Water heating and milk cooling contribute most to high energy bills on dairy farms

Electricity use on dairy farms can vary greatly but processes associated with water heating and milk cooling are commonly found to be amongst the most energy intensive. Optimising these processes represents the greatest potential to cutting electricity consumption and reducing operating costs.

Whilst replacing an uninsulated water heater with a pre-insulated tank is the best way to prevent heat loss and curb electricity consumption, farmers can also install an insulation jacket – typically made from glass fibre – on an existing tank. The guidelines are 50mm polyurethane foam or 85mm glass fibre.

All pipe work, including joints, should also be well-insulated, whilst the heater should be fitted as close as possible to the point of use to limit the distance water must travel, thereby minimising the potential for heat loss.

Installing timers on water heaters can also help to manage energy costs by automatically switching them off for a few hours during the day - especially during periods of peak demand for electricity - and then on again at night to ensure an adequate supply of hot water in the morning.

Installing a solar water heating system in combination with electric elements can help to reduce the cost of heating water - electric elements can be connected to a timer to have it switch on outside the peak hours of demand for electricity; the sun will provide the energy to heat water for the rest of the time.

In most cases, washing a milking machine requires soap to be mixed in water at a temperature of at least 70°C and contact time with the surface area of at least 20 minutes to be effective - in winter the circulating water cools down so quickly that the contact time is less than 5 minutes. Only a few dairy parlours have the hot water capacity to supply sufficient volumes of hot water, an advantage that is accompanied by high energy costs.

The alternative is to make use of an automatic washing machine, which measures the temperature of the ‘return-cycle’ water. When the temperature of the returning water drops below a certain temperature, the circulation is stopped, the water collected in a bowl - which is part of the CIP system - and reheated by an inline heater to the required temperature before being released for cycling again. Moreover, this washing machine does not require a geyser - the required temperature and contact time are ensured and, although the energy demand is high for a very short period of time, the washing cycle can be set to start outside peak periods of demand for electricity.

A similar system is available for the washing of bulk milk tanks.

Dairy farms have a few options for improving the efficiency of refrigeration and milking processes. On most farms, improving the energy efficiency of refrigeration comes down to optimising the design, operation and maintenance of systems. Farmers thinking about replacing energy intensive equipment should consider employing multiple energy-saving measures for maximum energy savings - these can include refrigeration heat recovery units, plate pre-coolers and variable speed milk pumps.

A refrigeration heat recovery unit transfers excess heat from the condenser of a bulk milk tank to pre-heat water for use in milk sheds, and can generate approximately 1 litre of pre-heated water for every litre of milk cooled. This normally generates much greater quantities of water than can be used.
effectively for normal washing and sanitising operations in the milking area - some innovative farmers recover heat from the exhaust of the vacuum pump during the milking and washing cycle to heat water.

Plate pre-coolers, also known as plate heat exchangers, use water to lower the temperature of milk as it flows from the milking system to the collection tanks. Using ordinary cold water from a tap or borehole as a heat exchanging medium to remove heat from the warm milk coming from dairy cows, a plate cooler can reduce cooling time by as much as 15 to 30 minutes. When using the cold water coming from an ice bank cooler as a heat exchanging medium, the cooling time will be reduced even more.

With smaller bulk tanks, the compressor unit is installed on a frame connected to the tank whilst with larger bulk tanks the compressor units are installed in a separate room - the vacuum pumps of the milking machine system are also positioned in this room. It is crucial that this room be designed correctly and built on the southern side of a dairy parlour. The same applies to the milk room where the bulk tanks are positioned. Moreover, there should be sufficient ventilation for any heat generated in the engine room to escape - the colder the ambient air around the condenser unit and electric motor, the better the cooling effect of the cooling system and the longer the lifetime of the electric motor. No direct sunlight should fall on the condenser unit and roof insulation should be sufficient to prevent any heat gains through the roof.

Installing a free rotating heat extractor (whirley bird) in the roof of the engine room could assist with this requirement.

These interventions can reduce refrigeration-related energy costs substantially whilst maintaining and sometimes even improving the quality of milk. However, before installing one or more of these measures, farmers should consult with a technology expert to ensure that they don't inadvertently increase their energy use.