system installed in the selected buildings

Digital Addressable Lighting Interface (DALI) lighting systems: Sophisticated lighting systems known as DALI are installed in case study B. The DALI lighting system is a two-way communication system that connects digital technology to lighting. The system allows the lights to communicate to the user, and allows the user to communicate back to the system using DALI regulators as shown in **Figure 11**, computers equipped with appropriate software or the appropriate Building Management System (BMS). This system allows the occupant to regulate the lighting with each light being individually addressable, which means each light can be dimmed or switched off depending on the users' preference. The DALI lighting system has sensors, which have a combination of being manually switched off and on and infrared readers which can sense if there are people in the building and automatically switches off the light if an area is not used.

Figure 11. Example of a Digital Addressable Lighting Interface (DALI) regulator.

Dali lighting systems have the ability to sense daylight in a specific area in the building and can automatically dim lights using artificial lighting and daylight to preserve luminance levels to reduce energy usage: this process is known as daylight harvesting. The lights are controlled by heavy materials such as gravel, sand or iron, which have high frequency regulators and produce no flicker or white noise. The use of these heavy materials in DALI lighting systems prevents the occupants from suffering eyestrain and headaches, which are caused by the older magnetic ballast installation lights. The additional benefit is a 50% reduction in energy losses due to ballast installation.

The lamps used by the DALI system are known as T5's (high frequency small diameter fluorescent lamps). It is acknowledged that these lights provide the highest industry standards in terms of lighting quality, colour, energy efficiency, with reduced maintenance costs and an average life span of 4 years per fluorescent. The lights can be dimmed to 10% of its total capacity when necessary thereby providing improved energy savings.

Occupancy/motion sensors for lighting were also installed in case study A, B, C and D in all public areas and stores. This system ensures that lighting is only used when required. When the space is not in use, the lights are automatically turned off and signalisation displays are dimmed. In addition, LED lights that use up to 80% less energy and last longer than conventional lighting is used in all the buildings.

3.4. Smart systems used in the selected buildings

Electricity sub-metering: An electricity sub-metering system is installed in case study B, in compliance with the proposed Smart Metering Standards (NRS 049) of South Africa. Electricity sub-metering measures energy consumption and provides users with the data necessary to monitor and control energy use in buildings. For example, if an area in a building is using a lot more energy for lighting than other areas, the building operator can identify this with the use of sub-metering and investigate the cause. Sub-metering identifies unnecessary equipment running at night or during the weekends, provides the ability to provide usage evidence to the operators and facility managers the same day and to provide operators with feedback the next day about implementing changes. With sub-metering, all areas and equipment in the building that use large amounts of energy are monitored. Energy meters for all main electrical equipment per floor and for lighting and minor power use, such as plugs, are linked to the Building Management System (BMS) installed in case study B, which saves data and can find averages and trends, enabling users to know when there is a problem in the lighting or power systems of specific areas.

Automated Building Management System (BMS): This system is used in monitoring energy and water use and efficiency. The BMS is installed in case study B to regulate the air-conditioning and lighting system to prevent energy wastage.

4. Equipment specification

Electrical, lighting and mechanical equipment in buildings are usually specified based on design calculations by the mechanical and electrical engineer and also in compliance with standards, policies and regulations subsisting in the country in which the proposed infrastructure/building project is located. Many buildings particularly old ones still make use of electrical, lighting and mechanical systems that are not energy efficient and eco-friendly.

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South Africa's electricity sector is regulated primarily by the National Energy Regulator of South Africa (NERSA), with the Department of Energy (DoE) as the custodian department. A number of standards and policies have been developed in South Africa to guide electrical equipment specification in buildings [4].

The key standards specified include the following:

SANS 10400-XA:2011 with SANS 204: These construction standards require that all new buildings and extensions to buildings are compliant with energy efficiency and energy use before receiving municipal approval.

SANS 941—Energy efficiency, energy performance and labelling of electrical and electronic apparatus: This standard covers energy efficiency requirements, measurement methods and appropriate labelling of energy efficiency electrical and electronic apparatus. This standard was published to ensure that at the time of purchase, buyers have all the relevant energy consumption information at their disposal. It also has implications for manufacturers and importers.

SANS 1544—Energy performance certificates for buildings: This standard specifies the methodology for calculating energy performance in existing buildings.

SANS 50010—Measurement and verification of energy savings: This standard was published in 2011 and specifies the methodology for calculating energy savings. This is a required tool for calculating savings for projects submitted on the 12L energy efficiency tax rebate programme.

VC9008—Compulsory specification for energy efficiency and labelling of electrical and electronic apparatus: This specification makes the SANS 941 a compulsory standard. It requires that a range of electrical and electronic apparatus adhere to certain minimum energy performance standards. It also requires that all appliances listed display the energy efficiency rating on the appliance.

Proposed smart metering standard—NRS 049 (advanced metering infrastructure): This specification will provide a standardised approach for municipalities and the electricity supply company of South Africa (Eskom) to follow. It will serve to describe the 'smart systems' which have been mandated for use by certain consumers in the Electricity Regulation Act.

