Using Time Of Use (Tou) Tariffs In Industrial, Commercial And Residential Applications Effectively.

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Abstract

Time of use (TOU) tariffs are commonplace in developed economies around the world. These tariffs incentivise customers to lower peak loads in order to reduce their electricity bills. The objective for the power utility is to reduce peak loads and/or shift load from peak to off-peak periods. This paper will discuss the effective application of TOU tariffs for industrial, residential and commercial power users.

Introduction

Historically electricity prices in South Africa have been amongst the lowest in the world. In the past this has made it uneconomic to introduce energy saving technologies. The authorities have realised since 1998 that rising electricity demand with fixed generation capacity would eventually result in shortages in South Africa. In order to incentivise consumers to reduce consumption and demand, Eskom DSM has had projects running to reduce energy & pay towards costs since 1994 [1]. These have not been able to offset the rising energy demand, and the reserve between generation and consumption has steadily been decreasing over the past decade.

From January 2008, there was sustained daily load shedding which lead the SA Government to declare a national power emergency. In order to stabilise the electricity network, an immediate reduction of demand of 3600MW is required. This equates to a 10% reduction in electricity consumption. These 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) [2]. These factors provide sufficient incentive for electricity users to become more energy efficient and manage their consumption more effectively.

Demand Side Management

Demand Side Management (DSM) refers to a process by which electric utilities, in collaboration with consumers, achieve predictable and sustainable changes in electricity demand. These changes are effected through a permanent reduction in demand levels through energy efficiency as well as time related reductions in demand levels through load management [1].

The practice of Demand Side Management has evolved over the past three decades in response to lessons learned from implementation in different global settings, and also in response to the changing needs of restructured power markets [3]. Traditionally, DSM programs have been confined to energy efficiency and conservation programs with load management programs such as the PCP being used to manage emergency situations. Electricity prices were assumed to be fixed when designing such programs, which reduced the eventual success. The most notable change that is occurring today is the inclusion of programs that emphasize price responsiveness in the DSM portfolio.

As a general rule, prices should convey to consumers the cost of the resources that are used to make a product, and convey to investors the returns they can expect to get by making the product. As electricity is also a product, this principle is equally applicable to electricity. When consumers do not see the real cost of electricity in their power bills, they over consume energy, and that misdirects excessive capital and fuel resources to the power sector. This is especially true during peak periods, when the cost of producing electricity is much higher than during the off-peak periods, largely because electricity cannot be economically stored in large quantities.

There are a number of ways to incentivise demand reduction and energy conservation. These include:

- Tariffs
- Technology
- Rebates
- Quotas
- Customer education etc

DSM programs that emphasize tariffs are aimed at introducing a negative slope in the demand curve in order to let demand and supply balance out at a reasonable price of electricity during tight market conditions. Programs involving demand response to tariffs fall into one of two categories:

- Load curtailment programs that pay the customer for reducing peak load during critical times
- Dynamic pricing programs that give customers an incentive to lower peak loads in order to reduce their electricity bills.

Both types of programs are largely designed to relieve peak capacity constraints.

Load curtailment programs include traditional programs that are based on an up-front incentive payment and new market-based programs that involve a pay-for-performance incentive payment. The former include direct load control of residential air conditioners and water heaters, and curtailable and interruptible rates for commercial and industrial customers. The latter include programs that pay a certain amount of money for each MWh of electric load that is curtailed during critical time periods. These are sometimes called demand bidding or buyback programs.

Dynamic tariffs are designed to lower system costs for utilities and bring down customer bills by raising prices during expensive hours and lowering them during inexpensive hours, as discussed further below. Their load shape objective is to reduce peak loads and/or shift load from peak to off-peak periods. Various dynamic pricing tariffs have been developed. These include:

- **Time-of-Use Pricing (TOU).** This rate design features prices that vary by time period, being higher in peak periods and lower in off-peak period. The simplest rate involves just two pricing periods, a peak period and an off-peak period.

- **Critical Peak Pricing (CPP).** This rate design layers a much higher critical peak price on top of TOU rates. The CPP is only used on a maximum number of days each year, the timing of which is unknown until a day ahead or perhaps even the day of a critical pricing day Extreme Day Pricing (EDP). This rate design is similar to CPP, except that the higher price is in effect for all 24 hours for a maximum number of critical days, the timing of which is unknown until a day ahead.

- **Extreme Day CPP (ED-CPP).** This rate design is a variation of CPP in which the critical peak price and correspondingly lower off-peak price applies to the critical peak hours on extreme days but there is no TOU pricing on other days.

- **Real Time Pricing (RTP).** This rate design features prices that vary hourly or sub-hourly all year long, for some or all of a customer’s load. Customers are notified of the rates on a day-ahead or hour-ahead basis.

