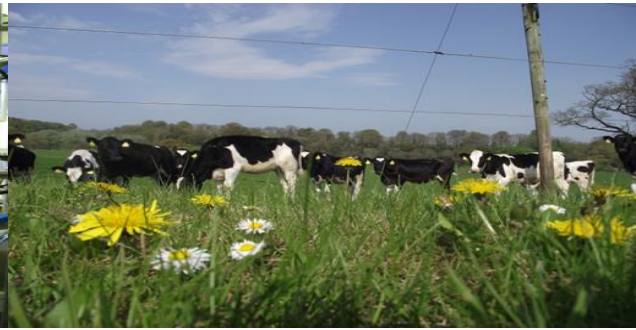
Energy Efficiency and Generation - Dairy





ConnectEd Series

Dr. John Upton
Livestock Systems Dept., Moorepark, Co. Cork

teagasc
Agriculture and Food Development Authority

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 CO_2 emissions may be 182,000 tonnes by 2020 unless mitigation strategies are implemented**

Dairy Farm Energy Consumption

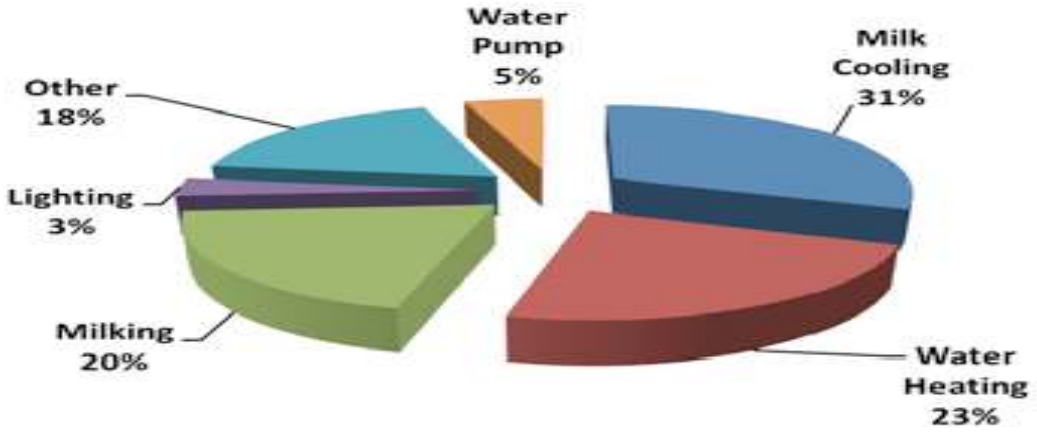
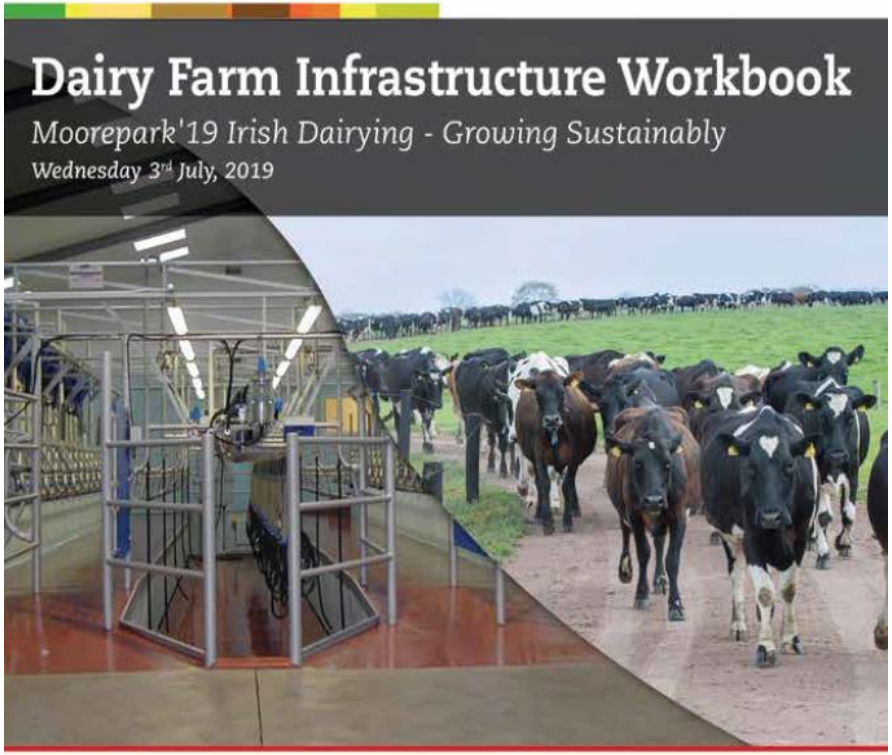


