Energy Efficiency Case Study – Woolenook Orchard

The Woolenook mixed orchard, including wine grapes, stone fruit and almonds, is set over 120 hectares near Paringa in the Riverland region of South Australia.

The tree and vine crops are irrigated using pressure compensating drip emitters, spaced approximately 0.60 metre intervals. Water is supplied through both PVC and asbestos cement mainlines. Two pumps supply four irrigation blocks (J & H blocks and P & R blocks).

Audit results

In the 2014-2015 season, electricity charges for irrigation on the J&H and P&R blocks totalled $86,478 + GST, comprising:

- $36,250 + GST (J&H pump)
- $46,822 + GST (P&R pump)
- $3,406 + GST – Service and meter fees ($1,703 per meter)

A breakdown of cost by electricity use shows how energy is expended throughout the irrigation system and highlights how energy is lost through static and friction losses.

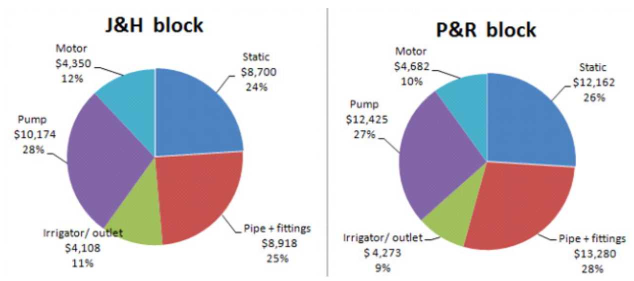

Table 1: Breakdown of irrigation costs by system component

Energy use

The irrigation systems were found to have the following energy requirements:

- J&H: 417 kWhr/ML
- P&R: 396 kWhr/ML

In comparison to the other systems audited through this project, the systems at Woolenook are in the higher range in terms of energy use. This is due to the higher static component as well as the pipe and fitting friction losses associated with the long conveyance distances for water.

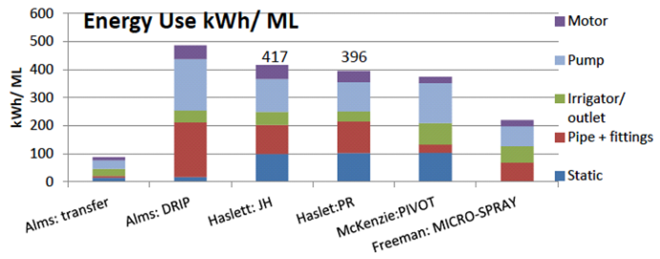

Table 2: Energy use (kWh/ML) for Woolenook in comparison to other audited irrigation systems

Energy costs

The cost of pumping a mega litre of water at Woolenook Orchards:

- J&H: $104.20 / ML
- P&R: $96.90 / ML

Considering just the cost per mega litre of water indicates that these irrigation systems operate at the higher end of the range.

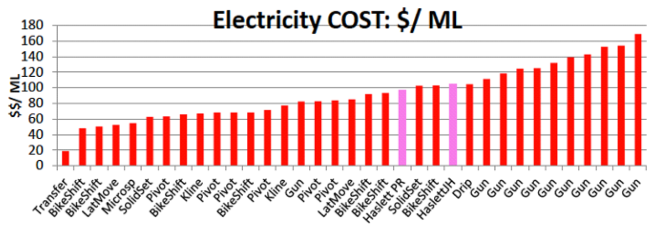

Table 3: Total electricity cost ($/ML) in comparison to other South Australian irrigation systems

However, when the length of mainlines is factored in, the systems are considered to be average or above average.

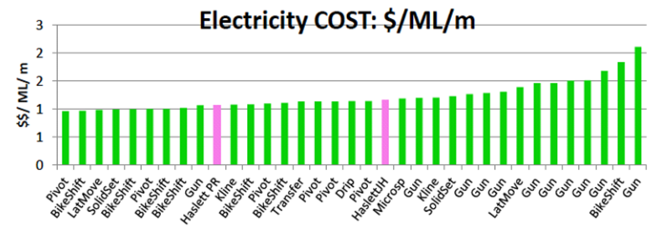

Table 4: Total electricity cost ($/ML/m) in comparison to other South Australian irrigation

Improving Energy Efficiency

For both irrigation blocks, installing an additional mainline would theoretically reduce pipe and fitting friction losses by 50%. Assuming the pumps for both blocks continued to run at the same efficiency, this would save approximately $7,400 (J&H blocks) and $10,463 (P&R blocks) in energy costs per annum. Further savings would also be likely through reduced energy losses at the pump and motor.