Differing tariff rates exposes customers and utilities to varying amounts of risk. For example, flat rates have the lowest risk from the customer’s viewpoint since there is a fixed charge irrespective of the amount and the time when the electricity is consumed. A flat rate would have the highest risk to the utility as they may need to produce additional electricity at a loss during peak periods. The utility-customer risk trade-offs associated with the rates are show in Figure 1 [3].

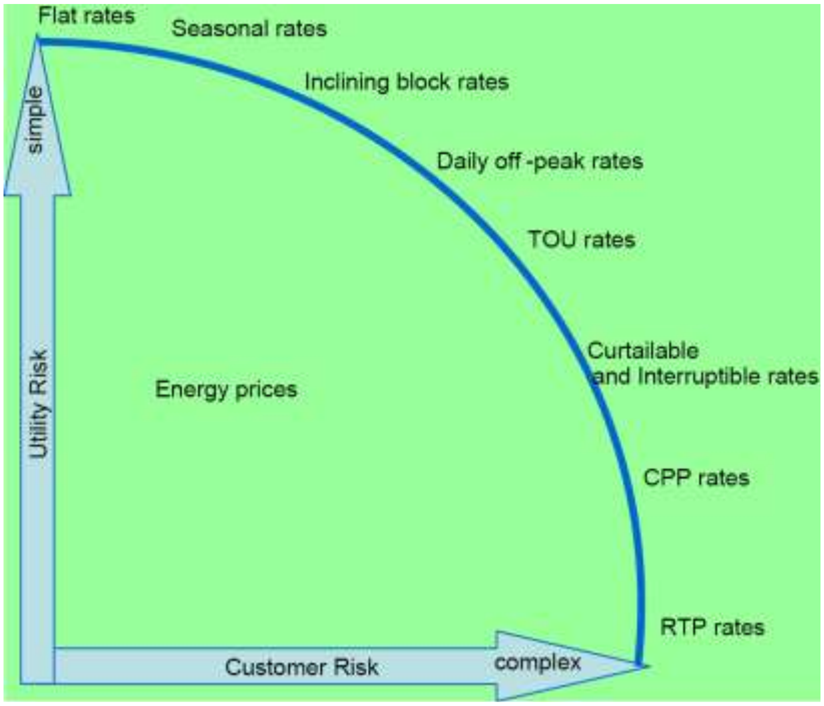

Fig.1: *Customer vs. Utility Rate Design Risk*

The electric utility is usually responsible for program design, implementation, evaluation and monitoring. Since these programs involve the implementation of new metering and billing systems, they are often conducted in close coordination with providers of such systems. In some cases, the programs involve the installation of end-use controlling equipment, such as smart, price-sensitive thermostats. Thus, they may involve the installers and manufacturers of such equipment.

Such programs can be targeted at any class of customer, ranging from the residential class to the commercial class to the industrial class. Most often, they begin with the industrial class of customers, and within a particular class they begin by targeting the largest customers.

Time of Use (TOU) Tariffs

TOU pricing is commonplace in many developed countries [3]. Electricite de France (EDF) operates the most successful example of TOU pricing. One third of its population of 30 million customers is estimated to be on TOU tariffs. This pricing design was first introduced for residential customers in 1965 on a voluntary basis, having been first applied in the country to large industrial customers in 1956.

TOU rates have been mandatory in California for all customers above 500 kW since 1978, as a state wide policy response to the energy crisis of 1973. These rates are mandatory in several U.S. states but the size threshold varies by state. Residential TOU rates are offered on a voluntary opt-in basis by utilities in all types of climates within the U.S.

The simplest variation of time-of-use tariffs involves two time periods. This is illustrated in Figure 2 [1]. customer is charged a peak rate tariff (e.g. R0.84 per kWh) for any electricity consumed between 6am and 9pm on weekdays, and an off-peak tariff (e.g. R0.22 per kWh) for electricity consumed between 9pm and 6am on weekdays and any electricity consumed on Saturday or Sunday. The Eskom's *Nightsave* tariff is an example of a two time period tariff.

