Energy Efficiency Case Study – Whispering Pines

Warren Jacobs owns and operates Whispering Pines Dairy at Mount Compass in South Australia – a 272 hectare property with a herd of 400 milking cows. With the aim of identifying strategies to reduce the cost of electricity, the enterprise was audited as part of Natural Resources SAMDB's energy efficiency project. The specific focus of the audit was to ascertain the energy efficiency of the milking operation.

Energy use and costs were analysed across the systems involved in milk harvesting, milk cooling, heating water, cleaning, removing effluent, delivering water to livestock and the dairy, feeding livestock (mills and augers) and powering the shed and office.

Audit results

During the 2014-2015 financial year, the total cost of electricity was $29,513 + GST, comprising:

$28,089 + GST electricity used
$1,424 + GST meter fees and charges

To understand the spread of energy use and costs of the core functions of the dairy, and the systems used within these processes, energy consumption rates and costs were broken down:

Cooling the milk accounted for the largest portion of power consumption (56%), followed by heating water (20%) and delivering water to livestock and the dairy (11%).

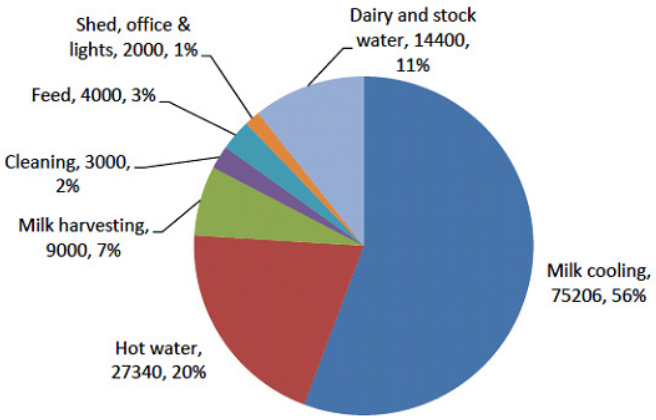

Table 2: Breakdown of dairy costs by system component

85% of electricity was sourced from the grid and the remaining 15% was generated by on-farm solar photovoltaic (solar PV) panels.

Function	Equipment	Total Consumption (kWhr)	Cost
Milk harvesting	Vacuum pump, Milk pump	9,017	$1,848
Milk cooling	Vat compressor, Compressor fan, Chiller compressor, Chiller fans, Chiller pumps, Vat agitator	75,218	$16,473
Hot water	Plant wash hot water service, Vat wash hot water service	27,380	$3,417
Cleaning and effluent	Water transfer pump, Yard wash, Shed wash	3,002	$645
Stock and dairy water	Pressure pump	14,427	$4,407
Feed	Feed mill, Delivery augers, Cablevey motor, Auger	4,044	$869
Shed, lights and office	Electric fence, Fridge, Air compressor, Fans, Single tube fluro	1,997	$429

Table 1: Summary of energy use and costs for Whispering Pines Dairy

Energy use benchmarks

Overall, Whispering Pines fared well in comparison to other dairy farms in South Australia. Even without factoring in the cost savings achieved through on-farm generation of energy through the solar PV unit, the enterprise uses only 42kWhr / 1000l of milk produced, less than the average. Solar reduced the theoretical energy cost from $8.80kWhr / 1000l of milk to $7.10, compared with the state average of $11.60.

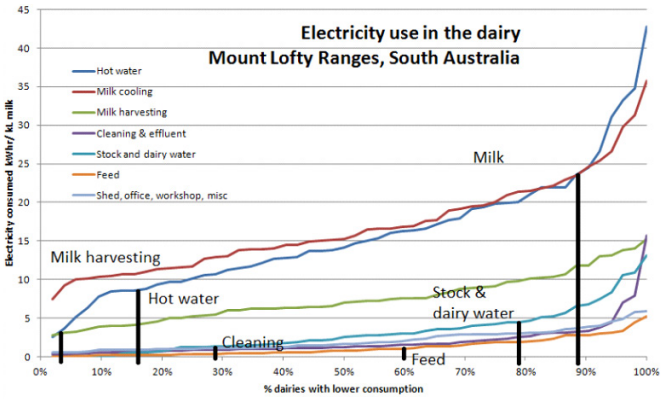

Table 3: Electricity consumed by component, in comparison to other dairy operations in the Mount Lofty Ranges

Milk harvesting

Costs associated with milk harvesting were lower than the average within the comparison groups, in terms of kWhr/kL of milk. A variable speed drive (VSD) is connected to both the vacuum and milk pumps, which can save up to 30-50% of energy consumption. A 40% reduction in energy use saves 6,850kWhr per year, worth $1,438 at the current tariff rate.

