# CARBON READY DAIRY DEMONSTRATION PROJECT

# DAIRY ENERGY EFFICIENCY – REFRIGERATION HEAT EXTRACTION

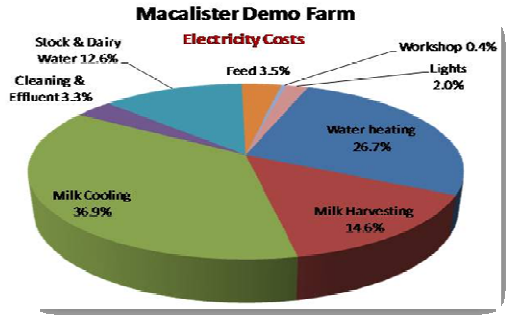
Information Sheet 10
JUNE 2011

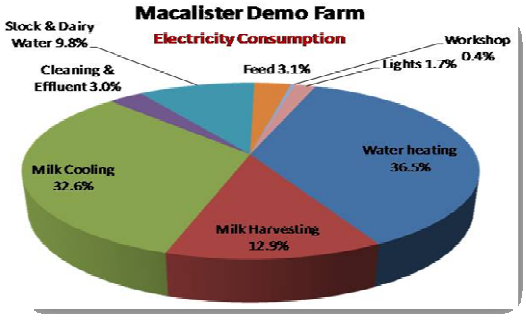
## BACKGROUND

In May 2009 the Macalister Demonstration Farm (MDF) made a successful application for a project to undertake a carbon emissions audit of the farm as a case study. The project is known as the 'Carbon Ready Dairy Demonstration' and will identify the source and size of carbon emissions generated by normal operations. This information has then been used to develop a Carbon Emissions Reduction Plan that includes strategies to minimise and offset carbon emissions and an analysis of the financial impact of the plan on the farm business.

With agriculture excluded from the proposed carbon trading scheme, the focus of the study shifted to farm inputs that would experience a price rise as a result of a price on carbon emissions. The greatest price rise is anticipated in power costs so a focus on reducing electricity consumption not only reduces emissions but reduces costs and, so, protects the farm business. The biggest user of power is the dairy so we invested in an energy audit at the dairy. However, it took some time to find someone who had expertise in not only energy use but was also very familiar with dairy plant operation. AgVet Projects in Warragul met the standard we had set and were excellent to work with. The audit report highlighted that milk cooling and water heating are the biggest energy users and should be the focus of our energy saving plan (Fig. 1).

***Fig. 1: Electricity consumption and electricity costs at the MDF dairy***




Of course, electricity costs are not exactly the same as electricity consumption because some of the consumption, like hot water, is only at off-peak power rates. But electricity consumption is directly related to the carbon emissions generated so if milk cooling and water heating can be reduced then carbon emissions will fall.

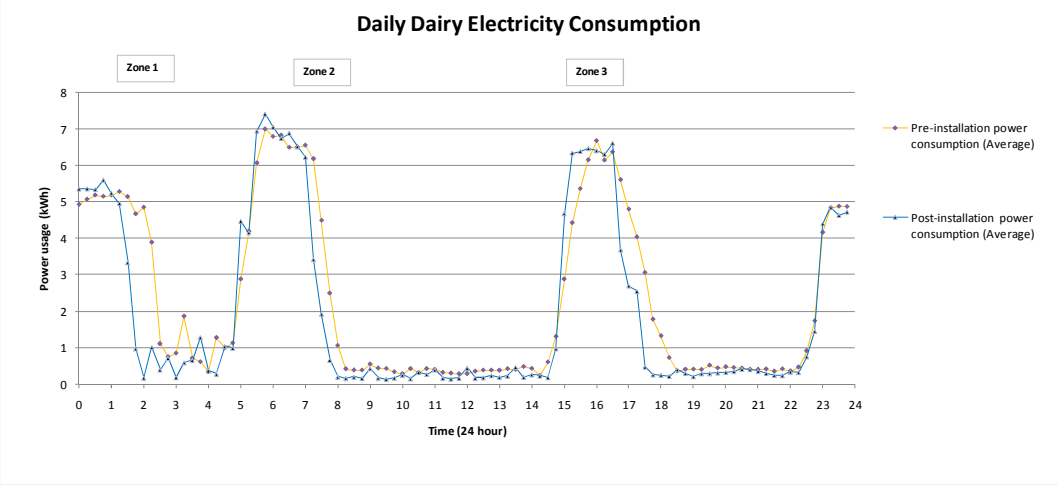
Apart from making sure that the plant is running efficiently and energy is not being wasted through poor practices, there are a number of investments that might be considered to reduce electricity consumption. One that was identified during the dairy energy audit was the installation of a heat recovery unit on the refrigeration compressor to lower the temperature of refrigeration gases. This not only improves the cooling efficiency of the system but traps heat from the milk that would otherwise be wasted to the atmosphere. Performance data suggests that the gain from a heat recovery unit may be equivalent to lowering the temperature of milk entering the vat by 2-3$^{o}$C while the heated water could be used as a feed for the hot water services. In both instances this is an energy saving. We decided to install and test a unit to see how much in emissions and how many dollars could be saved.

