



On most UK dairy farms there remains huge scope to reduce the annual electricity bill. Relatively simple changes in practice can produce savings of up to 25%.

Electricity consumption on dairy farms:

Keep the 'leccy' on the level

One of the largest invoices received by dairy farmers is for the electricity they use. While most will sigh and reach for the cheque book, a close look at where most of the power is being consumed could result in significant savings. Andy Collings discovers more

IT here was a farm manager I knew who took matters of energy conservation very seriously. One of his favourite methods of ensuring absolute economy was to have only a single 40W light bulb in his farm cottage and to move it from one room to another as required. Another tactic was to keep all plug and light switches in their 'off' position to prevent any 'accidental leakage', as he used to call it.

Now, while it would not be acceptable or even practicable for most of us to adopt such techniques, it does demonstrate the

fact that, however extreme it might appear, there are usually ways of reducing business electricity costs.

For dairy farms, where water pumps, milk pumps, vacuum pumps, coolers, fridges, water heaters, lights and a myriad of other electrical equipment conspire to clock up enormous electricity bills, efforts made to improve efficiency and reduce electricity consumption can be particularly rewarding. In this article, then, we examine ways in which energy savings can be made and how, by implementing changes not only to the type of equipment being fitted but also in

the way it's used, significant reductions in electricity cost can be achieved and margins improved as a result.

But first we need some guidance on what is considered by the dairy industry to be an acceptable level of electricity consumption – a way of assessing the good, the bad and the downright wasteful. According to Farm Energy managing director, Andrew Kneeshaw, the UK's average annual electricity consumption per cow is usually around the 350kWh mark.

"Where efforts have been made to cut energy consumption this figure can be as low as

200kWh, and at the other extreme it may be as high as 450kWh," he comments. "So there would appear to be plenty of scope for improvement throughout the industry."

For most dairy farmers, assessing their own kWh/cow figure will not be a difficult task, although, when looking at recent electricity invoices, it's worth being aware that estimated bills can be pretty wide of the mark and provide an inaccurate result.

Mr Kneeshaw also recommends, as a matter of course, carrying out weekly checks on electricity meters to monitor any sudden changes that could indicate a problem such as a sticking thermostat or incorrectly set timer unit.

But first things first. It may be useful, for example, to fully understand just what a kWh actually is and, on this point, there may be some confusion between what is electricity power and what is electricity energy. Power is the rate at which energy is generated or consumed and can be termed therefore in kilowatts or, for the more informed

familiar? Most dairy farmers will receive regular calls and correspondence from suppliers claiming all manner of deals based on unit charges, discounts, tariffs, contracts, fixed or variable charges.

It's a minefield that needs to be carefully picked over, although perhaps a key issue for dairy farmers to bear in mind is to have a tariff providing a cheap rate period during the night hours when high electricity consuming items such as water heaters and fridges can be in operation.



The hot water tank may be well insulated, but no lagging on the pipes will detract from the overall efficiency of the system.



Milk cooling costs can be pegged through the use of plate heat exchangers. The payback period, in some cases, can be less than a year.



Milk can be cooled by a tank that uses direct expansion or by water delivered from an ice bank positioned at the base of the bulk tank.

reader, joules per second. This is not to be confused with the amount of energy consumed, which is normally termed as kilowatt hours. One kilowatt hour is a unit of energy, and the usual illustration for this is the electricity used by a single bar on an electric heater when run for one hour.

So, if we take a 100W light bulb and switch it on for one hour, the energy used is 100 watt hours or 0.1 kilowatt hour. This is a measure of the energy consumed by the bulb. The same amount of energy would light a 40W bulb for 2.5 hours ($100/40 = 2.5$) or a 50W bulb for 2 hours – and so on.

Before we take a look at the specific areas of a dairy where it may be possible to realise savings in energy consumption, a word regarding the purchase of electricity. There are now many companies offering to supply electricity at competitive prices. Sound

So with electricity supply costs sorted and agreed, it's time to look at how it can be arranged to buy in as little of it as possible. No surprise to learn that the biggest consumers in the dairy are the water heater, the milk cooling system and the vacuum pump. Combined, these three are responsible for up to 85% of the electricity consumed – the rest powering lights, heating, scrapers and, when installed, ventilation systems. But it is water heating and milk cooling that account for the lion's share and, as a result, offer the greatest opportunity for improvement. The fact that one of these needs the addition of heat and the other needs to lose heat will not be lost on many readers, and that there are heat recovery units (HRU) available to enable this situation to be exploited will be appreciated as a logical development.

Ten useful tips to save electricity in the dairy

1. Insulate hot water tanks, pipes and connections
2. Install fluorescent lighting in the milking parlour and sodium lights in the barns
3. Use a plate cooler to pre-cool milk
4. Fit a timer on water heaters to exploit lower tariff electricity
5. Keep air intake screens clean on refrigeration units
6. Use on-demand vacuum pumps
7. Fit Heat Recovery Units to reduce water heating costs
8. Shop around to find the best electricity supplier
9. Monitor electricity meters regularly to detect any sudden increases
10. Switch off lights when not needed; consider a movement sensor to activate lights



A vacuum pump that alters its speed in respect of demand consumes less electricity than those that work at a constant speed.

HRU connects to the refrigeration system of the bulk tank and utilises the waste heat – which is normally discarded – to pre-heat water before it enters the water heater. Depending on size, an HRU unit costs about £2,000 and can help to halve overall water heating costs.

Growing interest in solar heating has resulted in a few installations being used to pre-heat water. An example is to be found at Greenmount College, Northern Ireland (profi 05/10), where its solar panels help to heat water to a temperature of 85°C so that it can be used for washing the clusters, pipelines and tank after each milking of the college's 130-cow dairy herd.

