Australian Government
Department of Industry and Science

Dairy Australia
Your Levy at Work

Smarter energy use on Australian dairy farms

Dairy energy audit lessons

Summary of the opportunities revealed by on-farm energy audits conducted in the Australian dairy industry.

Since 2012 almost 1,400 dairy shed energy assessments have been conducted in all dairy regions across Australia as part of the national Dairy Australia project *Smarter Energy Use on Australian Dairy Farms*, funded by the Department of Industry and Science as part of the Energy Efficiency Information Grants Program.

Introduction

The Energy Efficiency Information Grants Program provided funds for trained assessors to evaluate energy use in Australian dairies and identify opportunities to reduce consumption in order to lower energy cost and improve efficiency. After a detailed evaluation of annual energy, the farm owner/manager is given a report that identifies where energy is currently being used, whether the dairy system is working as efficiently as it should, and what improvements can be made to reduce energy consumption. It is then up to the farmer to implement the recommendations as they wish.

The following information is a summary of the sort of issues encountered by assessors during the delivery of on-farm assessments.

Dairy energy audit – the issues revealed

1. Milk cooling

Pre-cooling at the plate cooler and chilling in the vat

Plate coolers are a relatively common source of problems, especially when not working properly because of leaks, or blockages that reduced water or milk flow. It's easy to check if the plate cooler is working as it should – just measure the temperature of the water going in to the plate cooler and measure the temperature of the milk coming out – the milk should be no more than 2–3°C warmer than the water. If the temperature difference is greater than this, check the flow rate – it should take two or three times as long to fill a bucket with milk leaving the plate cooler than it takes to fill the same bucket with water. If the flow rate of water is too low, slow the flow of milk to the plate cooler or increase the flow of water. Check that the plate cooler pump can give you the flow you need and, if not, consider replacing it. Seek advice and get one well suited to the task.

If your access to water is limited by the source, for example from a bore or town supply, consider installing a storage tank to hold as much water as required for a milking so it can be supplied unrestricted. You can recirculate water to this tank, use what you need for cleaning, and then top the tank up from your usual supply to lower the temperature again.

Remember to pump water to storage in off peak.

The temperature of your plate cooler water could also be costing you money. Always go for the coolest source of water you can find. Channel or dam water might be convenient but in summer it can easily reach 28°C and is expensive to refrigerate. Bore water is typically 18–19°C and is a good source of plate cooler water.

Vat refrigeration and chillers are a bit of a technical mystery to most and tend to be ignored until they break down. There are cases where one of a bank of compressors was not working, placing the others under increased load and losing efficiency. There are two rules of thumb for vat refrigeration and chillers: if the milk entering the vat after passing through a glycol chiller is more than 2°C warmer than the glycol, get it checked out. Without a chiller, the vat refrigeration unit should be able to cool 60% of the volume of the vat to 4°C within three and a half hours of the start of milking. This can be complicated by a poorly performing plate cooler (so check that first) or by a very slow milking (a large herd passing through a small dairy). Talk to your refrigeration expert to find out what your vat should be doing.

Figure 1: Is your plate cooler taking enough heat from the milk?
At 6°C difference this system needs checking.

2. Cleaning
Vat cleaning cycles are generally set by the vat manufacturer and use small amounts of hot water, so are best left alone. However, there are variations in plant wash cycles. Some plant installers set the same cleaning cycle no matter what the system, and some farmers set the cycle according to what their father did, no matter how many dairies ago that was. Seek expert advice on the best cycle for your plant. Extra hot water is extra money and it's down the drain if you don't need it.

Another option is to consider some of the newer chemicals on the market that work at a lower temperature. Turning back the dial on your hot water service is an easy way to save.

3. Water heating
There are two main questions to ask when looking at water heating – is the water at the right temperature (not too hot, not too cold) and does the amount being heated match the needs of the cleaning cycle?