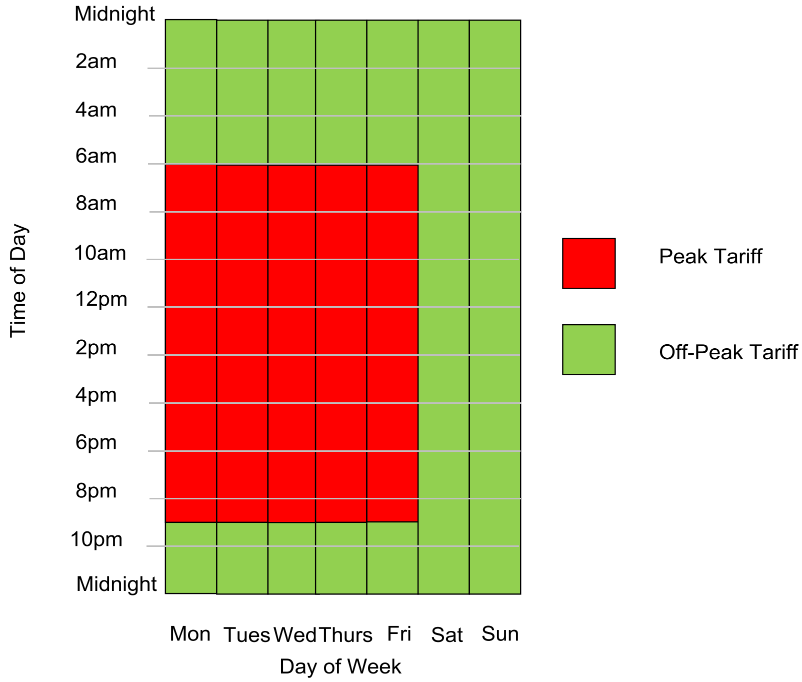

Fig. 2: *Simple Two Time Period TOU Tariff*

More complex designs feature a peak period, one or more shoulder or intermediate peak periods, and an off-peak period. This is illustrated in Figure 3. The Eskom MiniFlex, RuraFlex and MegaFlex tariffs use this more complex tariff structure

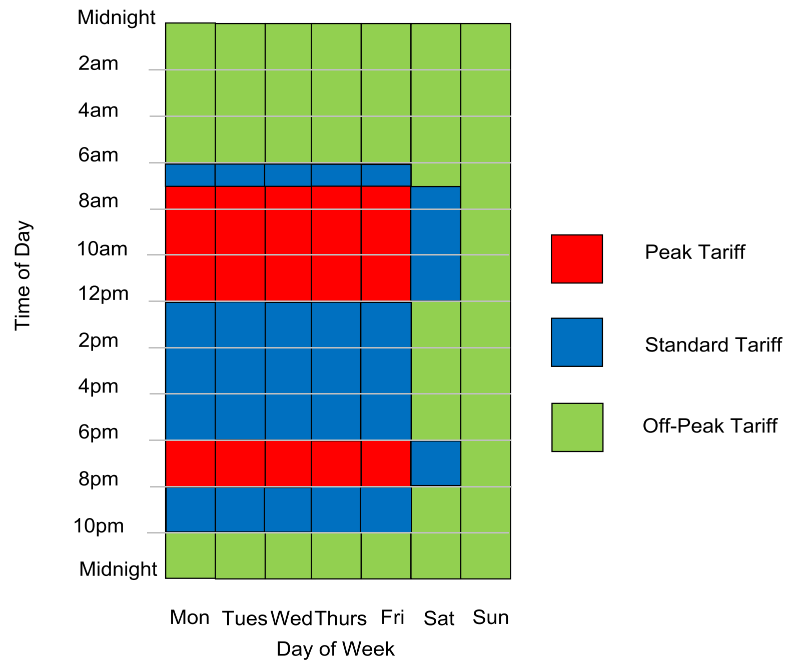

Fig. 3: *More Complex Time Period TOU Tariff*

In addition to the energy charge, most utility tariffs include a network access charge and a service charge. This is illustrated in the Table 1 [4].

Energy charges c/kWh	Peak, standard and off-peak TOU c/kWh rates Seasonally and hourly differentiated. Differentiated per Transmission zone and per Distribution voltage category (at the Distribution and Transmission loss factors).
Transmission network charge R/kVA	R/kVA - based on highest annual capacity in all periods. Differentiated per Transmission zone and per Distribution voltage.
Transmission reliability services charge c/kWh	Separate c/kWh charge. Differentiated per voltage category (at the Distribution loss factors)
Distribution Network access charge R/kVA	R/kVA - charged on annual maximum demand. Differentiated per voltage category
Distribution Network demand charge R/kVA	R/kVA - based on actual demand in peak and standard periods. Differentiated per voltage category
Administration charges	R/point of delivery/day based on capacity
Service charges	R/account/day based on capacity

Table 1: *Cost Reflective Tariff Structure (Eskom Megaflex)*

The extent to which TOU tariffs can be fully implemented depends on the customer that is being served, i.e. the practicality of implementation and the customer's ability to respond to the pricing signal. Any tariff or pricing intervention introduced on its own to promote efficiency will fail if it does not take the customer's perspective into account [5]. A pricing signal might have to be complex to provide the required theoretically economically efficient behaviour, but if in practice it cannot be measured because the cost of metering is not financially viable, such a pricing signal does not achieve its purpose. Moreover, if a customer cannot respond to the pricing signal, the pricing signal does not achieve its purpose. This typically happens where the customer's usage is very low and therefore the customer has no ability to shift or reduce load, or the customer has a fixed consumption of energy every day.