The installation represents an investment of about £12,000 and, by saving 50% of electricity costs, the payback is said to be about 20 years. This estimation is based on



Solar panels can make a contribution to a reduction in water heating bills, but the payback time can be lengthy. There is currently significant interest in using this source of energy.

a 130-cow herd consuming, say, 400 litres of hot water per day and taking 12,700kWh/year at a cost of £1,270. A 50% saving would then provide about a 20-yr payback. That's the logic.

A spur to this technology is the introduction this year of the Renewable Heat Incentive, which provides a financial reward for those who replace existing fossil fuel heating systems with a renewable technology – wood fuel or solar, for example. The tariffs payable are due to be announced in April.

More generally, it makes sense to ensure that hot water tanks are properly insulated. Without insulation, vast amounts of heat can be lost in just a few hours, and the same is true for the pipes and their connections. Mr Kneeshaw says that when insulation is poor or non-existent, the best route is to replace it with a purpose-built pre-insulated tank that has the required thickness of polystyrene foam or glass fibre around it. "Trying to wrap a tank in a glass fibre jacket may be cheaper but it will never be as efficient as a pre-insulated tank with its all-round coverage," he says.

It should go without saying that the water heater needs to be operated when the electricity is at its cheapest – between midnight and 07.00.



Dust on the intake of refrigerator systems drastically reduces the efficiency of the unit and means it has to run for longer periods.



Inspection of electricity meters provides a warning of any irregularities or system faults, which may result in excessive use of energy.

For cooling milk, which needs to be stored at a temperature of 4°C, in-line plate pre-cooling has proved to be one of the most efficient ways of reducing milk temperature



Sodium lights are a good option for illuminating the farm's barns and cubicle housing.

by up to 20°C. The actual temperature drop clearly depends on the temperature and volume of the incoming water and the size of the cooler unit. Sourcing water from either a borehole, spring or the mains supply, the ratio of water to milk is generally between 1:1 and 2:1.

To get the best results, it is important to have the water flowing through the cooler when the milk enters and, to fully exploit the system, the tepid water leaving the cooler can be used as drinking water for the herd. In the best scenario, the payback on an investment in a plate cooler – in the electricity saved refrigerating milk in a tank – is less than a year.

For milk tanks an option is to have one that incorporates direct expansion: evaporator plates are connected directly to the surface of the tank. This is considered to be an efficient method of cooling, but requires the refrigeration unit to be operated when there is milk in the tank that needs to be cooled, avoiding the opportunity to take advantage of off-peak rates when milking in the afternoon or evening.

The alternative is for milk to be cooled by water delivered from an ice bank, which is usually positioned at the base of the bulk tank. This 'indirect' system, which relies on electricity to make ice and then cold water

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to cool the milk, is less efficient but scores well in its ability to be operated with off-peak electricity to create the ice for the coming day.

Key to both systems, however, is to have an efficient refrigeration unit. And it has to be said that your average dairy farm usually has a dusty old condenser unit with a fan desperately attempting to pull cooling air in through a mesh covered in leaves, straw and the occasional polythene sack. The refrigerant in these units needs to be checked to ensure that its level is correct and not slowly leaking away, and, if possible, some consideration needs to be given to positioning. Stuck in an overheated, unventilated loft is far from ideal and means the units have to run for longer and use more electricity.

Latest developments in refrigeration include the installation of more efficient scroll-type pumps. Employing two identical scrolls, one remains stationary while the other orbits around it to compress in smaller pockets the refrigerant gas delivered by the evaporator. When it arrives at the centre of the scroll it is at the high pressure required for it to be used in the refrigeration cycle.

Switching the focus on to vacuum pumps, these machines are now quieter and no longer bark their presence across the field and valleys at some unearthly hour in the morning at the start of milking.

Most vacuum pumps have their vacuum set and regulated by a relief valve, which means they need to work constantly to create a vacuum that not only exceeds this level but also has the capacity to maintain it when clusters are removed, milk is pumped and pulsators do their job. More modern vacuum pumps, however, adopt a different approach and regulate vacuum levels by a pressure sensor, which then tells the pump to slow down or speed up. It's vacuum on demand, so, as a result, the amount of electricity required to power them is reduced – by as much as 70%.

Having looked, then, at the ways that water heaters, milk coolers and vacuum pumps can be made to operate more efficiently and use less electricity, a word or two about the other electrical systems.

While it's good to have decent illumination all around the dairy, the yards and cubicle housing, there are lights that run with relatively low demand on electricity supplies – and there are those that clearly don't.

As a rule, the most efficient lights are those that have a gas tube – fluorescent, sodium etc – while lights that have filaments are not

generally so frugal in their power requirements. Of the three, probably sodium would be the one most would select: it creates a low energy yet bright light, and the bulbs tend to last for a long time.

In the parlour, where lighting is important, strategically placed fluorescent strip lights are the popular choice and they do a reasonably economic job. There are, however, versions of fluorescent bulbs that offer even greater economy and extended life albeit at a higher initial cost.

And on the subject of lights the correct positioning of switches can make a significant difference to whether or not lights are left to burn all night or are switched off. We've all come across situations where the light is left on, because if it was switched off no

one could see to find their way out of the building. Which clearly doesn't make a lot of sense.

Summary: Unless a dairy has been built in very recent times, there is a good chance that an electricity audit will save money.

Andrew Kneeshaw says he would expect to be able to reduce a dairy's electricity bill by as much as 25% simply by addressing such matters as correctly set timers, clean air intake for compressors, fitting of low power bulbs, better use of plate coolers etc.

"There are many avenues to explore before considering the purchase of any new equipment," he says. "But there is no doubt that better and more economically operated kit is now widely available."

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