Water Heating Options for Dairy Farms

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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

Cost of electricity = €5.00 per tonne of milk sold
Max = €9.00 Min = €2.50

Dairy farm infrastructure workbook

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

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**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 CO\textsubscript{2} 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 CO\textsubscript{2} per 100 L

Water Heating Running Costs

<table>
<thead>
<tr>
<th>System type</th>
<th>Cost per 100 litres hot water</th>
<th>CO\textsubscript{2} emissions per 100 litres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day rate electricity</td>
<td>€2.10</td>
<td>5.5 kg</td>
</tr>
<tr>
<td>Night rate electricity</td>
<td>€0.94</td>
<td>5.5 kg</td>
</tr>
<tr>
<td>Gas (LPG) fired</td>
<td>€0.87</td>
<td>2.4 kg</td>
</tr>
<tr>
<td>Oil (Kerosene) fired</td>
<td>€0.56</td>
<td>3 kg</td>
</tr>
</tbody>
</table>

- 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

![Heat Recovery Diagram](image)

### 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

![Simple Efficiency Measures](image)
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 CO\textsubscript{2} 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.shinapps.io/AEOP_/

![Decision support for energy efficiency projects](https://messo.shinapps.io/AEOP_/)
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 CO$_2$ emissions

• Use dairy energy decision support tool to help with decision making