# Information Sheet

## 5.10 Energy inputs and electricity saving

In many irrigated scenarios, the water source occurs in low lying areas. Electrical energy is either required to lift water from the water source to the field edge or, electrical pumps are used to pressurise water for optimal distribution through modern discharge emitters. Electricity is a major cost component for irrigation and electricity tariffs have skyrocketed in recent times. This information sheet illustrates the factors that impact the electricity bill and how these factors can be manipulated to optimise the benefit from electricity consumption.

## Factors influencing Energy Use (EU) and energy cost in irrigation

Eskom energy costs are charged in units of Rand per kilowatt hour (R/kWH). The figure below illustrates what impacts on each of the components: Rand, kilowatts and hours.

**Energy Costs** → **R / kW H**

**Rand = *f* (Eskom Tariff options and Time of Use)**

**KW = *f* (Irrigation Design and Irrigation Management)**

**H = *f* (Irrigation Scheduling)**

In the remainder of this information sheet, the above-mentioned factors which play a role in determining the electricity bill are discussed in more detail.

## Tariff structure and charges according to time of use

The rural tariff options applicable to farmers consist of the Landrate, Ruraflex and Nightsave options. All tariff options include a fixed cost for the use of infrastructure, irrespective of whether electricity is used or not, and variable costs for the actual consumption of electricity.

The ***Landrate*** option is an electricity tariff for rural customers with a demand not exceeding 100 kVa. The energy charge is *fixed* and does not vary according to time of year, but is dependent on the size of supply.

The ***Nightsave*** tariff has a flat rate energy charge no matter what time of the day it is used, only increasing during the high demand months (June-August). This tariff has a maximum demand charge payable for peak times only. The kVa and energy charge varies according to the season (see Figure 1). The Nightsave option is best suited for high load factor applications e.g. 24x7 pumping for the month with a notified maximum demand of 25k Va and greater. These high load factor situations are not likely to occur in irrigation. The occurrence of rainfall, for example, will prevent continuous irrigation.

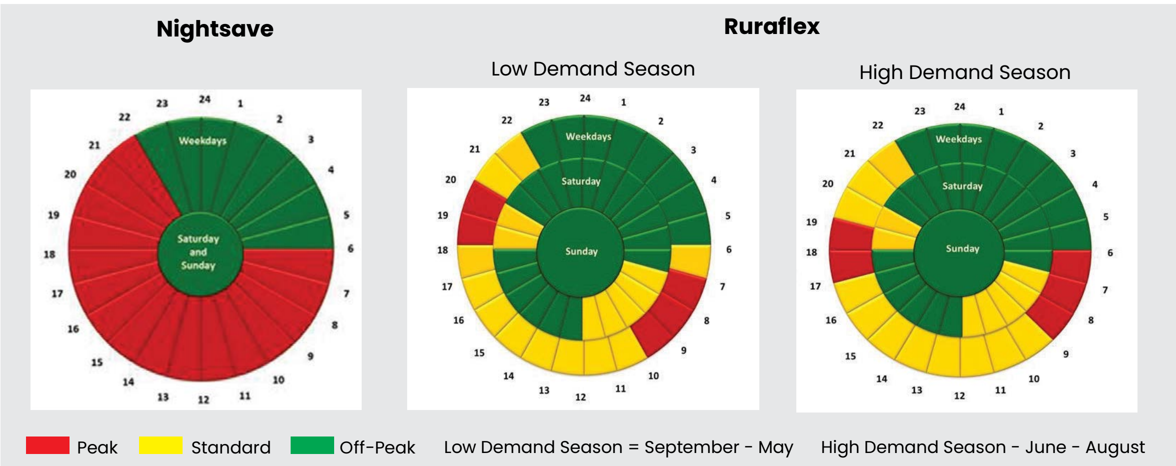



Figure 1. Designated peak, standard and off-peak periods for Ruraflex and Nightsave Rural tariff options.

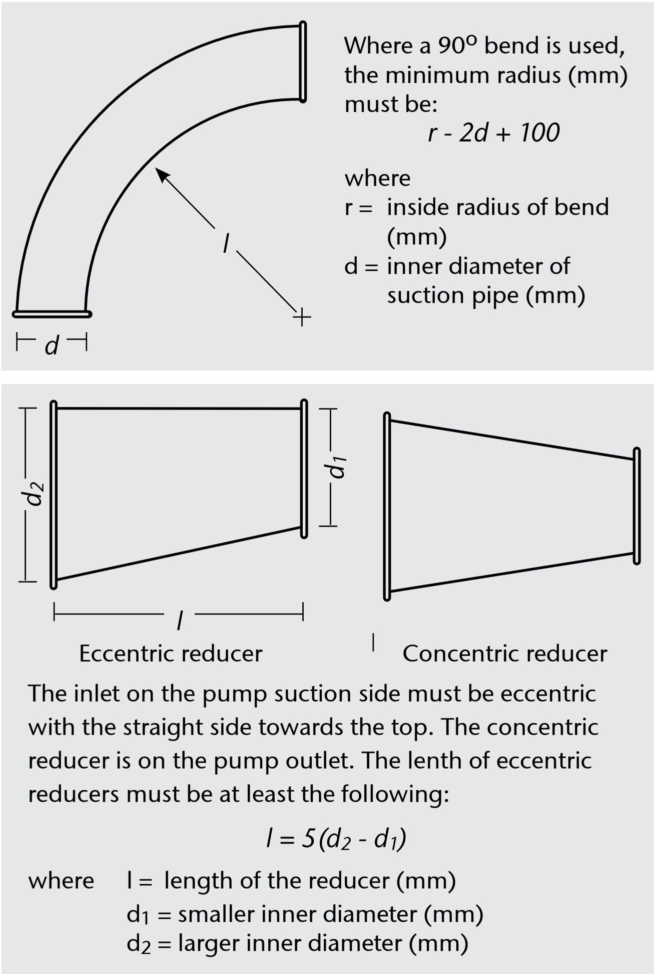
The ***Ruraflex*** option offers the most flexibility for irrigators and is generally the default option. It consists of basic charges according to supply size and energy charges depending on time of day and season (See Figure 1). It has no demand charge. The Ruraflex tariff provides opportunities where loads can be shifted to off-peak periods. In other words, use of electricity during low demand and off-peak periods is rewarded with lower charges.

