

Water Heating Options for Dairy Farms



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Milk Quality Symposium 2020



Irish milk production energy requirements

- Electricity consumed = 42 kWh/tonne milk produced (Upton et al., 2013)
- Projected that by 2020 Ireland will produce up to 8.8 billion litres; this will require ~ 378 GWh of electricity
- Electricity related CO₂ emissions may be 182,000 tonnes by 2020 unless mitigation strategies are implemented
- Requirement to improve efficiency by 30% and reduce primary energy use by 30% by 2030

Dairy Farm Energy Consumption

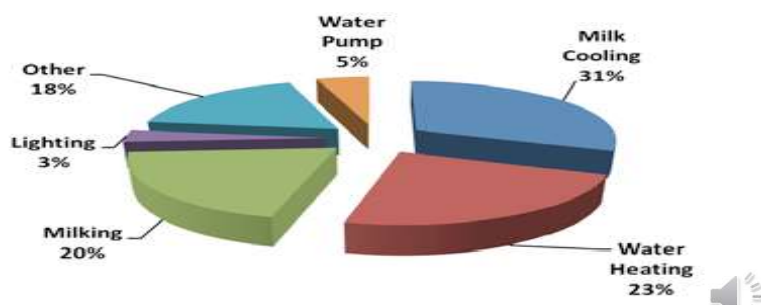
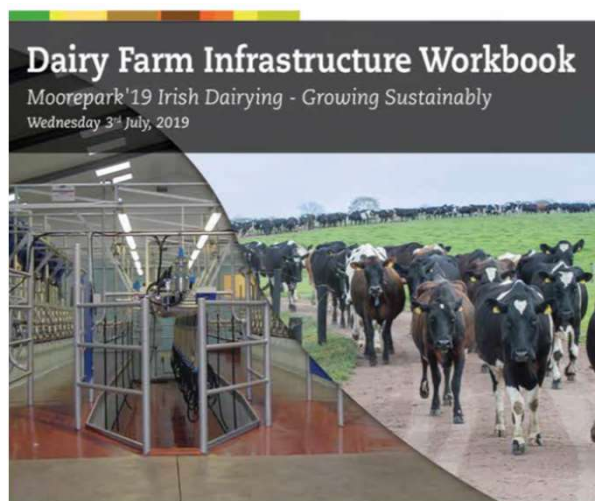


Figure 1. Shows the average component consumption on 60 commercial dairy farms

Cost of electricity = €5.00 per tonne of milk sold

Max = €9.00 Min = €2.50

Dairy farm infrastructure workbook



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<https://www.teagasc.ie/media/website/publications/2019/Dairy-Farm-Infrastructure-Workbook.pdf>

Water Heating Requirements

- Ensure adequate supply at the correct temperature
- 10 Litres of hot water required per cluster for machine washing – Generally at 80 degrees C, check wash trough size
- Allow for heating 2% of bulk tank volume for tank washing – Generally at 70 degrees C, check user manual



E.g. 16 unit parlour requires 160 L hot water per wash

- 8,000 L bulk tank requires 160 L hot water per wash
- 320 L required if washing both on the same day

Electrical water heating

- Low capital cost (approx €1,500 for a system of 500 L capacity)
- Best blend of capital and running costs up to 300 L per day
- Restricted by night rate electricity to keep running costs low
- Long heating times, approx 8 hours to heat 300 L from 10 to 80 degrees with 3 kW element
- Higher emissions – 5.5 kg CO₂ per 100 L



Night Rate Electricity

- Day rate = €0.18 / kWh
- Night Rate = €0.085 / kWh
- Free installation, small standing charge
- Use timers with battery back up
- Night rate from 12 midnight to 9am – summer
 - 11 pm to 8am – winter time



Oil fired water heating

- Reduced heating times, 1.5 hours to heat 500 L from 10 to 80 degrees with 26 kW oil boiler
- Not restricted by night rate electricity
- Higher capital cost (approx €3,500 for a 500 L hot water capacity)
- Available either tanked or instant
- Ensure system can deliver required volume quickly
- Lower emissions – 3 kg CO₂ per 100 L



LPG fired water heating

- Not restricted by night rate electricity
- Higher capital cost
- Typically installed as instant heaters
- Ensure system can deliver required volume quickly
- Lower emissions – 2.4 kg CO₂ per 100 L



Water Heating Running Costs

System type	Cost per 100 litres hot water	CO ₂ emissions per 100 litres
Day rate electricity	€2.10	5.5 kg
Night rate electricity	€0.94	5.5 kg
Gas (LPG) fired	€0.87	2.4 kg
Oil (Kerosene) fired	€0.56	3 kg

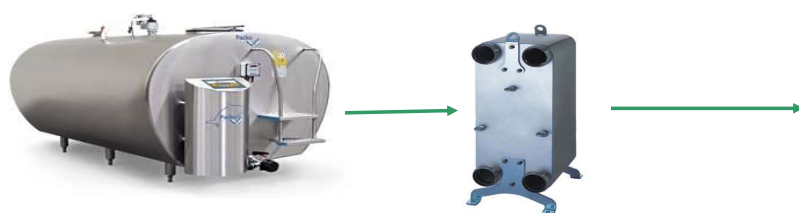
• Oil and gas systems worth considering from a financial point of view where daily use exceeds 300 L of hot water per day

• Convenience also affects decision making around system choice - Prices correct on 08/12/2020



Options to increase efficiency - Heat Recovery

- Heat energy is removed from milk during cooling
- Energy transferred to a tank of water
- Can reduce water heating costs by 40-50%
- Retrofitting is possible
- TAMS grant available



Simple efficiency measures

- Test water for hardness – install a water softer for heating system if result is over 300 mg/L calcium carbonate
- Use best quality insulation
- Time system to reduce standing losses
- Service gas and oil systems annually



Solar Photovoltaic (PV)

- Generates renewable electricity from the sun
- TAMS grant for example 6 kWp system (Max 11 kWp)
- Important to size systems for self consumption
- Saves ~ 3 tonnes CO₂ per year for 6 kWp system
- Qualifies for accelerated capital allowances
- Water heater can be used for storage of excess electricity



Decision support for energy efficiency projects

Energy Optimisation Tool

<https://messo.shinyapps.io/AEOP/>

Current Farm Setup

Herd size:

Morning Milking Time:

Evening Milking Time:

Number of Milking Units:

Milk Cooling System: ☒ DX ☐ IB

Water Heating System: ☒ Electric ☐ Oil ☐ Gas

Hot Wash Frequency:

Milk Collection Interval: ☒ Every two days ☐ Every three days

On-farm Technology Investments

Select Potential Technology:

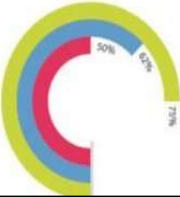
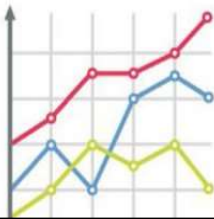
- ☒ Variable Speed Drive (VSD)
- ☐ Heat Recovery
- ☐ Solar Water Heating
- ☐ Solar PV
- ☐ Wind Turbine

Investment Cost:

Level of Grant Aid (%):

Rate of Inflation (%):

Run Technology Calculator

Summary

- Calculate volumes required – ensure that water heating system can deliver the quantities required rapidly
- Chose a cost efficient system with low running costs and low CO₂ emissions
- Use dairy energy decision support tool to help with decision making