Figure 1. *Shows the average component consumption on 60 commercial dairy farms*

Cost of electricity = €5.00 per tonne of milk sold

Max = €9.00 Min = €2.50

Dairy farm infrastructure workbook



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

Milk Cooling - Direct Expansion

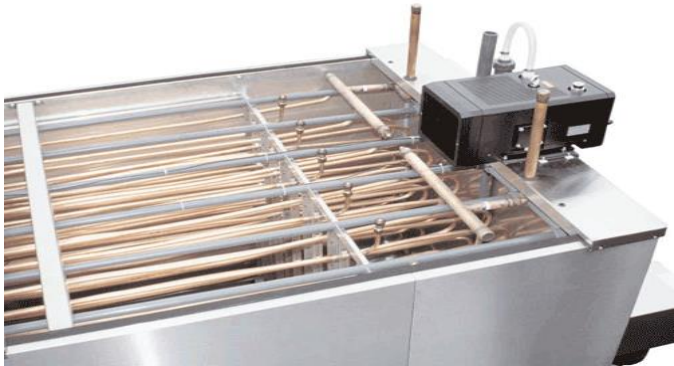
- Positives
- The most efficient way to cool milk in terms of kWh/litre of milk cooled
- Higher COPs
- Lower capital cost

- Negatives
- Larger compressor units (could be a problem for large farm on single phase supply)
- Higher proportion of day rate electricity used (Especially during evening milking)

Milk Cooling - Ice Bank

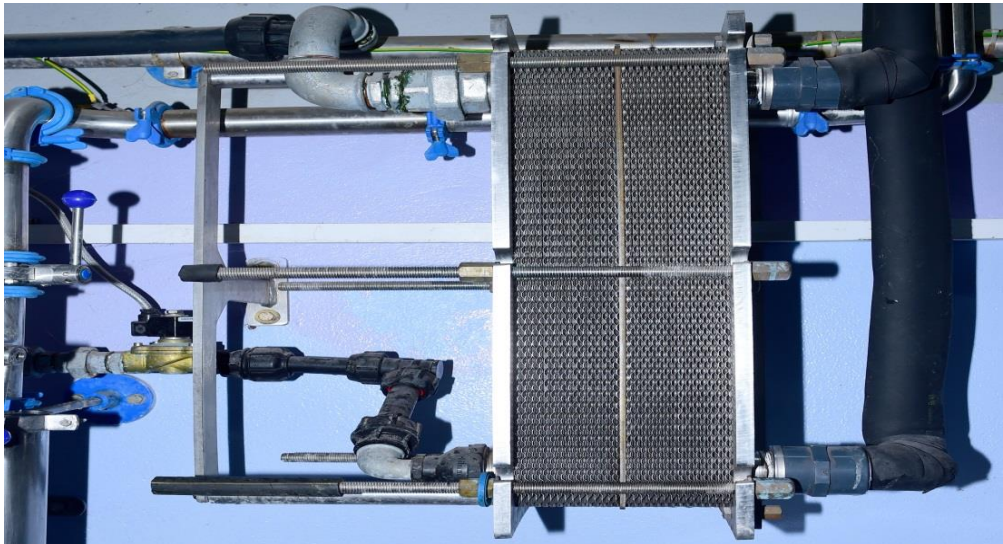
- Positives
- Can be configured to use 100% night rate electricity resulting in low running costs
- Smaller compressor units
- Can be used in conjunction with a dual stage plate cooler to instantly cool milk.

