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Energy Efficiency in the Dairy Shed

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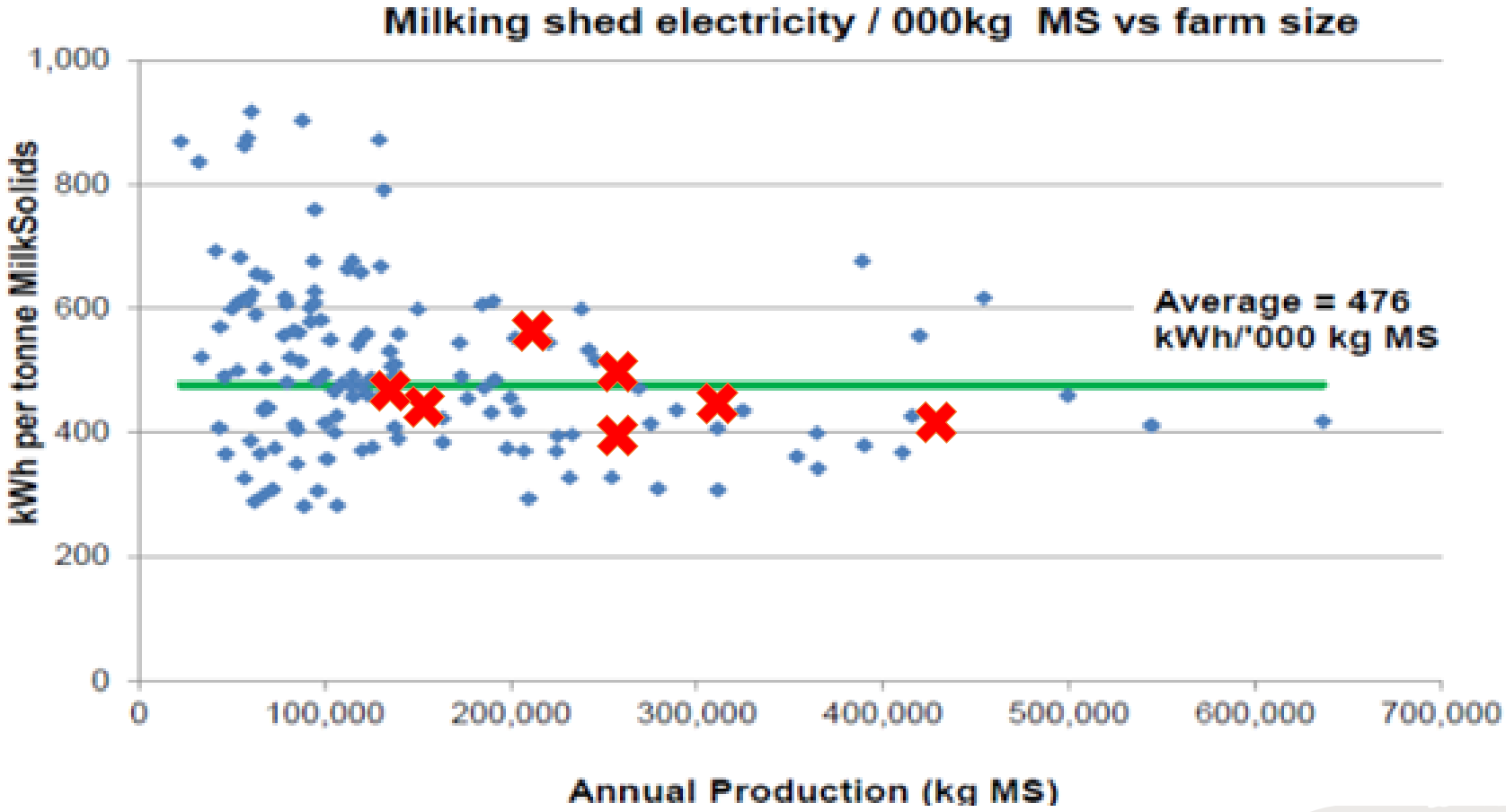
Taiari Dairy Shed Survey

Seven farms in the Taiari Catchment area were visited to assess energy efficiency.

