Irrigation in orchards

The 'Watts in Your Business' project has completed energy audits of 30 packhouses and orchards Australia-wide. This fact sheet shows how changing irrigation in orchards can cut energy use and save money.

The audits showed that across Australia irrigation is a primary user of electricity on an orchard. On average, 18% of a fruit business's energy use (orchard plus packhouse) is applied to irrigation.

The audits also showed that nearly 80% of businesses can upgrade their irrigation systems to save energy and money.

Not unexpectedly, the main energy savings come from the newer technologies – variable speed drives for pumps, modern high efficiency pump motors, and even new meters to measure the electricity used.

Top tips to cut energy costs:

- Install variable speed drives.
- Use high efficiency motors.
- Automate irrigation control.
- Choose smart meters and off peak pricing.
- Design irrigation efficiently.

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A pumping station with a high efficiency motor connected to a variable speed drive that is automatically controlled. FS2 (Sep 2014)

Irrigation inefficiencies

The wrong size motor for the job

Selecting appropriate pumps, motors and impellers to match the orchard's varying irrigation needs is important for efficient irrigation. Inappropriately sized motors can result in insufficient water supply to the orchard or cause excess electricity consumption. Consult specialist irrigation advisors and research manufacturer's data sheets and pump curves before selecting motors. Take into account the planted area, block size, site slope and crop water requirements during the season. Ideally motors should have variable controls to adjust to variable irrigation needs.

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Aged, inefficient equipment

Many motors used for irrigation systems are standard motors that have been rebuilt and rewound many times. Each time a motor is rebuilt or rewound efficiency is reduced. Advances in technology, design and materials mean that new motors usually have improved service life and energy efficiency.

Control inefficiencies

Manual timers, partially automated systems and fully automated systems are used to control irrigation systems. The use of inappropriate or poorly designed control systems can cause improper watering regimes that result in excessive water usage, electricity consumption and costs.

Unsuitable electricity tariff regime

Tariff regimes determine the price of electricity depending on when it is used. Inappropriate tariff regimes may result in overcharging and spending more on electricity consumption than necessary.

Inefficient irrigation design

A poorly designed irrigation system can result in inefficiencies in the motors, flow rates, pressures and filtration that can cause high electricity and water use.

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An older motor that has been left outside and exposed to the elements.

Costs, savings and payback periods for improving irrigation systems of audited businesses:

	Ave cost of upgrade (once off)	Value of average annual energy saving	Average simple payback period (years)
Meter exchange	$100	$1,293	0.1
Variable speed drives for pumps	$5,922	$1,066	5.6
High efficiency motors	$2,989	$436	6.9
And in the longer term…			
Automated irrigation controls	$81,339	$2,862	28.4

Solutions and opportunities

Install variable speed drives

A variable speed drive is used to adjust flow to meet the actual demand of a system and is fitted to the irrigation motor. This regulates the frequency of the electrical power supplied to the pump to match volume or pressure needs of the irrigation system.

On average an irrigation motor with a variable speed drive can reduce speed by 7% to 10%, which equates to 20% to 27% less energy consumption. The opportunity to retrofit variable speed drives to existing motors was available at 57% of the businesses audited.

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Use high efficiency motors

Standard electric motors generally operate at 88% efficiency to convert electrical energy to rotational energy. Modern, high efficiency motors generally operate at 93%.

High efficiency motors have a larger upfront capital cost than standard motors, but they offer a lower whole-of-life-cycle cost as a result of increased operating efficiencies. High efficiency motors could be considered as an alternative to standard motors when purchasing new motors. The opportunity to retrofit existing motors with high efficiency motors occurred in 63% of businesses audited.

Automate irrigation control

Many irrigation systems are manually controlled so orchard blocks are irrigated during the day. To use off- peak pricing tariffs, an automated irrigation system could be installed. Irrigation automation allows a manager to remotely set the area, frequency, start time, end time and the duration of irrigation.

Automated irrigation control is not viable if the orchard's main driver is financial savings through reduced electricity costs. However, the automated systems can increase the availability of staff and increase the reliability of scheduling irrigation events. The opportunity to install automated irrigation control systems was available at 10% of the businesses audited. This opportunity has limited capacity to reduce electricity use; however it reduces the electricity costs.

Choose smart meters and off peak pricing

Each electricity network and retailer offers a variety of different tariffs for supplying electricity to irrigation systems. Time of Use (TOU) tariffs may be available to orchards to enable them to take advantage of cheaper off-peak pricing for irrigating at night. To take advantage of this: select a TOU tariff, choose a smart meter or TOU meter and select irrigation times so equipment is on when electricity is cheapest. This can be done using automated controls, installing basic timers for pumps or manually turning irrigation on during off-peak times. This opportunity will only reduce costs, there are no direct energy savings, and was available to 17% of the businesses audited.

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A variable speed drive connected to an irrigation pump regulates the frequency of the electrical power supplied to reduce energy use.

Costs and savings of different irrigation options from audited businesses:

Electricity Meter Exchange	Range	National Average
Capital Costs	$0 - $640	$100
Annual Cost Savings	$149 - $4,724	$1,293
Simple payback (years)	0.0 – 0.9	0.5

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Automated irrigation controls	Range	National Average
Capital Costs	$10,000 - $119,000	$81,339
Annual Cost Savings	$1388 - $5,600	$2,862
Simple payback (years)	7.2 – 72.0	28.4

Variable speed drives	Range	National Average
Electricity Savings (kWh)	1421 – 26,294	5,493
Capital Costs	$2000 - $16,500	$5,922
Annual Cost Savings	$270 – $2,669	$1,066
Simple payback (years)	2.4 – 14.7	5.6

High Efficiency Motors	Range	National Average
Electricity Savings (kWh)	399 – 10,070	2,290
Capital Costs	$600 - $15,500	$2,989
Annual Cost Savings	$84 – $1,554	$436
Simple payback (years)	1.0 – 22.3	6.9

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Design irrigation efficiently

To analyse and audit the performance of an irrigation system, a detailed irrigation design is essential. A design outlines pumps, mains, lateral supply lines, flow rates and pressure and considers the orchard's location, production, climate and available natural resources.

Design tools such as IrriCAD Pro and HydroCalc can be used to build an irrigation design.

A specific irrigation design helps deliver water and nutrients to the crops with minimal water and energy wastage and maximum efficiency. For many orchards a total irrigation design is not practical because there are established crops and an existing irrigation system. However, as new blocks are established, this opportunity should be considered.

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