- Negatives
- More electricity used
- Higher capital costs
- Lower COPs



Pre-Cooling

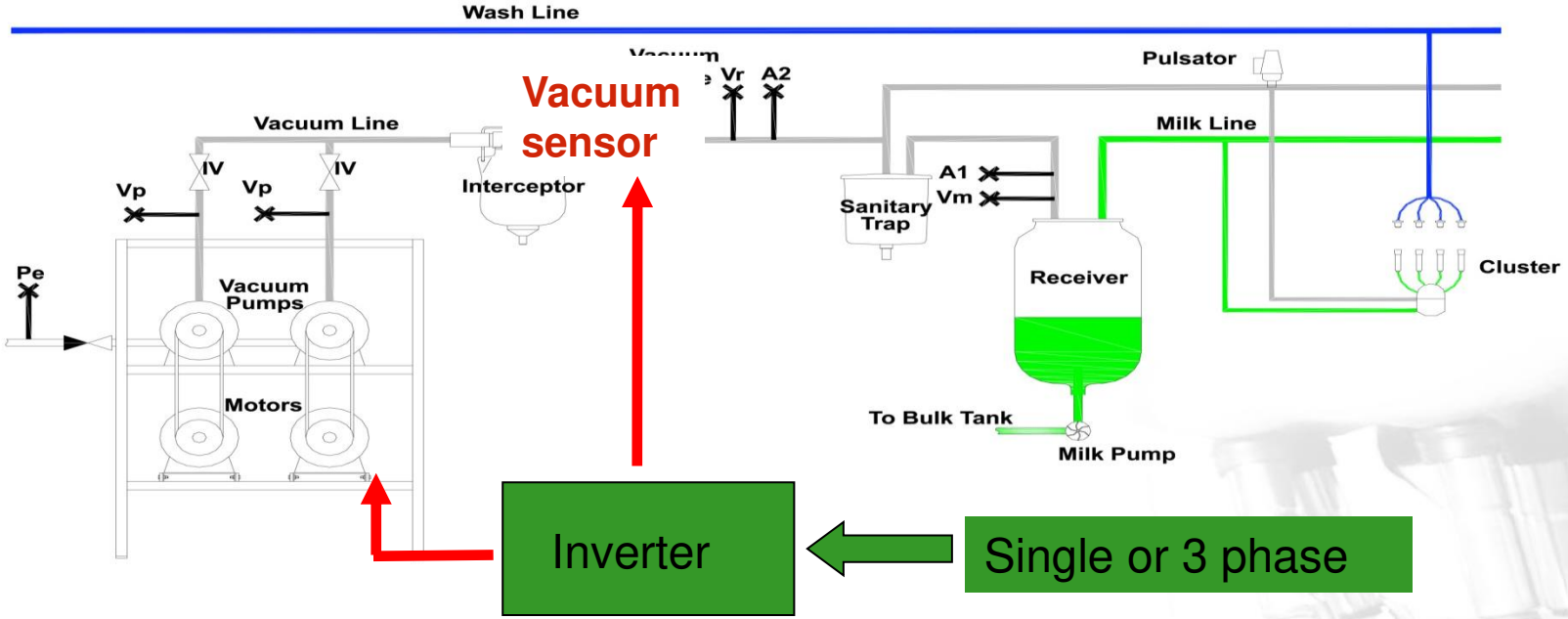
- Can reduce cooling energy use by 40%
- Goal of pre-cooling is to cool milk to within 5°C of incoming water temp
- Milk : Water ratio 1:2
- VSD milk pump
- Increased water pipe sizes



Vacuum Pump

- **Use Variable Speed Control (possibilities for over 60% savings)**

Vacuum Pump – variable speed control



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 cleaning product advice**

- **Allow for heating 2% of bulk tank volume for tank washing – Generally at 70 degrees C, check cleaning product advice**

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**

Water Heating Running Costs

System type	Cost per 100 litres hot water	CO_2 emissions per 100 litres
Day rate electricity	€2.10	6 kg
Night rate electricity	€0.94	6 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 28/08/2020

Night Rate Electricity

- Day rate = €0.18 / kWh
- Night Rate = €0.085 / kWh
- Free installation, small standing charge
- All electrical water heating should use night rate
- Use timers with battery back up
- Night rate from 12 midnight to 9am

Options to increase efficiency - Heat Recovery

- Heat energy is removed from milk during cooling
- Energy transferred to a tank of water
- Retrofitting is possible
- TAMS grant available

