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Energy efficiency in commercial properties

Eskom

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Energy efficiency opportunities in existing commercial properties

1. Introduction

Eskom's energy supply is still severely constrained and future demand is predicted to exceed supply unless energy consumers reduce their consumption. With the local commercial property sector currently consuming up to 15% of Eskom's energy output, commercial properties need to find ways to reduce their consumption, not only in the long term, but also in the immediate term.

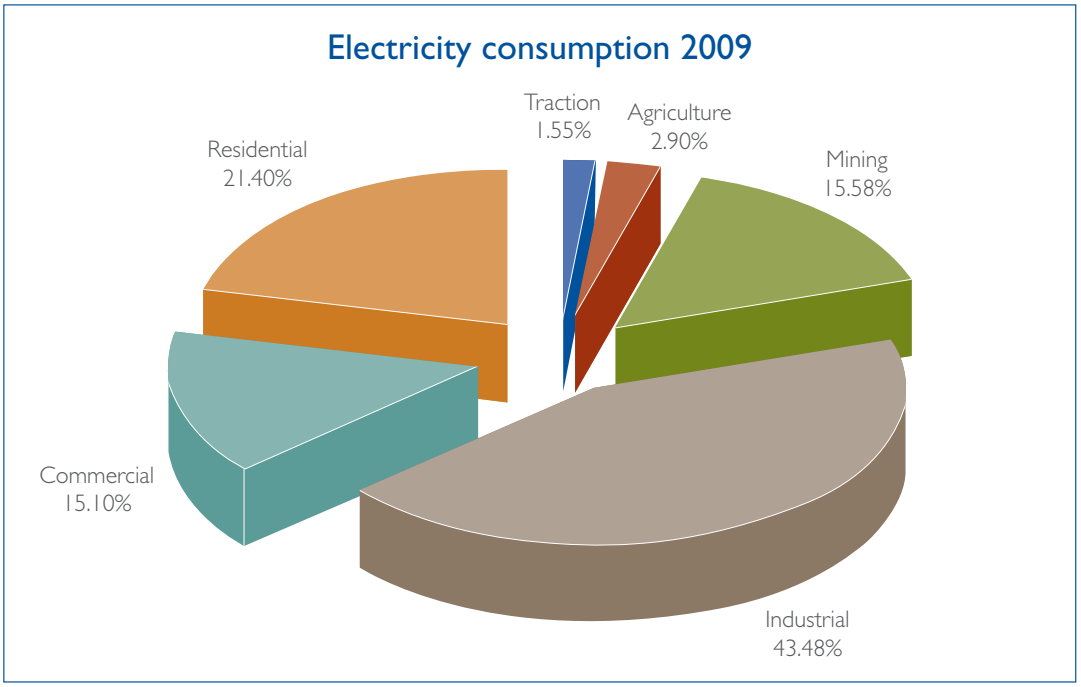

Figure 1: Electricity Consumption 2009

Until recently the commercial property sector had not paid much attention to reducing the energy consumption of their facilities, but this is changing with the Department of Energy having proposed national standards for energy efficiency in buildings. Referred to as SANS 204 (South African National Standard), a 15% target for a reduction in energy demand and annual consumption by commercial and public buildings has been set for 2015.

In addition to using less energy, SANS 204 also looks at the orientation of buildings, their usage of alternative sources of energy for water heating, as well as more efficient climate control.

Furthermore, recent and projected tariff increases in electricity has also seen property owners turning their attention to ways to reduce energy consumption and costs within existing buildings.

While there are many energy-efficient technologies and adaptations available to this sector, property owners often find it difficult to decide on the best approach that will continue to meet their energy requirements, especially when weighing up the initial outlay cost against cost savings achieved as a result of energy savings.

Eskom's Energy Efficiency Demand Side Management (EEDSM) department, in partnership with energy service consultants, have conducted numerous pilot projects in terms of energy efficiency retrofits. The intelligence gained from these studies has enabled EEDSM to determine which technologies produce the best results in reducing energy consumption, and ensuring favourable payback periods.

