Energy efficiency on a shoestring budget

Key points:

- Saving energy can sometimes save operational costs.
- Know your system.
- Measure, meter & record.
- Look at the large energy uses first, it is easier to find small savings on large uses.
- Do the obvious & easy options first and then think about large scale adaptations if required.
- Reuse water wherever possible.

Know your system and current costs

Following the last year of milk price, many farms have been looking into ways to cut their costs of production. Waste, water and heat were the three areas discussed at the recent Focus Farm meeting held at Woodhead.

Agricultural Engineer Adrian Jones was the guest speaker and he explained from the outset that it is important to know your system and current energy & water usage and costs. The use of simple meters and recording sheets can help you get a realistic figure of actual use and allow you to work out where potential saving could be made. (See the 'Practical Guide' section of our website for energy & fuel recording spreadsheets to get you started.) Careful consideration must be given to the maintenance, running and replacement costs of new energy systems. It is important to consider all the simple and obvious alterations that can be made first, rather than to jump straight into a whole revamp.

The processes discussed included heating, cooling, pumping and transport. Electricity costs were discussed and there was an average of 7-8p/kwh for night rate and 12-13p/kwh for day rates. Diesel was generally taken to be about 50p/litre, and water costs range from ranged from 80p—£1.50/m$^3$ on mains water, but can be as little as 30p/m$^3$ from a borehole without any treatment (assuming the £15k 100m deep borehole lasts 10 years and pump is replaced at 5 years).

Next meeting

‘Cow Health and Comfort in Your Shed’ is on Tuesday 28th February 2017 11am - 2pm at Muirhouse Farm (by kind permission of the Love Family) Kilmarnock KA2 0BT. Guest speaker Jamie Robertson, Livestock Management Systems Ltd. Everyone welcome.
Benchmarks

Typically energy figures for dairy cows are 1kwh/cow/day. A recent study in Wales has shown that over the year this figure can equate to between £40-£200/cow/year. The table below shows the generally accepted breakdown of energy production costs within the dairy.

<table>
<thead>
<tr>
<th>% Total of costs</th>
<th>For 150 cow unit (£)</th>
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<tbody>
<tr>
<td>38% = Milk Cooling</td>
<td>£2,250/yr</td>
</tr>
<tr>
<td>31% = Water heating</td>
<td>£1,875/yr</td>
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<tr>
<td>20% = Vacuum pump</td>
<td>£1,200/yr (£ 660/yr)</td>
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<tr>
<td>(with Variable speed drive)</td>
<td></td>
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<tr>
<td>Remaining</td>
<td>£  675/yr</td>
</tr>
<tr>
<td>Total</td>
<td>£6,000</td>
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In terms of water usage, it is accepted that standardised water consumption is taken as 18 litres/milking point and 5% of the total capacity of the bulk tank. For drinking water it is estimated that 100 litres/cow/day should be allowed.

Taking all of the water usage into account, a 150 cow dairy farm such as Woodhead, it was estimated that total water consumption could be as high as 9,000 m³ per year. Assuming a water cost of £1/m³, if all the troughs are mains fed this would be a bill of £9,000/year.

Cold water usage

Surface washing using a pressure washer can potentially save £602/yr on a 150 cow farm in comparison to using a volume hose. This assumes that the surfaces are washed for 10mins twice daily. A volume hose will require 1.6m³ whilst a pressure washer will only require 0.2m³ per day. Assuming a total cost of £1.18p/m³ to allow for pumping costs on top of water unit cost.

Impressed by the potential savings, the group discussed the practicality of a pressure washer and a conclusion was made that this would be a worthwhile switch if using a fan spread nozzle and at a lower pressure than that required to wash the tractor!
Focus on...

Dairy savings

With water heating accounting for approximately \( \frac{1}{3} \) of the tank room & system water use, any potential savings should be explored. Assume 260 litres per day is to be heated from \( \sim 10^\circ C \) to \( 85^\circ C \), at an energy cost of 16p/kwh. Total cost could be £1,520/yr. Savings can be made through insulating the hot water tank—at a cost of c.£20 a saving of £132/yr can be made. Using 75% of the energy during the off peak tariff period could save c.£523 & if a heat recovery system was installed, there is a potential of £760 (50%) to be saved (leaving a £3,000 installation cost being paid back within 4 years potentially).

Adrian suggested that all farmers should be aware of their milk cooling costs and various online calculators are available. There are a number of ways to improve efficiency here. The water flow rate could be increased, the size of the plate cooler can be increased at anytime, and the flow rate of the milk can be slowed down to increase the efficiency. This can be achieved by either a variable speed drive pump or a stepped control pump. The minimum flow rate required is 2:1.

Secondary usage of the water from the plate cooler was also discussed at this point. Since it is already warmed up it can be stored in a buffer tank and brought to temperature to be used for plant washing, or can be offered up as drinking water for the cows; studies have shown that cows prefer warm water to drink. This will improve water intakes as the cows leave the parlour.

Borehole water—minimize risks

- If using borehole water, consider treatment for biosecurity. Available treatments include filtration & UV treatment. Costs are minimal in comparison to purchasing mains water.
- If storing heated borehole water, think carefully about the system used to mitigate any potential legionella risk.

Water is often overlooked when reviewing efficiency. If you have paid for it once, you should maximise the use you get from it. Reducing the amount used through reuse can help with slurry storage and improve the efficiency of slurry application.
Pumping Slurry

Generally farmers pay contractors by the hour for slurry pumping, not by the m³. With a lot of the time being spent reeling layflat piping, it is worth bearing in mind any inefficiencies of the pumping system to ensure you get maximum flow rate & efficiency during the pumping time. Costs of slurry spreading vary from c.80p—£2.30/m³. Watch the angle at the pump as any kinks or bends in the layflat pipe should be minimised. Any kinks or bend in the layflat pipe will reduce output. Consider sinking solid pipes at gates or over roads (but cap to prevent rabbits entering!) maintaining a 30° angle dropping down and returning back up from the underground flat.

Pumping & Head loss

Calculating the head loss within your pumping systems can help you identify problems. Head loss occurs throughout any pumping system whether it be water or slurry. Adrian discussed the variables of loss and explained how small pipes and fittings can increase head loss as the velocity increases. This was highlighted by the losses seen in 100mm & 150mm pipes assuming a velocity of 100m³/hr (an umbilical system)

- Loss in 100mm diameter = 70m/1000m
- Loss in 150mm diameter = 9m/1000m

In a water pumping situation, assuming a tap flow rate of 1.5m³/hr:

- Loss in 20mm diameter = 90m/1000m
- Loss in 60mm diameter = 0.6m/1000m
- 1 elbow of 20mm diameter = 1.3m/1000m
- 1 elbow of 60mm diameter = <0.1m/1000m

It is worth keeping this in mind when considering the water flow to troughs in a shed, can the number of elbows be reduced? If the head loss is greater than the head height, the water flow at the end of the pipe may be insufficient. Options available are to re-plumb, consider a ring system, add an electric pump and use larger valves at water troughs.