- General trend of “economies of scale”
- Heat recovery is the biggest opportunity to improve efficiency for all sheds visited
- Comparison between sheds is not completely reliable

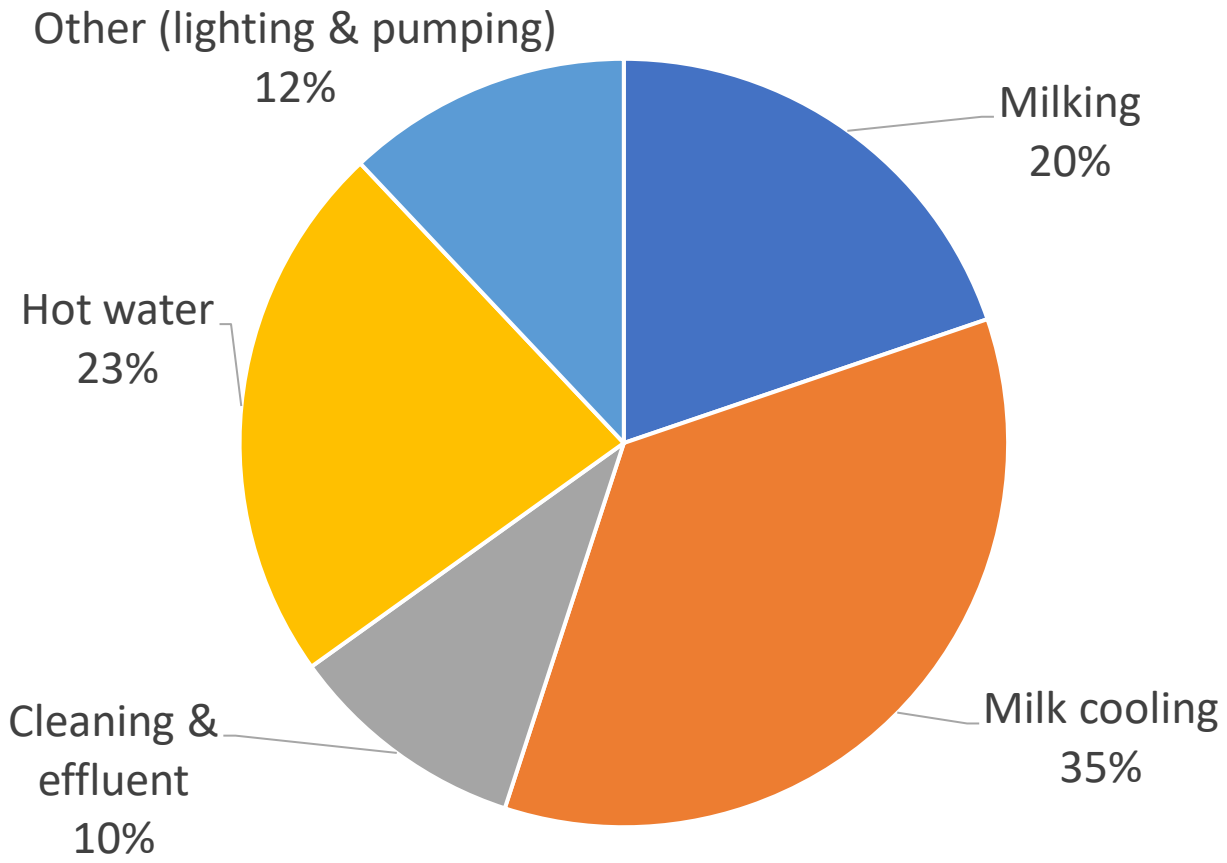
Shed #	Herd Size	Bales	Shed type	Annual kWh	kWh/ tMS
Shed 1	830	60	Rotary	169,900	409
Shed 2	630	54	Rotary	127,250	414
Shed 3	530	28	Rotary	125,320	482
Shed 4	500	40	Herringbone	74,730	393
Shed 5	400	40	Rotary	107,765	536
Shed 6	300	24	Rotary	68,065	454
Shed 7	280	30	Herringbone	63,000	467

Energy use benchmark



Source: DairyNZ Presentation "Energy Use on the Dairy Farm", April 2015

Energy use breakdown



Useful to understand where energy use is being used on the farm.