The estimated cost of upgrading both mainlines completely are in excess of $100,000, however, it may be feasible to upgrade sections of the mainline and associated fittings to gain better cost efficiencies and improve pressure available at the emitter. This is particularly the case where asbestos concrete mainlines are concerned.

Similarly, upgrading the pumps and motors would improve system efficiency, but may well require a level of up front capital that would deem the exercise financially unviable. The same applies to upgrades to the motors, although high efficiency motors should be considered as and when they need replacing. A high efficiency motor delivering up to 95% efficiency could in theory save a total of $4,305 annually.

Distribution Uniformity

Distribution uniformity was measured at 91% across all four blocks. While this is a positive performance indicator, there are emitters applying significantly less than the average application.

Running the system longer so underperforming emitters apply at least the average less 5% would equate to additional costs of $8,963 per annum.

Irrigation Scheduling

While the system emitters have a nominal application of 2.3L/hour, measurements taken show that the average application across blocks J&H are 2.6L/hour and 2.8L/hour on blocks P&R. If scheduling is based on the nominal application guidelines, this equates to an additional $13,319 in power costs per annum.

Electricity Tariffs

Because the annual energy consumption is greater than 100MWkr, the bills at Woolenook are deemed 'contestable' - meaning that monthly peak energy requirement charges will form an extra component of electricity cost on top of used electricity charges.

In 2014-2015, the tariffs for consumption were 31.0c/KWhr (peak) and 12.6c/KWhr (off-peak). On J&H blocks, 67% of energy used was at the peak rate and the remainder (33%) at the off-peak rate, equating to an average tariff of 25c/KWhr.

On the P&R blocks, 64% of electricity used was charged at the peak rate, with the remaining 36% at the off-peak rate, giving an average tariff of 24.5c/KWhr.

Additional fees included service charges of $1,570 for each meter.

A review of alternative tariff models revealed that the current tariffs are the cheapest currently available.

	Current efficiency rating	Inefficiency costs	Ideal efficiency rating	Potential savings
Pumps (J&H Blocks)	68%	$10,000	70%	$981
Motor (J&H Blocks)	70.5%	$4,300	94%	$2,314
Pumps (P&R Blocks)	88%	$12,000	76%	$3,379
Motor (P&R Blocks)		$4,700	94%	$1,992
	Total inefficiency costs per annum	**$31,000**	**Total potential savings per annum**	**$8,766**

Table 5: Potential costs savings through improved energy efficiency measures

Alternative energy sources

Diesel

At the time that the audit was undertaken, a highly efficient diesel genset could feasibly produce electricity for the same price as the grid tariff (25-26c/kWhr). Given the investment and maintenance costs involved in having a genset unit, it is unlikely that diesel generated power would be cost effective option.

However, since then the cost of peak and off-peak power has continued to rise, so reviewing the suitability of a genset unit could well be worthwhile.

Woolenook has already installed one diesel genset to operate an on-site fruit processing facility in response to the high costs of upgraded grid energy supply infrastructure.

Because Woolenook uses more than 100 MW/hr/year, demand charges are significantly higher than actual energy use charges. Therefore generating electricity via a diesel genset may enable them to avoid costly peak demand spikes during the irrigation season.

An on-site diesel genset unit has been installed to help reduce the costs associated with processing fruit.

Solar PV

The nature of irrigation limits the benefit of solar photovoltaic (solar PV) systems because power is used intermittently rather than consistently. Additionally, electricity is produced during sunlight hours, but irrigation is often delivered at night to reduce water losses through trans evaporation.

With a lack of effective power storage solutions, solar power systems generally present irrigators with little benefit. However, if irrigation scheduling can maximise the solar PV generated (i.e. irrigation is delivered during the day), there may be an advantage over grid-based electricity.

For example, using the average pump hours per day for the J&H blocks for the 2015-2016 season, a 100KWp solar system would have a payback period of around five years. In this scenario, irrigation would need to be scheduled to work every day, except when water is not required.

Almond Trees blossoming at Woolenook.

For more information

Jeremy Nelson Project Officer – Sustainable Agriculture

Natural Resources South Australian Murray Darling Basin
2 Wade St, Berri, SA, 5343

Tel: (08) 8580 1800
Mob: 0429 845 216
Email: Jeremy.nelson@sa.gov.au

www.naturalresources.sa.gov.au/samurraydarlingbasin

This project is supported by the South Australian Murray-Darling Basin Natural Resources Management Board, through funding from the Australian Government's National Landcare Programme and the NRM Levies.