Property and portfolio owners can now benefit from EEDSM's technical advisory services for turnkey energy efficiency solutions and flexible funding models that take into account the energy requirements of the tenants. To take advantage of this offer, interested parties can contact the advisory service on **08600 ESKOM (08600 37566)**, and log a query for an energy advisor in your area to contact you.

The following technologies and concomitant behaviour adaptations currently form part of EEDSM's commercial sector energy efficiency focus:

2. Commercial lighting

Lighting accounts for a substantial portion of the monthly energy consumption and costs of commercial and industrial buildings. In fact, lighting is estimated to be responsible for between 37% and 45% of electricity consumption in office buildings.

Over the years, commercial lighting solutions have evolved to fit modern building design and layout, as well as meet energy efficiency and health and safety requirements.

The large variety of components available today means that there are lighting solutions to fit almost any context.

The following steps can be taken to improve the energy efficiency of an organisation's lighting:

2.1 Switch to energy-efficient lighting

Replace magnetic ballast luminaires with energy-efficient lights (electronic ballast) such as T5 fluorescents and LEDs.

LEDs have long been used to illuminate exit signs and in brake and indicator lights on vehicles. Thanks to advancements in quality and colour rendering, they can now be used in a much broader range of applications. LED lights use dramatically less power while providing better light and reduced flicker. They also last much longer.

Energy-efficient lights run at much lower operating temperatures than traditional lamps. Because they run cooler, there's less heat for the air conditioning system to deal with, and light fittings and cables do not deteriorate as quickly.

2.2 Label light switches

Clearly label light switches so that employees know which switches control which lighting zones. If they know where to switch off, they'll be more inclined to do so when they leave an area unoccupied. This is especially relevant for employees working outside of normal office hours.

2.3 Go light on colour

Choose lighter colours for ceilings, walls and surfaces. This helps reduce the amount of artificial light needed.

2.4 Light up enclosed spaces separately

Enclosed spaces should have individual light switches so that they are not left lit unnecessarily. These switches can be used in conjunction with room occupancy sensors.

2.5 Install occupancy sensors

Occupancy sensors control lighting based on occupant detection. These can be used to control lighting in intermittently occupied areas such as meeting rooms, toilets and print rooms.

2.6 Deploy daylight sensors

Use daylight sensors to brighten, dim or even switch off lights according to natural light levels as they change throughout the day. This will reduce operating and energy costs.

The influence of artificial and natural lighting has been intensively studied, and it is proven that exposure to daylight and productivity is strongly related.

2.7 Use programmable control systems

Lighting control systems can switch off lights automatically or step-down lighting levels for night time security or reduced occupancies.

2.8 Reduce consumption of downlights

Switch to new generation compact fluorescent downlights lamps which use 90 % less power than regular halogen bulbs. They are also light-weight, compact and last about four times longer than traditional incandescent bulbs.

There are low-energy LED (lamps) bulbs available for downlighting applications. However, these can be a little pricey, and opting for lower-cost varieties usually means compromising on colour, quality and distribution (spread) of light.

Replace standard 50 watt halogen bulbs with either 35 watt or 20 watt bulbs. These will reduce the energy used, but will lower the light output as well.

And install a dimmer on existing downlights systems that will reduce the energy used, but will lower the light levels. The light output of these lamps will decrease faster than the energy reduction, but overall there will be a reduction on the energy used.

3. Heating, ventilation and air conditioning (HVAC)

Another area of energy consumption that Eskom has studied is that of climate management in buildings (HVAC). Workers in offices and shops work most effectively and comfortably when the ambient temperature is kept in the "golden zone" - between 18°C and 22°C.

In winter, when the temperature falls below this zone, the air in the building must be heated. In summer, when temperatures rise above 22°C, the air must be cooled until it drops to within the ideal zone.

Both heating and cooling are extremely energy-intensive. Several techniques are employed to reduce this load. Architects and construction engineers are offered assistance in orienting new buildings to make optimum use of natural light, and in specifying the most energy-efficient sizes and orientation for windows and entrances, and with efficient surface cladding and construction materials.

When HVAC equipment is planned and installed, engineers are encouraged to use ingenious methods of minimising power use. One such way, during the summer heat, is to "flush" the building with cool night air, dropping the temperature and giving it a cool start to the day. Another is to have adjustable fascias that deflect the sun's heat away from the building in summer, but make maximum use of its warmth in winter.