Concentrate on the big pieces of the pie.

- Hot water
- Milk cooling
- Milking equipment
- Pumping

How can I assess my own farm?

You will need:

- Energy use and milk production data to calculate your kWh per tMS (12 months)
- PVC stick-on thermal strips or other temperature measurement device
- Ears
- Eyes

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Hot water system

Check to make sure the HWCs aren’t oversized. More than 100L in excess of requirements should be remedied. “Working volume” of cylinders can be reduced by adjusting ball cocks or level sensors.

Check for evidence of leaking hot water (internal and external). Internal leaks look like hot pipework.

Flash steam is indicative of avoidable heat loss.

Condition of lagging? Check for cracks or corrosion.

Heating schedule? Just-in-time heating is most efficient, night rate heat may be cheaper. Aim to reduce the time tanks spend at operating temperature.

Milking equipment

Vacuum pump is the big fish, best practice (for energy efficiency) is a rotary vane pump with a variable speed drive (VSD). A VSD can reduce energy use and improve vacuum control.

Bleed valve actuation – the sound of frequent or continuous air rushing through the valve is just wasted energy! In this case, a VSD would be advisable.

Rotary sheds vacuum systems typically more efficient.

Transport pumps – not much that can be done, check that washdown and sump pumps are not running unnecessarily.

Milk cooling

Plate heat exchanger pinch temp – 2 °C ideal – over 10 °C means something isn't working right. Cooling with bore water is the best!

Milk can level control / VS milk pump – steady flow of milk enables best cooling performance.

Heat gain in the vat can be reduced by ~80% using a vat wrap on an uninsulated vat. Vat outside surface temp can be as low as 5 °C.

Insulating the larger, low-pressure gas line back to the compressor improves cooler performance.

Heat recovery

Milk cooling creates a significant amount of waste heat that can be recovered to offset hot water energy demand.

Systems to protect from freezing and bursting in winter are essential!

A well-tuned desuperheater can generate 50 °C water, but this is only useful if the warm water has somewhere to go.

Maximise recovered heat – buffer tank is required.

Without buffer tank, ~20% of water heating electricity use could be saved.

Transport pumps

Typically, the effluent pump is the largest pump on the farm.

Positive displacement type pumps are best practice for effluent pumping applications. However significant cost of replacement is hard to justify on energy savings alone.

If your effluent pump needs replacement – consider a positive displacement pump!

4kW PD pump can do the job of a 15kW centrifugal pump. Efficiency increase from ~20% to ~70%.

Power factor correction capacitors should be checked in older sheds.

Lighting

Replacing fluorescent tubes with LED fittings reduces lighting power demand by ~50%. This is not typically justifiable.

Drop-in LED’s for fluoro fittings do not save much power (Ballast).

Best practice for lighting efficiency looks like:

- Occupancy sensors for non-milking areas in the shed
- Daylight sensors for yard and shed lighting.

Solar for the milking shed?