A 'Superheater' unit was installed in May 2011 (see Box for technical specifications) and measurements were taken every fifteen minutes of pre- and post-installation power consumption. This is presented in Fig. 2. There is a noticeable difference between the power consumption curves after installation of the unit. Zone 1 represents the power used to heat hot water using off peak power. The 'Superheater' has been installed so that it stores 450 litres of water warmed to 45$^{o}$C until 11pm when it is then used to feed the main 1000 litre hot water service. This means that the hot water service heats water with an incoming water temperature of 32$^{o}$C up to 90$^{o}$C rather than from an incoming water temperature of 18$^{o}$C prior to installation. The result is that the hot water service now operates for about an hour less each day and saves about 20% of water heating costs or a little more than 12kWh per day.



Information Sheet prepared by Neil Baker MDF Contact on 0488 175 366 or neilbaker@aapt.net.au

***Fig. 2: Daily Dairy Electricity Consumption before and after 'Superheater' installation***




Zones 2 and 3 represent the power consumed to chill the milk going into the vat. At each of these times the hot water service is not operating and when these measurements were taken the farm was on a night pick up. You can see that the vat chiller runs for a shorter time after both the morning and afternoon milkings because of improved cooling efficiency. The result is that electricity consumption for vat refrigeration is down, saving about 18% of refrigeration costs or 14 kWh per day (Table 1).

***Table 1: Water heating and milk cooling savings with a 'Superheater'***

| Source of saving | Saving (kWh/dy) | Saving ($) |
|---|---|---|
| Water heating | 12 | $1.48/day |
| Vat cooling | 14 | $3.02/day |
| Total | 26 | $4.50/day |
| NOTE: Off-peak power - 12.03 c/kWh includes weekends; Peak power - 25.403 c/kWh | | $1,373/305 day lactation |

| | |
|---|---|
| Unit cost (incl. installation; excl GST) | $7,500 |
| Payback (assume 305 days of savings; no interest on borrowings) | 5.5 yrs |
| Payback (assume as above plus impact of carbon price on electricity costs) | 4.8 yrs |

With a saving of $1,373/year on dairy electricity and the 'Superheater' under warranty for five years we can expect to have continued savings for at least a further ten years on the unit. The benefits will become even more significant as power costs rise, particularly with the advent of a carbon tax or carbon trading scheme. As well as savings on the power bill, a drop in power consumption of 26 kWh/day or 7,930 kWh/year equates to an annual reduction of 11 t CO2-eq in carbon emissions. While this represents only 0.5% of total farm emissions it is a productive contribution towards the national target of a 5% reduction in emissions by 2020 without threatening business viability.

**SuperHeater**

**Commercial Heat Recovery unit**

- 450 litre pressurized
- Connection of up to 2 compressors
- Stainless steel outer skin
- Safety relief valve
- Internal vessel pressure tested to 250 PSI
- Fully insulated
- Dimensions: 750 x 1575mm
- Refrigeration connection size: 1 1/8"
- Inlet & outlet pipe size: 1 ¼" NPT
- Shipping weight: 189 kilograms

***This project is supported by funding from the Australian Government Department of Agriculture Fisheries and Forestry under its Australia's Farming Future initiative.***

Australian Government
Department of Agriculture, Fisheries and Forestry



**Information Sheet prepared by Neil Baker MDF Contact on 0488 175 366 or neilbaker@aapt.net.au**