In the HVAC plant itself, motors that drive fans, pumps and compressors must all be rated as energy-efficient. Eskom's Energy Efficient Motors Programme is designed to create awareness around the vital contribution these motors can make to increasing electricity savings. It offers rebates to people exchanging inefficient motors for approved, energy-efficient models.

The use of electronic sensors and controllers to switch off HVAC equipment in unoccupied parts of buildings and during night times and weekends sounds simple, but it is often overlooked. It is very effective in reducing the total amount of energy consumed by a building.

The following steps can be taken to improve the energy efficiency of climate control systems:

3.1 Modify setpoints

Choosing thermostat setpoints that stretch the upper limit in summer and lower limit in winter of the acceptable thermal comfort boundaries saves energy, e.g. 24°C in summer and 17°C in winter.

3.2 Temperature of server rooms

Increasing the setpoint in server rooms can save energy – some ICT equipment can tolerate higher than the recommended temperatures, but the meantime between failures could reduce.

3.3 Ensure controls are working well

Correctly functioning controls ensure that no energy is lost because unnecessary demands are made on HVAC equipment.

3.4 Preventive maintenance programme

A scientific comprehensive maintenance programme ensures that equipment works as efficiently as possible, makes it last longer and cuts operating and energy costs.

3.5 Cooling tower maintenance

A comprehensive cooling tower maintenance programme ensures chiller efficiency does not decrease.

3.6 Re-set mechanical plant

Rebalancing and recommissioning all plants ensures that systems operate as efficiently as possible and keep running costs at their minimum.

3.7 Reset chilled water temperature

Raising chilled water temperatures (e.g. to 12°C – 18°C) when conditions permit improves chiller system efficiency.

3.8 Maintain ductwork

Insulating ducts and pipes and repairing leaks in ductwork promptly keeps energy losses at a minimum.

3.9 Zone controls

Zoning air conditioning systems can improve energy consumption by ensuring that only relevant parts of a building are cooled. It also improves thermal comfort for occupants.

3.10 Digital plant control

Digital control systems can control and modify flow rates, compressors, pumps, fans, valves, etc., ensuring accurate and efficient use.

3.11 Heat recovery

Heat recovery systems transfer heat between inbound and outgoing air flow streams, reducing heating or cooling demands on inbound air.

3.12 Solar boosted hot water

Solar boosted hot water for kitchens, showers, etc. reduces energy use.

3.13 Underfloor air supply

Air supply through a raised floor plenum (typically around 400 mm) ensures even air distribution and uses less energy than conventional ceiling ducts and grilles.

4. Variable speed drives (VSDs)

A VSD is a system that controls the speed of an electric motor by controlling the frequency of the electrical power supplied to the motor. Variable speed drives are also known as variable frequency drives (VFDs), adjustable-frequency drives or inverter drives.

VSDs are not as widely used as they should be. In energy-intensive installations, particularly older ones, systems use constant speed motors combined with other equipment to manage the process flow and speed. This system is less efficient and consumes more energy than one that uses a VSD.

For example, in ventilation systems for large buildings, variable speed motors on fans save energy by allowing the volume of air moved to match the system demand. Variable speed drives are also used on pumps and other equipment to match the needed rotation, thus ensuring that waste is kept to an absolute minimum.

VSDs are particularly suited to electronic control systems such as programmable logic controllers (PLCs) and computers (PCs). These systems are typically used in complex building climate control systems. By responding to inputs from various sensors in the building and adjusting the speed of relevant motors, the process can be kept at an optimum speed and wastage is minimised. VSDs are ideal for equipment with varying load conditions.