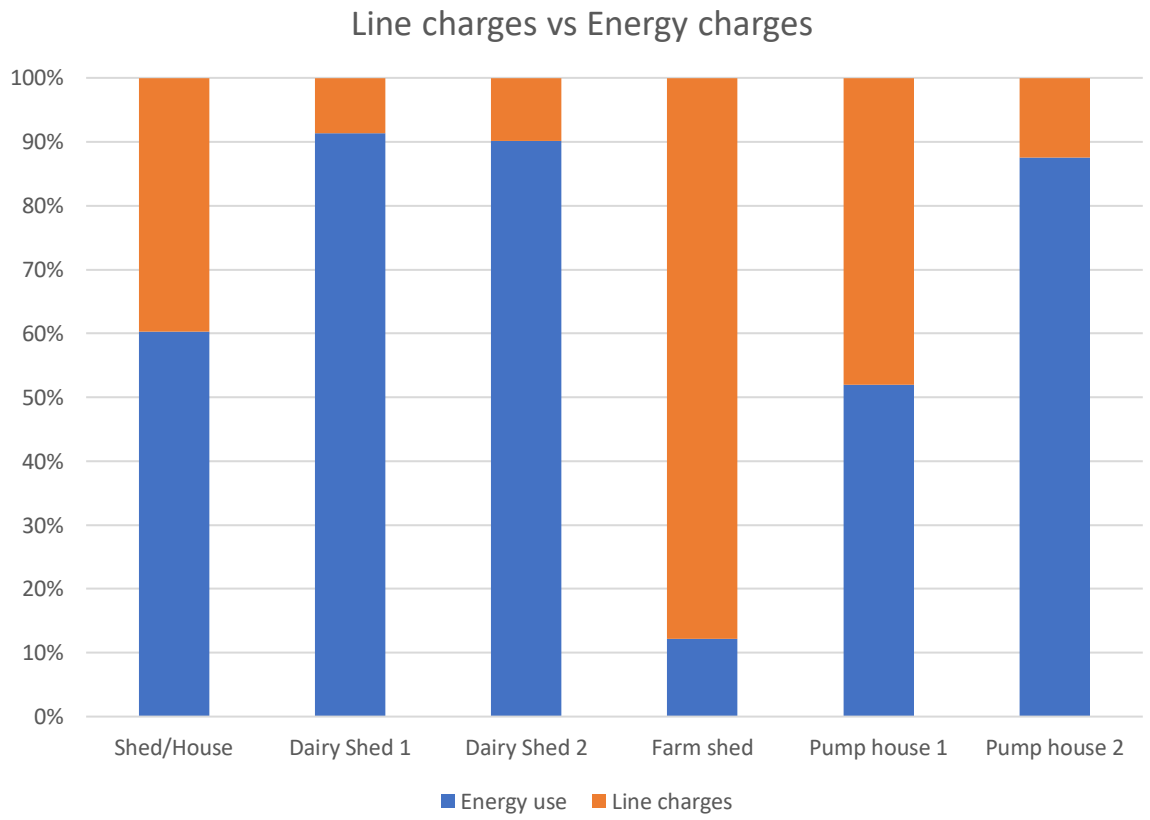
Energy from our local mega-nuclear reactor (the sun!) is abundant and viable even at latitudes as far south as Otago and Southland.

Solar energy can be captured either directly into water or another fluid with a solar water heater (SWH), or as electricity with photovoltaic (PV) panels.

50% energy savings are the best that can be expected with a SWH system on a milking shed. These systems are quite expensive and generally are not economically attractive.

A small PV installation is also of middling benefit, peak electrical demands of milking do not align with typical solar generation times.

Optimise your power bill



You pay for more than just the power you use!

Farms typically have multiple connections (ICPs) and merging ICP's almost always will save money.

Check connection capacity is appropriate. Your retailer can provide you with your half-hourly demand data.

CPD – ensure non-essential equipment doesn't run during milking (water heaters, effluent pump).

Night rate is ~2c/kWh cheaper

Summary

- Wrap your vat, especially if you are on second-day collection.
- Wrap your low-pressure refrigerant line, a pool noodle and electrical tape is not pretty but quite effective.
- Heat recovery, heat recovery, heat recovery
- Solar collection from SWH or PV is not a good fit for dairy sheds in the south
- Ask your retailer for your half-hourly demand data, use it to check if your connection capacity is appropriate
- If something is hot or cold to the touch, insulate it.

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For more info and guidance visit:
https://taiariwai.nz/

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