

# Pumping system energy efficiency



## Introduction

High sugar cane yields in the Burdekin are possible due to an abundance of sunshine and the availability of irrigation. However, irrigation water is a major expense for canegrowers, and the costs of irrigation water and electricity for pumping have been rising. As a result, it is becoming increasingly important to apply the right amount of irrigation water in the most efficient way possible. Many Burdekin cane farms have old irrigation systems that weren't designed to optimise efficiency. Here we consider the energy side of the irrigation system and identify the most common areas where inefficiencies occur.

There is a theoretical minimum energy requirement dictated by the laws of physics to lift water (see the background info below), but a farm pumping system will have a higher energy requirement because of various forms of friction losses in the system. Pipes, valves, elbows, meters and outlets will add resistance to the flow of water. A pump must lift the water from the source, overcome these additional resistances, as well as meet the water velocity and pressure requirements of the system. All these factors increase energy consumption. We want to encourage you to consider the often one-time costs of increasing the efficiency of your pumping system relative to the ongoing costs of running a system that has not been optimised.

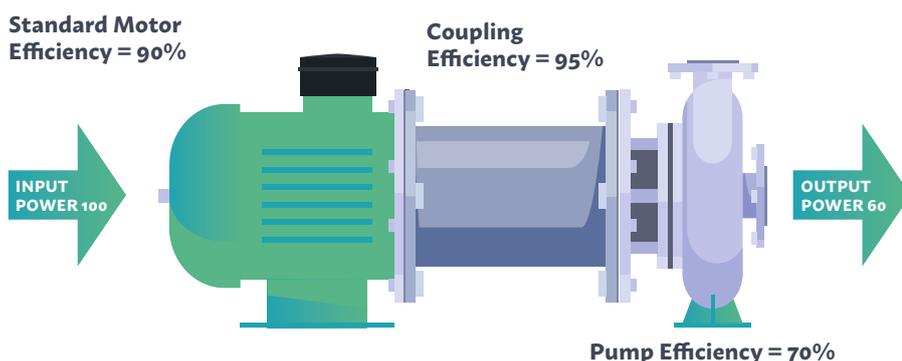
## Background

The energy demand of your pumping system depends on two things: the theoretical head, and the efficiency of this system to deliver the desired flow and pressure at the end point.

The theoretical head is the difference between the height of the water source and the height of the outlet. In a perfect world, 1 ML lifted 1 m requires 2.73 kWh of electrical energy.

Unfortunately, pumps are imperfect. An electric pump will have unavoidable energy losses: for example, in the motor (10%), drive train (5%) and wet end (pump) (30%). This increases the theoretical energy consumption to 4.55 kWh/ML/m. Efficiencies typically get lower with the age of equipment.

**Figure 1: Efficiency losses in a typical electric pump**



*Across the Burdekin, it is common to see sub-optimal irrigation installations, like this sharp elbow (pictured right) that will increase turbulence. See over the page for other features that may make your irrigation system inefficient.*



## How many of these problems does your pumping system have?

### The chosen pump doesn't match the demand of the pumping system

Was the pump selected on the static lift only, or was the total dynamic head determined? A butterfly valve may provide a quick fix to problems caused by an oversized pump but increases energy consumption. A variable frequency drive might help in this context but the cost should prompt a review to confirm a VFD would be the best fix.

### The diameter of pipe and fittings is too small for the required flow

Water has to travel faster through narrow pipe - this applies to the suction and delivery side of the pump. This adds unnecessary resistance to the system, and can make a significant reduction to the flow.

### Abrupt changes of flow direction

Any sharp bend, T-piece or cylinder entry causes more pressure loss than a smooth transition. Direction changes should be as gentle as possible to minimise the energy loss.

### Unnecessary fittings in the pipeline

Every elbow, valve or other impediment to undisturbed waterflow adds resistance.

### Cylinders are filled from the top

Filling a cylinder from the top pumps water to a height greater than is needed to get it to the block. This requires the pump to service that maximum height even if the required water level in the cylinder to push water to an outlet is much lower. If the pump connects to the bottom of the cylinder, it only has to service the actual height of the water level inside the cylinder.

## Conclusion

Upgrading an irrigation system often begins with the low-hanging fruit. That is, upsizing restricting choke points and getting rid of unnecessary bends and check valves, etc. Addressing these is cheaper than replacing long sections of pipeline, which may be prohibitively expensive. Once all possible efficiency gains have been made, it is then sensible to identify the right pump for your lower resistance irrigation system.



*Sudden changes in direction caused by T-pieces will increase turbulence.*



*This photo shows a pump connected to a cylinder via two unnecessary 90° direction changes.*



*Minimise pump energy use by connecting the delivery line to the bottom of a cylinder.*

To find out more about the Burdekin Irrigation Project contact **Terry Granshaw**, SRA District Manager - Burdekin [tgranshaw@sugarresearch.com.au](mailto:tgranshaw@sugarresearch.com.au) or call **0457 650 181**.

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