Industrial Power Users

The ability of industrial power users to take advantage of TOU tariffs depends on the nature of the production process and the ability to shift electrical loads to a period where the tariffs are more favourable. The potential saving can however be significant. This can be illustrated in the following example.

Tariffs are based on the Megaflex tariff structure for 2008/2009 [6]. These tariffs are shown in Table 2.

TOU Tariff	**High-demand season (June to August)**	**Low-demand season (September – May)**
Peak	74,21c + VAT = 84,60c/kWh	21,06c + VAT = 24,01c/kWh
Standard	19,62c + VAT = 22,37c/kWh	13,07c + VAT = 14,90c/kWh
Off Peak	10,67c + VAT = 12,16c/kWh	9,26c + VAT = 10,56c/kWh

Table 2: *Eskom Megaflex TOU Tariffs*

An industrial user who operates 24 hours a day, 7 days a week and is able to shift 1MW for one hour from a higher tariff rate to would reduce the active energy charge on his annual electricity bill as illustrated in Table 3.

Peak to Standard	Peak to Off Peak	Standard to off Peak
R1 898 022.60	R2 373 319.20	R475 296.60

Table 3: *Potential Annual Savings From Using TOU Tariffs*

Where it is not possible to shift load from a higher tariff, it will still be possible to reduce the active energy charge by improving the energy efficiency of equipment. The following checklists can be used to reduce electricity consumption [7].

Electric Motors

Older electric motors are not energy efficient. Motors should be examined and old units replaced with energy efficient motors where possible. Eskom is currently running a subsidy scheme which is available for the replacement of old motors [8]. The combination of capital expenditure savings with operational savings leads to an accelerated payback. Additional benefits include compatibility with variable speed drives, presenting operators with an opportunity to improve drive systems and optimise processes. Increased supervision and control of motors will maximise benefits. Switching off drives that are running, but are not being used will reduce energy and running costs.

Power Factor Correction

The improvement of the overall power factor of plant will not contribute to a reduction of the active energy charge. The Eskom Megaflex tariff does however include a maximum demand charge of R10.83 / kVA during peak and standard periods per month as well as a reactive energy charge of 4,26c/kVARh supplied in excess of 30% (0,96 PF) of kWh recorded during peak and standard periods [6]. The installation of power factor correction can reduce these charges. Loads that has been shifted to the off-peak tariff period do not attract either the maximum demand or reactive power charges. This provides additional incentive to move load to off-peak periods. Other benefits that are obtained from improving power factor include increased plant capacity and the reduction of power losses in feeders, transformers and distribution equipment.

Compressors

Regular audits of compressors and the compressed air distribution system equipment should be conducted. The development of a comprehensive maintenance and leakage prevention plan can significantly reduce leakages and lead to significant energy and cost savings. Training and education can reduce the use of compressed air for functions such as regulating ambient temperatures and general cleaning.

Boilers

Regular examination and maintenance of boiler systems are essential to effective energy savings. Consideration should be given to:

- Checking the gas and air tightness of boilers regularly
- Exercising care when operating above maximum continuous rating as this could reduce the life span of the boiler
- Calibrating feed water and steam flow meters to determine boiler leaks.

Lighting

- The use of electronic ballasts is not common in commercial and industrial lighting systems, yet they can save up to 60% of the electricity required.
- Install efficient lighting systems.
- Many lights are generally left on unnecessarily in buildings during the day and night. Lighting controls in buildings can ensure that energy is conserved during periods of low occupancy.
- When buildings with centralised air conditioning plants are fitted with energy efficient lighting, these systems generate less building heat load, so energy is saved on cooling equipment.
- Optimising the design and location of light fittings can also save energy. It is prudent to make use of the services of lighting specialists when making choices on lighting system design.