The design team of case study B observed that lighting is the greatest energy consumer when compared to other building elements such as the air-conditioning system (as shown in **Figure 12**). Lighting is a continuous load that consumes a lot of energy. The design team therefore proposed a reduction of 94% in energy consumption in the case study B by introducing automatic lighting sensor systems an improvement on the requirements of SANS 204 of 2008, sub-metering systems and BMS.

The purpose of SANS 10400-XA:2011 with SANS 204 and SANS 941 is to ensure that buildings are more energy efficient, while SANS 1544, SANS 50010, VC9008 and NRS 049 is to ensure that energy consumption in buildings is effectively managed. Energy-efficient buildings translate into energy savings and less pressure on the public power supply and national grid, a reduction in power outages and rolling blackouts and ultimately the need for government to build new power stations, the attendant impact of power generation plants (either nuclear or coal powered through carbon emissions) on the environment is also reduced. The selected buildings complied with the key standards that guide electrical installation that aims at reducing energy consumption and conserving energy. For instance, case study A, B and C installed systems—wind turbines, regenerative lifts, geothermal loop systems and smart systems, with specifications above the minimum required is shown in **Figure 12**.

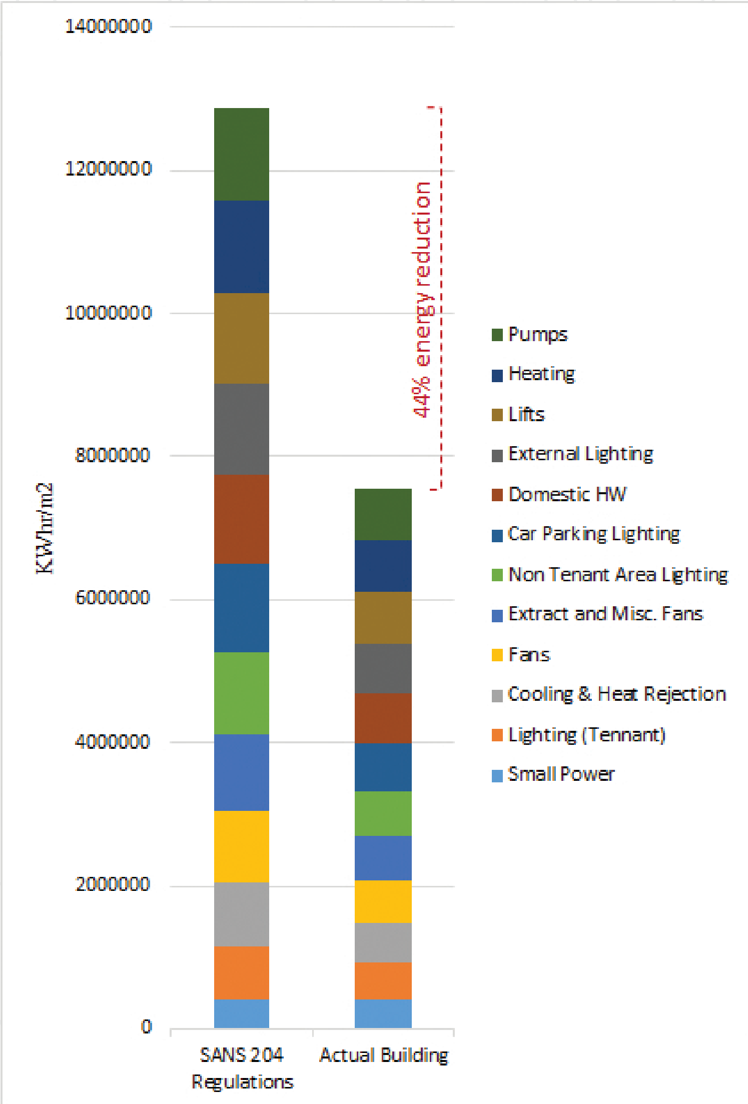

Figure 12. Energy consumption based on SANS 204 requirements vs. energy consumption in case study B.

Compliance with the standards outlined above will make it possible for buildings to attain targeted reduction in energy consumption when compared to conventional buildings that were

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constructed before the South African National Standards (SANS), which specifies minimum requirements for energy efficiency in buildings. The selected buildings targeted significant reduction in energy consumption. While the project team for case study A targeted a 25% reduction in energy costs above conventional building standards, those of case study B and D targeted 56% and 30% reduction in energy costs, respectively. Implementing and going above the minimum standards saw a substantial change in energy consumption in the selected buildings.

The key policies on energy efficiency include:

Energy White Paper of 1998: This paper requires energy policies to consider energy efficiency and energy conservation within the framework of the Integrated Resource Plan (IRP), in meeting energy service needs from both the supply and demand side. It identifies the need for demand side management and the development and promotion of energy efficiency in South Africa.

NEES 2005, (2008): This policy sets out a national energy efficiency target of at least 12% by 2015. Sector targets range from 9% for transport, through to 15% for industry, commerce and the public sector.

Integrated Resource Plan (IRP) 2010: Specific targets for renewable energy and energy efficiency are set out in the IRP 2010 policy. This policy's revised balanced scenario provides an overview of the proposed new-build options including renewable options. The policy also outlines the energy savings expected from demand-side management programmes.