Ensuring the vacuum pump is switched off when not in use could further reduce costs, as the 9.0kW motor costs approximately 60cents per hour. Regular maintenance is essential including checking the VSD for efficiency.

Milk cooling

Costs involved with cooling milk were at the higher end of the comparison group. Recorded data shows that carrier compressor was operating at around 2kW, well below its 4.1kW rating, effectively doubling the consumption of kWhr / year.

Although compensating for this inefficiency accounts for $7,446 in electricity costs, the solar PV unit supplies a portion of this power. Ironically, if the performance of the compressor increased, the value of the solar PV system would be reduced (more power would be sold back to the grid), but it would still be worth engaging a technician to diagnose the issue.

Hot water

The hot water systems were found to be working efficiently and within the range of industry expectations. Typically, 480L of hot water was used per milking shift (12L/cow/milking) to wash down plant, well within the common range of 7-15L/cow/day.

Vat washing is undertaken daily at Whispering Pines, using 250l at 70° for 75% of the year. With a 14,000l vat, this equates to 1.7% of the vat capacity, within the 1-3% common range.

The hot water services used allow a sufficient amount of water to be heated overnight, utilising off-peak tariff rates. For this reason, they are considered to be the best systems for the enterprise.

Lights and fans

Currently, 20 single fluorescent tubes are used to light the dairy, operated for around 6.5 hours per day for 30% of the year. As the battens need to be replaced in the near future, a cost analysis was undertaken as part of the audit to identify the most cost effective solution.

LED tubes were considered to be the most appropriate option given they use around 50% of the electricity that fluorescent tubes do, and have a significantly longer life span (five times longer).

		Existing system				Upgraded System				
	Number	Hours of use / day	kWhr / day	kWhr / year	kWhr / year	Savings/ year	Purchase cost per unit	Installation	Total costs	Payback time (years)
Lights	20	2.0	1.8	657	329	$71	$70	$1000	2400	34
Fans	6	1.1	0.7	241	157	$34	$200	$1000	2200	64

Table 4: Payback timeframes for upgraded lighting and fan systems

Upgrading the fans in the shed could also achieve a reduction in energy costs. Currently the five fans being used consume up to 100W and newer energy efficient DC motor fans consumer 35W. A cost benefit analysis shows that replacing the current fans is not a worthwhile exercise in itself, but may be an option once the current system reaches it's natural end.

Solar PV

An on-farm solar photovoltaic (Solar PV) system with a capacity of 15.3kWp was installed in 2012, and is used to generate electricity to supplement grid-supplied energy. The system was assessed as part of the audit to see how well it was producing electricity, and how much energy it is likely to produce in an ongoing capacity.

Monthly PV generated

Month	PV amount (as per from system monitoring) (kWhr / month)	PV amount (as per Bureau of Meteorology records) (kWhr / month)	Difference
January	2,862	2,297	-20%
December	2,766	2,348	-15%
November	2,491	2,315	-7%
October	2,106	2,163	+3%
September	1,544	1,795	+16%

Table 5: Solar PV production comparison between monitoring and solar radiation levels (taken from Bureau of Meteorology records)

Data monitored over the five-month period shows that the amount of PV generated by the solar system at Whispering Pines is similar to Bureau of Meteorology (BOM) records of solar radiation, indicating that the system is operating well. Using the BOM data and system capacity, it is estimated that an average of 20,990 kWhr of electricity will be produced per year by the solar PV system. In the 2014-2015 financial year 20,647 kWhr of solar PV generated electricity was used by the farm representing a saving of $5,242 + GST in energy costs.

A total of 1,813 kWhr of power was fed into the grid during year, the equivalent of 9% of solar PV energy produced.

Other savings

Additional savings could be realised through the following strategies:

- **Switching off equipment when not in use** eg lights, fans and pumps. The milk vacuum pump should be switched off before the tank is full (to prevent overflowing as well as wasted electricity costs). An automated system may present an advantage here.
- **Regular and ongoing maintenance of equipment** to maximise energy efficiency. Compressors should be serviced yearly to clean dust and dirt of the fins, replace damaged fins. The anodes in the hot water services should also be checked and replaced if required.
- **Replacing equipment with energy efficient models.** While many immediate system upgrades are cost prohibitive, it is worthwhile considering upgrading units when they reach the end of their natural life.
- **Solar pumping.** As a pump reaches the end of its life, it would be worth considering replacing it with a solar pumping option. This is especially applicable to pumps that are operated during peak demand periods. Solar units require the capacity to store energy for several days, to allow for days where the pump is not operated.

Compared to other dairies in the area, the systems involved with milk harvesting are operating in a relatively efficient manner.

Whispering Pines Dairy, at Mount Compass in the Adelaide Hills.

For more information

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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.