Heating Ventilation and Air Conditioning (HVAC), Fans and Pumps

- Pumping is the biggest single application of motive power. Fans also use significant amounts of electrical energy. Systems with fans and pumps offer many opportunities to save energy on pump and fan drives. Basically the fluid or gas has to be delivered at the end of a system of pipes or ducts. If the pipes or ducts are poorly placed or designed, then the pump or fan motors use more energy than would be the case to deliver the same volumes with more correctly designed fluid and gas flow systems.
- Leaky pipes, valves or ducts also require more motive power to deliver the same useful volume where and when it is needed. Prevention of leaks is important. Filters and fan belts that are not replaced at the appropriate times or maintained properly could also cause inefficient energy consumption.
- Pumps or fans may not be running as efficiently as they could because the pump or fan curve has not been properly matched to the load curve. In this case it would possibly help to trim impellers.
- In some cases where valves and damping vanes are used to regulate fluid or gas flow, there may be too much energy dissipated by the valves or dampers, simply because the fan or pump is oversized. Right-sizing of pumps and fans to match the load is important in implementing energy efficiency.
- Technical knowledge, operations and maintenance skills on fans and pumps in industry is essential. Avoid fan belt slippage - replace if worn

Variable Speed Drives

- The use of variable speed drives on loads such as compressors and fans can save significant energy costs during peak tariff periods
- Replace efficient motors rather than rewinding them
- Upgrade to higher efficiency motors

Commercial Power Users

Commercial power users operate between fixed hours (e.g 8am to 6pm) and have less flexibility to shift load from a higher tariff structure. TOU tariffs are available to commercial users. These include the Eskom Nightsave and MiniFlex tariffs. Commercial buildings are however more likely to use flat rate tariffs such as the Eskom BusinessRate tariff due to their inability to shift significant loads. The most significant savings will be achieved by concentrating on the overall reduction of energy used by the building.

An examination of the energy use in commercial buildings is shown in Figure 4 [9]. The single largest user of energy in commercial buildings is the heating, ventilation and air-conditioning system (HVAC) at around 50%, with lighting using 25% and office equipment and other loads using the balance.

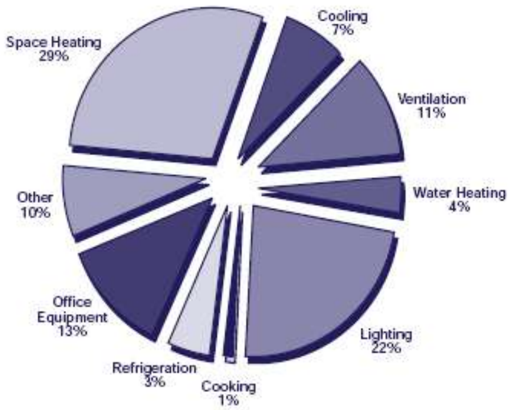

Fig. 4: *Commercial Building Electricity Use*

The location, design and construction of a building are a key factor in establishing its potential operational energy requirements. The building envelope is a critical component of any facility since it protects the building occupants and plays a major role in regulating the indoor environment. The flow of energy between the interior and exterior of the building is determined by the foundation, walls, roof, windows, and doors. A well designed envelope allows the building to provide comfort for the occupants and respond efficiently to heating, cooling, ventilating, and natural lighting needs.

Additional loads such as lighting, building occupants and equipment add to the heat load in a building. The heat flow in a typical building is illustrated in Figure 5 [9].

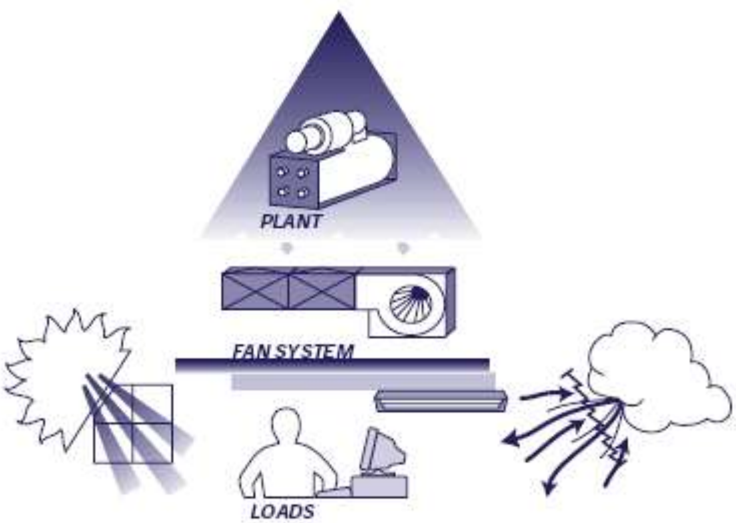

Fig. 5: *Heat Flow in Commercial Buildings*

It can be seen that energy efficiency starts with good building design. This is also addressed in the chapter on Green Buildings. In order to improve the energy efficiency of existing buildings it may be necessary to undertake a retrofit. Building tune-ups and equipment recommissioning can also be used optimize energy performance and savings by continually monitoring the energy consumption of the heating, cooling, and electrical loads. Recommisioning can be a cost-effective retrofit in itself, sometimes generating more savings than the cost of the retrofit measure. This can result in additional savings other than direct energy cost reductions. Recommissioning may avoid the need to install new or additional equipment, resulting in capital savings. In the recommissioning phase, numerous cost-effective strategies are implemented to reduce the heating, cooling, and electrical loads, and the overall energy consumption, while maintaining or improving occupant comfort.