The temperature of the vat hot water should be 65–70°C and, because it is typically only used once a day, the time of refill is not so important as it will reheat overnight. The temperature of the dairy plant hot water service should be set at 92°C allowing the morning wash to begin at this temperature. By afternoon the temperature, without further heating, will fall to about 82°C, at the lower end of what is acceptable. It is not uncommon to find plant hot water services filling up during the day and lowering the temperature of the water in the tank even further, possibly compromising what should be a hot wash at afternoon milking. This is usually caused by the failure of a timer so keep a careful watch on your timers. If you do the machine wash before 7 am during off-peak this will let the tank refill, so alter your hot water time clock to turn off at 6 am if this is the case.

Check the temperature of plant hot water regularly – if it's not 90°C before the morning milking and 82°C+ before the afternoon milking, then find out why.

It's also worth checking how much hot water your milking plant needs in the cleaning cycle and compare with how much you have in storage. On most farms this is not an issue except where heat pumps have been installed or the hot water service is home built. Too often there is more water warmed in the heat pumps than can fit into the plant hot water service. Turn off and disconnect what you can't use. If you can adjust the water level in your hot water service then make sure it matches how much you use each day. Don't pay to heat more water than you need.

Don't assume that your heat pumps are working – you need to check. On farms where heat pumps are not working, water enters the hot water system much cooler than expected. Heat pumps need maintenance too.

Figure 2: Heat pumps
Do you have too many?

Last thing about hot water – do you know how much a dripping hot water tap costs you? It could be as much as $1,000 per year! But that's nothing compared to a leaking hot water service, particularly if you have to keep it filling and heating during the day to give you enough hot water for the afternoon milking. Don't delay – get it fixed or replaced.

4. Equipment
Make sure when you replace a pump in an emergency, you don't forget to go back to it once the pressure is off and make sure you have installed the right pump for the task. There are many examples of the wrong pump for the job costing money in inefficient pumping.

Where are the opportunities?

The number one priority is to have all of your dairy plant, water heating system and cooling system running exactly as it should. But there are a couple of options to consider:

Pre-heating water
There are many ways to pre-heat the water that goes into your hot water service – options include solar hot water systems, heat pumps, and heat extraction from refrigeration units. The number one rule when it comes to pre-heating is to work out which one is best for your system. You only need to pre-heat water once so to add any other system is a waste of money.

Heat pumps are three times more efficient at heating water than your standard hot water service and can be a good option. If you have enough heat pumps installed to supply both hot water systems, consider dedicating one heat pump to the vat wash and deleting the domestic water heater. Heat pumps bring water to the right temperature for the vat wash so you don't need to have two hot water systems to do the same job. Heat pump hot water units should be run off-peak and charged to temperature before being sent to the main bulk cylinder, so starting the heat pumps at 11 pm and the main cylinder at 1 pm will still allow plenty of time to charge the main cylinder to temperature, especially if the incoming water is at 60°C.

On the other hand, solar hot water systems and heat extraction from refrigeration units have few moving parts and, once installed, give you access to solar energy which is abundant and refrigeration heat which is a waste product. You will need to think about where you can mount solar panels to get the best orientation to the sun and be aware that to get the best value out of a heat extraction unit you need to have reasonable shed time, i.e. if you only milk for one hour it will be too quick to get a reasonable hot water charge. Spend time investigating what will work best for you.

The decision of what to install comes down to the effective lifetime of the unit, payback period for the investment and ongoing running costs (if any). Every farm is different so become as well informed as you can to make the best decision for your farm.

Remember to base you payback figures on your off peak power rate only as you should be making all your hot water in off peak to begin with.

Vacuum pumps
There are many questions about fitting or buying new a Variable Speed Drive on the vacuum pump. This makes sure that the pump works as hard as it has to and can be quite an energy saver. With the cost of running a vacuum pump between $2,000–$8,000/year (and well over $10,000/year in a big operation) the right decision will depend on what the capital cost is and whether the return on that investment is worth it.

Remember, every dollar saved goes straight into your pocket. And every tonne of carbon dioxide saved can be counted against the dairy industry's contribution to emissions reduction – that's good for the environment and good for the industry.

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