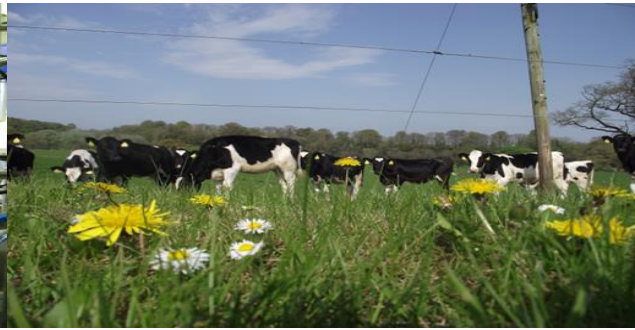


Energy Efficiency and Generation - Dairy



ConnectEd Series

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Livestock Systems Dept., Moorepark, Co. Cork

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**

Dairy Farm Energy Consumption

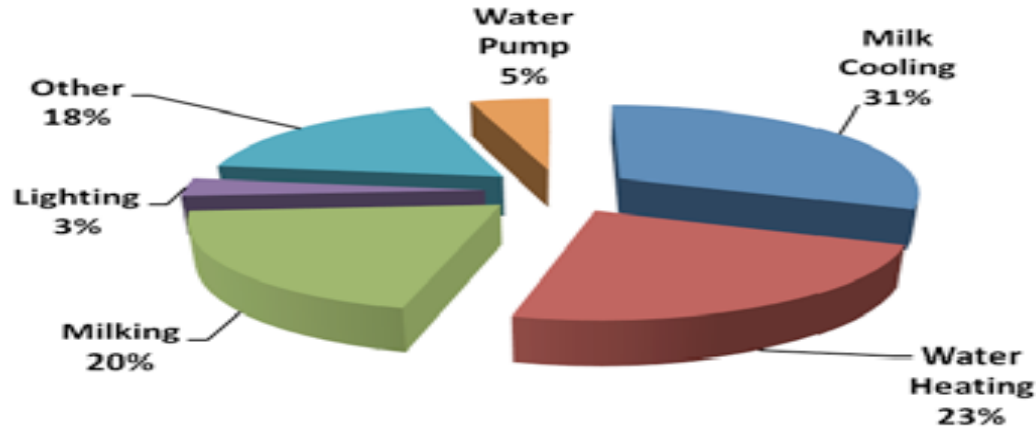


Figure 1. Shows the average component consumption on 60 commercial dairy farms

Cost of electricity = €5.00 per tonne of milk sold

Max = €9.00 Min = €2.50

Dairy farm infrastructure workbook

Dairy Farm Infrastructure Workbook

Moorepark'19 Irish Dairying - Growing Sustainably

Wednesday 3rd July, 2019



Introduction	6
Grazing infrastructure	7
Paddock size and layout.....	9
Farm roadways.....	12
Fencing.....	22
Water system.....	24
Case study farm example.....	31
Milking practices and energy use	34
Milking efficiency.....	34
Milking facilities worksheet.....	41
Energy efficiency.....	46
Electricity usage survey.....	48
Energy audit worksheet.....	49
Notes	52

<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

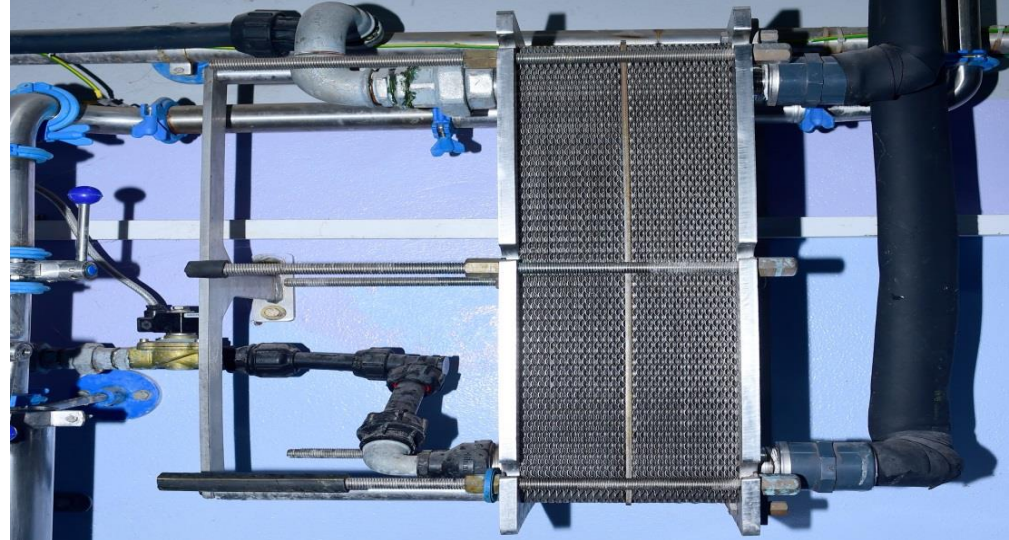
- **Positives**
- **Can be configured to use 100% night rate electricity resulting in low running costs**
- **Smaller compressor units**
- **Can be used in conjunction with a dual stage plate cooler to instantly cool milk.**