A key regulation includes:

The National Energy Act (Act 34 of 2008): This Act was legislated in support of economic growth and poverty alleviation in South Africa, by ensuring that diverse energy resources are available to the economy in sustainable quantities and at affordable prices. The Act is in pursuant of the development of the Integrated Energy Plan (IEP). It takes into account the interactions among economic sectors and environmental management requirements.

5. Power demand and energy consumption in buildings and its relationship to energy bills

Power rating of electrical appliances is usually measured in Watts (W) whilst the rated demand is measured in Kilo Watts (kW). The unit of electricity consumed is measured in Kilo Watts Hour (kWH).

Therefore, if the rated demand of an electrical appliance is known and the length of time for which it is used is also known, it is possible to calculate the cost of the energy supplied to the consumer in order to reduce expenses made on electricity. **Table 1** shows the power demand and energy consumption of some domestic appliances.

S/No	Appliance	Type	Rating	Rated demand in kW	Rated current in AMPS	No of hours for 1 kWH
1	Lamp		40 W	0.04	0.2	25
2			60 W	0.06	0.25	17
3			100 W	0.10	0.4	10
4	Iron	Small	750 W	0.75	0.75	1.3
5		Medium	850 W	0.85	3.6	1.3
6	Toaster	Regular	1000 W	1.0	4.3	1
7	Kettle	Small	2000 W	2.0	8.6	0.5
8		Medium	3500 W	3.5	11	0.3
9	Water heater	50 L	1200 W	1.2	5.2	0.8
10		100 L	2500 W	2.5	11	0.4
11	Cooker (four plate)	Regular	8000 W	8	34	0.12
12		Large	10,500 W	10.5	45	0.1
13	Single plate cooker	Portable	1800 W	1.8	7.7	0.6
14	Fan	Table	0.08 HP	0.06	0.25	17
15		Ceiling	0.3 HP	0.22	0.9	4.5
16	Air-conditioner	Small	1.5 HP	1.1	4.7	1
17		Medium	2 HP	1.5	5.6	0.7
18	Refrigerator	Small	0.2 HP	0.15	0.6	7
19		Medium	0.25 HP	0.19	0.8	5
20		Large	0.3 HP	0.22	0.9	4.5
21	Transistor radio		5 W	0.005	0.02	200
22	Stereo system		100 W	0.1	0.4	10
23	TV (black & white)		200 W	0.2	0.9	5
24	TV (colour)		300 W	0.3	1.3	3
25	Vacuum cleaner	Small	700 W	0.7	3.0	14
26		Medium	900 W	0.9	3.9	1
27	Water pump	Small	745 W	0.745	3.2	1.3
28	Washing machine	Automatic	600 W	0.6	2.5	2
29	Ditto + heater	Automatic	3000 W	3	13	0.3

Calculated from: Watts = Amps (current) × Voltage.
And 1 HP = 0.75 W.
Source: Windapo and Windapo [11].

Table 1. Power demand and energy consumption of some domestic appliances.

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6. Determination of equipment that aid energy efficiency in buildings

Using the power ratings marked on the electrical, mechanical and lighting equipment (made mandatory as labels by SANS 941 in South Africa), it is possible to determine the equipment that optimises energy efficiency in buildings. The energy consumption level of the equipment can be compared to that of other comparable equipment. This can form the basis of value management and bringing about the improvement of energy performance in existing buildings.

7. Conclusion

This chapter examines the common equipment used in electrical, mechanical and lighting systems in four contemporary commercial buildings (offices and hotels) in Cape Town that aids energy efficiency. It was observed that photovoltaic panels, three 3 kW wind turbines and regenerative lifts were used in case study A as sources of energy generation, while geothermal loops and occupancy sensors were used in energy conservation. In addition, it was found that case study B employed an efficient lighting and sub-metering systems; case study C made use of a sea water cooling system, displacement ventilation, occupancy sensors and a BMS system; while case study D made use of LED lighting system and an efficient air-conditioning system. The study determined that the equipment used in these contemporary buildings are compliant with key specifications and policies guiding energy efficiency in buildings in South Africa. The chapter also presents an overview of power demand and energy consumption in buildings and an insight into how this is determined for household appliances and its implication for value management and energy efficiency initiatives. It was also observed that owners of the case study buildings were able to obtain significant reduction in energy consumption and running costs as a result of the installation of the equipment outlined above. Based on these findings, it can be concluded that energy-efficient equipment, which reduces energy demand in buildings, are widely adopted within contemporary commercial buildings in South Africa, in compliance with key standards, policies and regulations promulgated in South Africa to guide electrical equipment specification in buildings, with the main goal of achieving improved energy efficiency and reduction in energy consumed by buildings and by extension reduction in utility bills. This will provide significant savings for commercial buildings and private property owners.

Further studies that compares the energy demand of the equipment identified in this chapter to more conventional equipment is required. This will provide evidence to support the long-term energy savings/sustainability initiatives proposed by the government and private sector, and to present a business case for the use of these equipment in buildings.

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