Reducing energy will require constant examination of the building and taking steps to correct items that may be wrong. These steps have a cumulative effect and all contribute to energy savings [6]. This could include:

- Ensuring that doors between air conditioned and "un-air conditioned" spaces are closed at all times. The use of automatic doors, self-closing doors and air curtains should also be investigated.
- Sealing cracks and broken windows that allow air conditioned air to escape.
- Installing blinds and awnings to reduce the amount of sunlight penetrating rooms through windows in summer. By opening them in winter, more heat is allowed in, reducing the need for heating.
- Switching off electric lights in areas that have high levels of natural light.
- Replacing incandescent bulbs with compact fluorescent lamps.
- Checking the airflow through the building. If it is not efficient it will require the heating, ventilation and air conditioning system to work harder to achieve desired temperatures.
- Installing wall and ceiling insulation to reduce heat loss and consider the installation of double glazed windows.
- Installing a building management system that automatically connects the lighting and heating, ventilation and air conditioning system, automatically regulating use of both.

Lighting

Lighting often represents greatest immediate energy savings opportunity. Optimum lighting levels must be determined for each office or workspace. Often work areas are incorrectly illuminated as the lighting fixtures are installed for “general” use. The energy efficiency of lights vary substantially and where possible older technologies such as incandescent lights should be changed to new energy efficient lamps such as compact fluorescent (CFL) and LED. The ballasts in the older fluorescent fixtures can be upgraded to the energy efficient electronic ballasts.

Lights that need to stay on permanently such as emergency lighting in stairwells and exit signs should be changed to the highest possible efficiency lamps as there is no duty cycle. Timers or motion sensing devices can be used to automatically control lights which are on after hours or when offices are unoccupied.

Light output can be significantly reduced when the lamps are dirty. Periodic maintenance and cleaning of lamps and fixtures should be instituted. It should also be noted that lamp efficiency changes with time as shown below. It may be economical and more energy efficient to use fewer lamps and change the globes before failure when the light output is below a certain threshold.

Heating Ventilation and Air Conditioning (HVAC)

HVAC can consume 50% or more of the electricity used in a building. The heat flow has already been presented in figure 5. The external environment has a significant effect on the heat flow into and out of a building. This is shown in figure 6 [9].

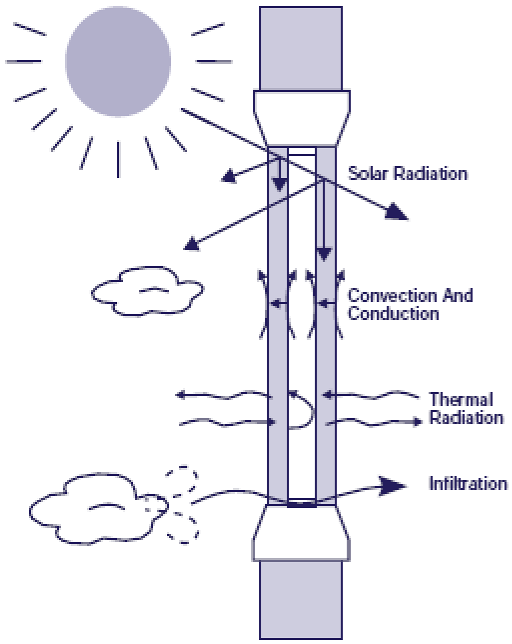

Fig. 6 *Heat Flow Interaction between the Building and the Environment*

Evaluating commercial building loads is complex and time consuming. A number of software programs are available to help designers perform this evaluation. The following factors influence building heat loads:

- Solar. Solar radiation can have an enormous influence on the heating and cooling required in a space. Standard double-glazed windows can let up to 75 percent of this energy penetrate the building, where it becomes a cooling load. Additional window treatments such as tinted and reflective glazing, shading and draperies can further reduce solar gains.
- Lighting. Typically, 70 to 80 percent of the electrical energy used by lighting ends up in the conditioned space as heat. Lighting power is often about 20 W/m^2 in office buildings but can be as high as 40 to 50 W/m^2
- Equipment. The equipment load (also called plug-load) is often in the 2- to 5-W/m^2 range but can be as high as 15 to 20 W/m^2
- Windows. Heat can also be radiated out of the building through the windows in winter if outdoor temperatures are much lower than room temperature.
- Outside air temperature and types of insulation. Heat gains or losses through walls, floors and roofs.
- Internal gains from occupants (including latent heat for cooling purposes): Each adult will typically generate about 75 W of sensible energy and 55 W of latent energy

Other energy efficiency considerations include the use of a central chiller and air handling unit vs. wall mounted & split air conditioning units. Wall mounted units are less efficient for the total building but can be used to condition small spaces more efficiently.