All farms will have a unique set of constraints and care must be taken to ensure that the tariff option selected is most beneficial for those unique circumstances. Eskom field advisors should be approached to provide specialist advice on this issue. In addition, care must be taken to ensure that any strategy to reduce irrigation during peak electricity periods must be evaluated very carefully to determine the impact on cane yields, management and profitability before being implemented. *An Eskom Energy Advisor can be contacted on 08600 ESKOM (37566).*

## Irrigation design factors

The climate, soil, crop, water source, slope of land, pipe layout, irrigation system choice and area to be irrigated simultaneously (number of hectares) will naturally shape the irrigation design. In the design process, the required flow rate and pumping pressure head is used to select a suitable pump and motor, which ultimately determines the pumping energy requirements in kilowatts. Hence, it is important to ensure that both the design and installation adhere to SABI norms and standards. For example, sizing of main pipelines to minimise friction and pumping head requirements is key. Similarly, items in the pump house such as the allowable velocity in suction lines, the radius of 90° elbow bends and length of eccentric reducers relative to inlet and outlet diameters (see Figure 2) can have an impact on the frictional losses or pumping efficiency and therefore, the kW absorbed by the pumping system.

The pump and motor combinations should be selected for maximum pumping efficiency. Over-sizing of motors is common and can cause an unnecessary increase in energy requirements. The motor should be selected to operate at a high load and high utilisation. The key to an efficient pumping system is to select the best motor/pump combination at the design stage. If the better combination is more expensive, an economic evaluation should be conducted to determine if the possible savings in energy outweigh the additional capital cost. Similarly, if the current installed pump and motor combination are over-sized, the payback period from energy savings for reinvestment in correctly sized pumps and motors should be determined. The use of competent and professional designers cannot be stressed enough.




▲ Figure 2. Important SABI norms which influence energy use by pumps.

Consideration should also be given to variable speed drives if the operational requirements (flow rate and pressure head) are expected to be dynamic. For example, if for agronomic reasons such as fallows, dry-off or green manure crops, the number of blocks to be irrigated change considerably over time, the pump delivery requirements will also change. A variable speed drive is capable of matching the pump performance to the operating requirements by reducing the motor and pump speed (rpm), correspondingly reducing the energy (kW) absorbed.

## Irrigation management (including irrigation scheduling)

Irrigation design, installation and selecting the electricity tariff option are important, but typically, a once off event. Hence the opportunity to optimise energy use and costs through design or tariff selection is also, typically, once off (or less frequent). In this section the operational factors which routinely influence energy use are discussed. Careful planning and consideration must go into deciding which blocks/fields should be irrigated simultaneously. The infield flow rate, determined by the number of active discharge emitters, and the pressure head requirements, determined by the location of active discharge emitters (distance from and height above the pump), should always be aligned to the pump duty point. Failure to do so will result in the pump operating at a lower efficiency, resulting in higher energy use.

It should go without saying, that an irrigation system must be maintained to operate as per design. Leaking pipes, worn out rubber seals, nozzle and impeller wear, clogging of foot valves, etc., will all contribute to increased energy use and poor irrigation performance. Regular monitoring, maintenance and evaluation of systems are essential.

The *biggest opportunity* for reduced pumping hours is through better use of rainfall. Through effective *irrigation scheduling,* opportunities to switch off when rainfall occurs can be maximised, significantly reducing the amount of irrigation water pumped, and through that, reducing energy use.

Secondly, given that irrigation systems only need to operate at their peak capacity for part of the season, irrigation scheduling can inform when irrigation hours can be further reduced (as a result of reduced crop ET). During these periods, it is beneficial to operate the irrigation system at night whenever possible and only extend into electricity peak periods when irrigation demand requires it. Full use should be made of the off peak pumping opportunities, if on the Ruraflex tariff option. Practical application includes the use of timer switches to automatically stop and start the pump and infield control valves to schedule irrigation blocks.

Electricity tariff increases appears to be an ongoing phenomenon. Efforts to reduce the burden of electricity tariffs is, therefore, likely to be increasingly beneficial.

kVA = Kilovolt-ampere – which is the apparent power available via the ESKOM supply transformer.

kW = KiloWatts – represents the real power which can been drawn from the supply transformer.

The difference between apparent power (kVA) (power supply) and real power (kW) (power drawn) arises because of transmission losses/inefficiencies. The electrical transmission efficiency is normally expressed as ratio of real and apparent power and is called power factor PF = kW/kVA

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