5. Hot water management

Commercial properties with facilities that have major hot water demands, such as kitchens, multiple ablutions, laundries etc. can save as much as 40 – 60% of their energy costs by adopting more efficient water heating processes, and by reducing their consumption of hot water. Solar water heaters and heat pumps are both recommended by Eskom as energy-efficient alternatives to water heating using a conventional electric geyser. Eskom recommends that the customer take his circumstances into consideration when choosing either one of the water heating technologies. The following points can be considered and discussed with the suppliers of a solar water heater or heat pump:

- **Type of facility** – Space and location would have to be taken into consideration when looking at the appropriate technology. Solar water heaters and heat pumps have differing spatial requirements.
- **Geographical location** – Both technologies have limitations in terms of the climate/weather experienced in a particular area. A customer would have to discuss his particular situation with the technology supplier in order to make an informed choice
- **Maintenance** – Both technologies have particular maintenance requirements to be taken into consideration and an end user would have to consider this when choosing the appropriate type of water heater. This must be discussed with the suppliers.
- **Affordability** – Capital, installation and maintenance costs vary for each technology based on size as well as location, and a customer would have to take his financial situation into consideration when choosing the technology.

By installing either a solar water heater or a heat pump, consumers will reduce their electricity consumption and save on electricity costs while still experiencing the same level of service as a conventional electric geyser.

5.1 Solar water heating (SWH)

Electric hot water cylinders, or geysers, are widely recognised as major consumers of electricity in buildings and homes. Supplying hot water to washrooms, canteens and bathrooms, the geysers waste significant amounts of energy at times when no-one uses the water.

Solar water heating has many benefits for building projects and for society at large. Benefits include vastly reduced energy costs, reduced pressure on the national electricity supply and reduced carbon emissions. Buildings equipped with solar water heating are seen as attractive purchases, relieving new owners of the headaches involved in a retrofit.

Eskom, the National Energy Regulator of South Africa (NERSA), Department of Energy (DoE) and several other organisations have recognised that solar water heating is an under-utilised resource. They have collaborated to develop a five-year solar water heating rebate programme to stimulate the solar thermal market. The rebate that Eskom offers to those installing solar water heating reduces the initial cost of purchase and installation, increasing the attractiveness of the technology.

The potential number of installations that this programme is generating is an incentive for contractors to acquire the skills and increase their turnover. Solar is becoming a significant industry, and many contractors are gaining valuable, marketable skills.

5.2 Heat pumps

Currently, most commercial enterprises, particularly those with major hot water demands for kitchens, laundries, restaurants, ablution facilities and industrial processes heat their water with geysers and steam cylinders called calorifiers.

An important technology that is simple and effective in lowering electricity usage is the deployment of heat pumps. Heat pumps offer major consumers of electricity a significant opportunity to reduce costs related to water heating. A heat pump can save up to 66% of energy consumption and, in some circumstances, even more than that.

In effect, heat pumps transfer heat from a source such as air or water to the water which is to be heated. Heat pumps use the reverse cycle of a refrigeration utility to heat water.

A heat pump can be up to three to four times more efficient than a hot water system which is powered by a normal resistance element. For every kWh of electricity supplied to the heat pump, more than three kWh of thermal energy in the form of hot water is produced. A thermostat keeps the hot water at a constant temperature between 55 and 65°C, with 60°C being the most commonly used setting.

An additional benefit which is often used to increase the economic benefits of a heat pump is that of the cooling cycle which can be utilised to simultaneously cool a portion of or an entire building. This is especially useful in the hospitality industry where cool air can be channelled into lobby areas, thus saving on the cost of a separate stand-alone air conditioning system.

Heat pumps are typically mounted on the outside walls of buildings under the eaves or at ground level depending on the configuration of the system.

5.3 Shower heads and water flow regulators

Many large buildings include ablution facilities for workers where multiple showers consume large volumes of hot water on a daily basis. Together with solar water heating or heat pumps, one very effective way to reduce this drain on resources is to fit energy and water saving shower heads or water flow regulators. Facility managers should use the services of an accredited plumber when retrofitting showers, because factors such as water pressure will influence what products are most suitable.

Eskom EEDSM is committed to helping its customers in the commercial sector make informed decisions and energy-wise changes that will ensure the maximum return on investment on retrofit projects.

Support and advice

Advice on the many techniques and technologies that are available for the purpose of saving energy can be obtained from independent consultants or Eskom's energy advisory service. Interested persons can call the Eskom Contact Centre on **08600 Eskom (08600 37566)** and arrange for an Eskom Energy Advisor in their area to contact them or visit our website on **www.eskom.co.za/dsm**

References:

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3. Eskom Annual Report - 2010

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