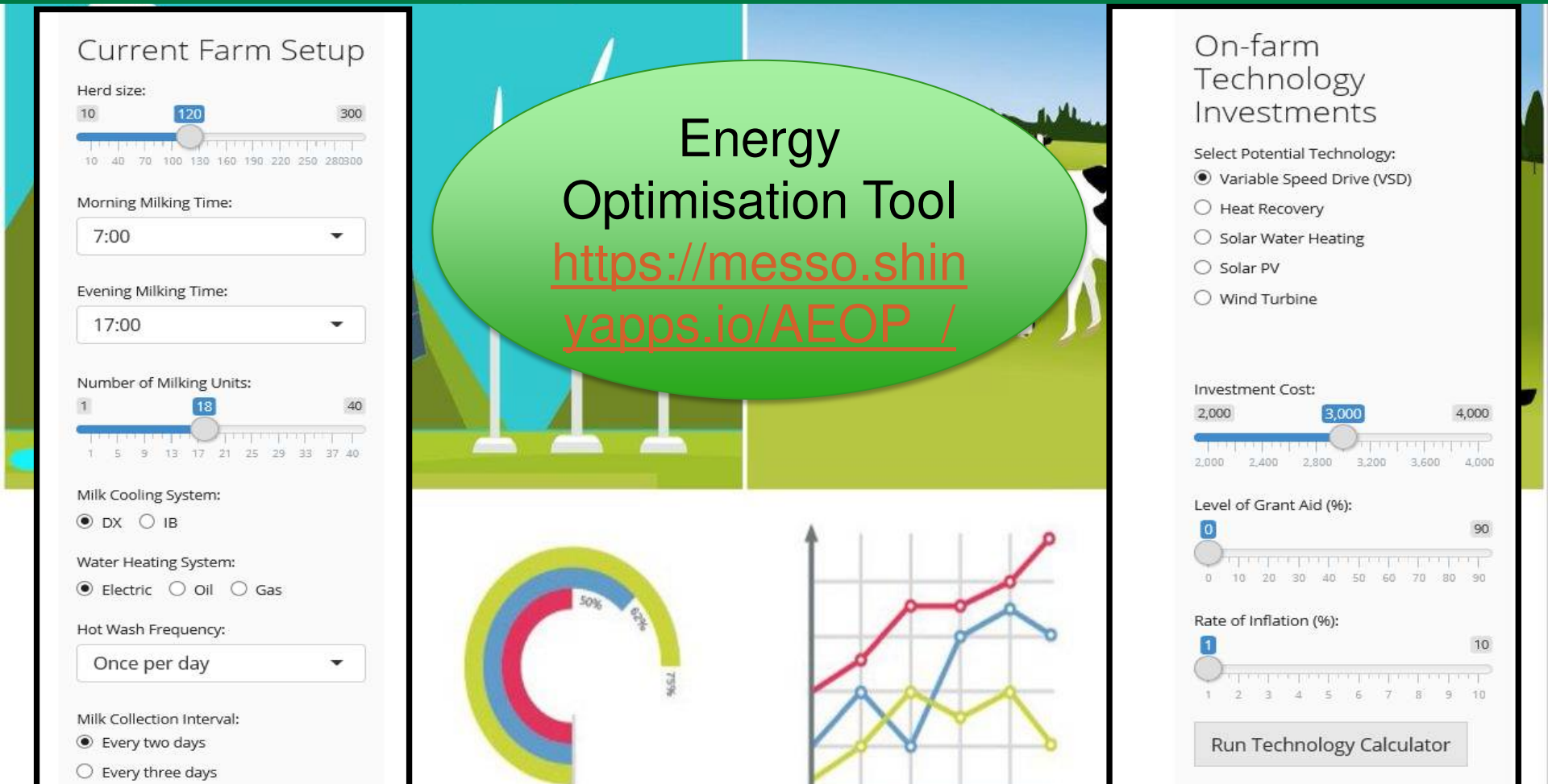
Solar Photovoltaic (PV)

- 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_2 per year for 6 kWp system
- Qualifies for accelerated capital allowances
- Water heater can be used for storage of excess electricity

Necessity for decision support

- **Every farm is different (cows numbers, farmer age, expanding, greenfield, water supply, milking system, grant eligibility)**
- **Many farms going through a phase of facility renewal (good opportunity to build in energy efficiency)**
- **Difficult to distil generalised recommendations**
- **Ability to deliver farm specific advice related to energy management decisions is a huge step forward**

Decision support for energy efficiency projects



Summary

- **Very achievable to reduce energy use by 30% and generate 30% of power demand from renewable sources in dairy**
- **We have the knowledge and technology to meet our targets, adoption is the next hurdle**
- **Decision support tool is available to help guide specific on-farm energy efficiency and renewable projects**

Thank You