When the building is unoccupied the building temperature can be adjusted to save energy. In addition wall mounted / split units are often left on when offices are unoccupied. A timer or remote control can be used to turn these units off when not required.

The HVAC equipment in many buildings is old, inefficient or poorly maintained. These units can consume considerably more electricity than necessary. A calculation can be made to determine the economic point for replacement and maintenance.

HVAC-Retrofit

On older HVAC systems certain components can be very inefficient. This can cause the HVAC system to operate inefficiently. The following components can be examined for efficiency retrofits [10]:

- Chillers: Determine the COP (coefficient of performance) of the chillers. Compare this to the manufacturer specification and a new chiller's performance for a benchmark. The COP is the relation between the amount of cooling of the chiller and the electricity used. The higher the COP, the more efficient the chiller. The COP usually ranges between 1,5 and 3,5.
- Cooling Towers: The chiller performance is directly related to the cooling tower performance. Check the temperature of the return coolant from the condenser and the temperature of the coolant leaving the cooling tower. Compare the temperature change to the manufacture specification and a new cooling tower performance as a benchmark.
- Ducts: Check cold air ducts for quality of insulation or for any leaks. If the insulation is not up to standard consider improving it. If there are leaks repair them because cooling energy is lost. Both cases would result in an increase of the HVAC's energy consumption.
- Humidifiers and Dehumidifiers: Check if the humidifiers and dehumidifiers are working properly. If they are not working correctly the comfortable temperature range changes. When the dehumidifiers are not working correctly the operators reduce the inside temperature set point, to counter act the effect of high humidity. This increases the electricity consumption and can cause sick building syndrome. Sick building syndrome can also occur if the air is not humid enough. ISO and ASHREA have internationally recognised specification on the humidity and temperature set points.
- Coolant pipes: Check that the coolant pipes do not leak. Check the insulation around the coolant piping. If the insulation is not up to scratch cooling is lost; this would increase energy electricity consumption.
- Type of HVAC: VAV (Variable Air Volume) systems are usually more efficient than CAV (Constant Air Volume) systems.
- Economiser: Determines if the economiser cycle is functioning properly.
- Variable Speed Drives (VSD): VSD on the compressor motors can reduce consumption up to 50% depending on the system.
- Lights: Install lights with low thermal emissions, the low thermal emissions would reduce the heat load of the building. A reduced heat load would reduce the energy electricity consumption of the HVAC system when cooling.
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HVAC - Control

Optimise controls to ensure user comfort and minimise electricity accounts bill. These should be examined:

- Set internal temperature to the maximum acceptable point.
- Evaluate night setback control against dynamic control.
- Relate chilled water temperature to building load.
- Reduce warm fresh air intake to an acceptable limit and recycle colder inside air. Consult international standards on the amount of fresh air that has to be supplied to a conditioned building.
- Use the cold outside air during the night to cool the building (free cooling). This is usually done in places with low humidity.
- Switch off non-essential electrical loads or enable power save mode, if available, during the night. This reduces non-essential electrical load energy, electricity consumption and reduces temperature build up in the building. Energy Electricity is also wasted by the HVAC system in overcoming this temperature build up.

HVAC - Thermal Energy Storage

There are two main types of thermal energy storage (TES); structural and storage tank TES. With structural TES the storage capacity of the building envelope and internal matter is used to store cooling energy. With storage tank TES an additional storage facility is built that stores cooling energy. The storage medium can include water and, ice, etc. In both types of TES, the storage medium is cooled during the night in off- peak when the electricity tariff is low.

The storage is then used during the day to replace or decrease the chiller electricity consumption. This is the most significant opportunity to shift load in a commercial building to make use of savings from TOU tariffs.