- **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

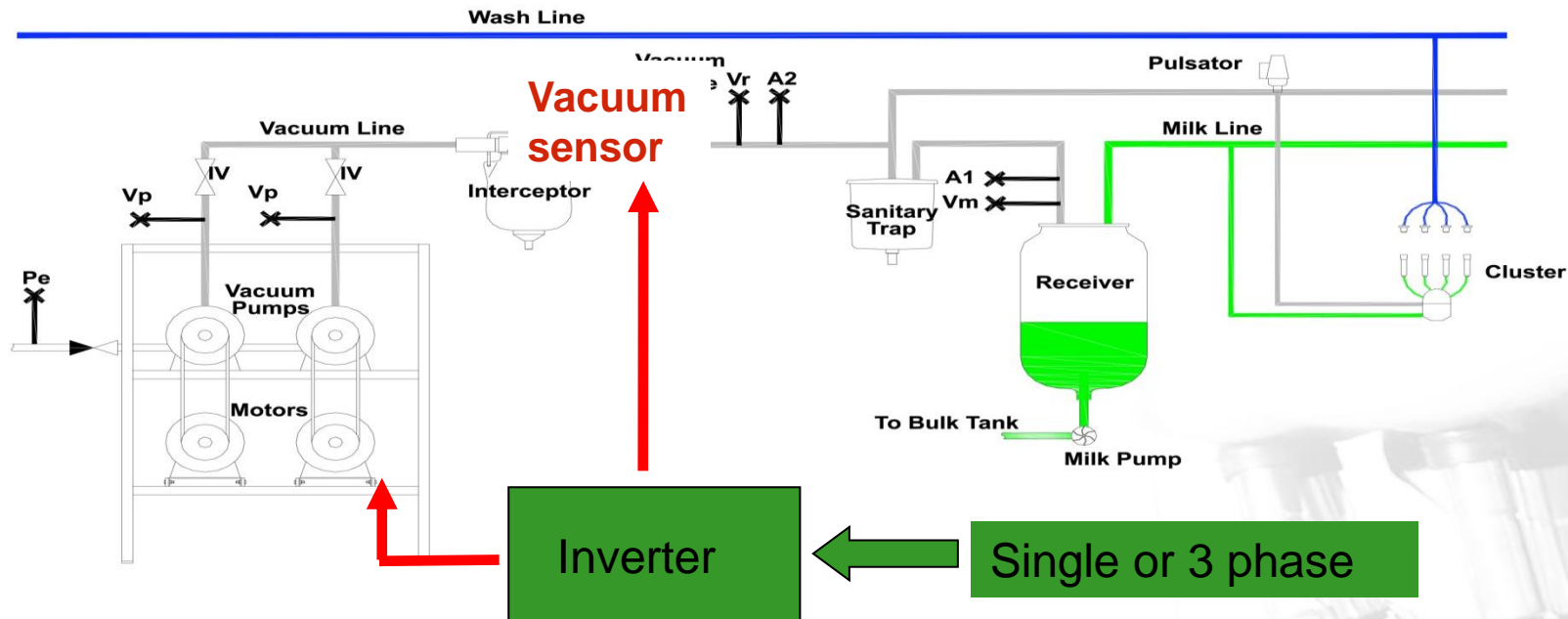


Vacuum Pump

- 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

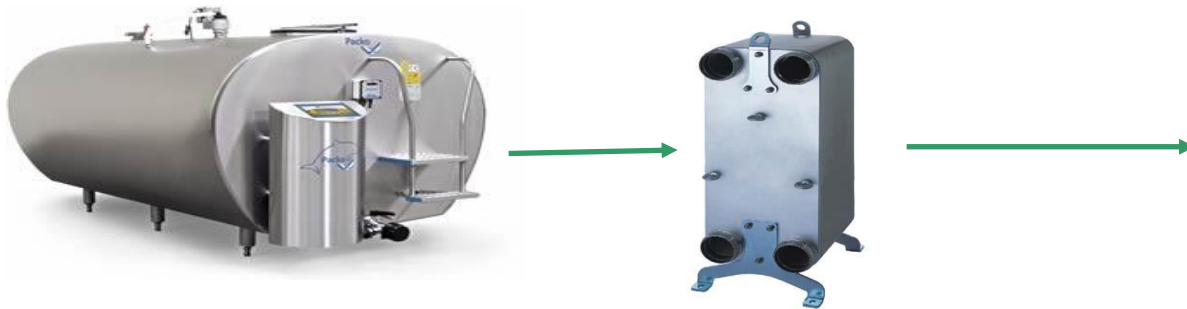
•Convenience also affects decision making around system choice - Prices correct on 28/08/2020

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 CO₂ 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

Current Farm Setup

Herd size:



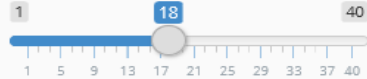
Morning Milking Time:

7:00

Evening Milking Time:

17:00

Number of Milking Units:



Milk Cooling System:

DX IB

Water Heating System:

Electric Oil Gas

Hot Wash Frequency:

Once per day

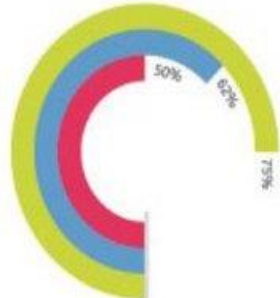
Milk Collection Interval:

Every two days

Every three days



Energy
Optimisation Tool
<https://messo.shinyapps.io/AEOP/>

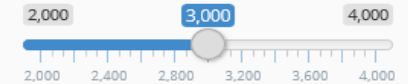


On-farm Technology Investments

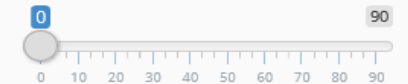
Select Potential Technology:

- 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

- **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