Office Equipment

Electrically powered equipment directly affects the building load. In addition for many types of equipment, much of the energy consumed will ultimately end up in that space as heat. Thus, improving the efficiency of your electrical equipment not only reduces your electrical loads but also reduces your cooling load. The following factors influence electricity consumption by equipment:

- Nameplate rating. Most electrical equipment will be fitted with a nameplate that specifies the wattage or current consumption of the equipment. Faulty equipment can consume significantly more power and periodic checks should be done to ensure correct operation.
- Efficiency at various loads. Equipment such as electric motors operates at a much lower efficiency at lower speeds. Ensure that equipment is operating at the correct speed to ensure the highest efficiency.
- Operating time. Energy use is directly proportional to operating or ON time. Where possible, unused equipment should be switched off automatically by a timer or control system. The running time for some equipment is different during summer and winter. The appropriate adjustments should be made.
- Energy Efficiency. Equipment should comply with one of the recognized energy efficient branded products such as ENERGY STAR®
- Off or “On Standby”. When possible switch OFF equipment not in use. Surveys indicate that equipment in left on standby consumes between 5% and 13% of the ON power
- Ensure appliances in kitchens are not left on (urns etc) when they are not required.
- Switch off office lights at night in unoccupied areas
- Use natural light during the day instead of switching on lights
- Air conditioning is switched off in rooms that are unoccupied.
- Educate building staff to make efficient use of office equipment and appliances. Staff can contribute to energy savings by making sure that lights, equipment and HVAC are switched off when not being used and when the office closes.

Residential Power Users

Approximately 9 million homes across South Africa use electricity. Traditionally electricity use for domestic purposes peaks twice a day. The first peak occurs in the morning from 07:00 to 10:00, while in the afternoons demand for electricity increases between 18:00 and 21:00. It is during these times that the most stress is placed on the national grid as power stations around the country work at their hardest to meet demand and that power outages is most likely to occur [11]. The largest single load in a residence is the hot water geyser. Residential power users could benefit significantly from TOU tariffs. Items such as swimming pool pumps could take advantage of a lower tariff. At present (December 2008) there is no Eskom TOU tariff for residential power users. Eskom has been investigating the introduction of TOU tariffs. The findings are as follows [12]:

- Eskom identified the need for a residential time-of-use tariff as a DSM strategy to encourage peak load shifting and energy efficient customer responses.
- A tariff (Homeflex) was developed and various pilots were run together with load management strategies i.e. customers’ geysers were managed.
- A potential of 84MW can be shifted out of peak, if the tariff is applied to Eskom’s niche residential market of 120 000 suburban customers.
- Results and knowledge gained from the pilots were incorporated into the current design of the tariff.
- Tariff is initially aimed at medium to high usage residential customers in Eskom, customer consuming on average 500kWh/m and more (existing Homepower customers).
- The long term strategy is to implement the tariff to other market segments, including municipal customers

The proposed Eskom Homeflex tariff is shown in table 4.

Charges	Network charge (per day)	Service charge (per day)	Energy charge (per unit)			
			High demand (June – Aug)		Low demand (Sep – May)	
Homeflex 1	R2.07 + VAT = R2.36	R 1.34 + VAT =R 1.53	Peak	83.45c + VAT = 95.70c/kWh	Peak	32.63c + VAT = 37.20c/kWh
Homeflex 2	R4.46 + VAT = R5.08					
Homeflex 3	R8.98 +VAT =R10.24		Off-peak	27.47c + VAT = 31.32c/kWh	Off-peak	22.00c + VAT = 25.09c / kWh
Homeflex 4	R1.06 +VAT =R1.21					

Table 4: *Proposed Eskom Homeflex TOU Tariff*

There are a number of energy saving and energy efficiency that can be implemented for Residential power users. These include [13]:

- Switch off appliances and lights when not in use
- The single largest residential load is the hot water geyser. It uses 39% of all household electricity. It should be switched off when not used for prolonged periods. Use hot water sparingly.
- Insulating geysers and hot water pipes saves energy and money
- Reducing the temperature at the geyser thermostat to 60ºC saves electricity
- Showers use less hot water than baths.
- Aerated shower heads use less water
- Use compact fluorescent lamps (CFL's) to replace incandescent bulbs.
- Do not leave TV's DVD players and other appliances in stand-by mode. Standby mode consumes up to 13% of the ON electricity
- Close fridge doors as quickly as possible when taking out items
- Keep room temperatures between 18ºC and 22ºC
- Wear warm clothes and hot water bottles instead of using heaters
- Fill kettles with only the required quantity of water. Heating up excess water wastes energy.

Conclusion

The global increase in energy prices coupled with a new capacity build program by Eskom has led to significant increases in electricity prices. In addition there is growing concern over greenhouse gas emissions. This has led to electricity users examining energy usage and prompted the introduction of a number of energy efficiency programmes. Time-of-use tariffs which do not incentivise a reduction in energy consumption, do however encourage electricity consumption at off-peak times. Where possible, consumers on a TOU tariff should shift consumption from peak to off-peak periods. It was shown that this can lead to significant cost savings. While the practicality of this change in consumption is not always possible, a reduction in energy use through energy efficiency programmes will also lead to significant cost savings.

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