HEATER Webinar – "Energy Monitoring for Sustainable Communities"

Digital Technologies for Energy Optimisation in Dairy Farming

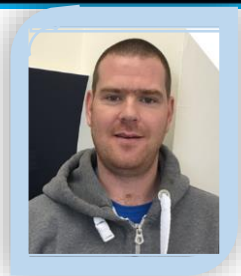
Malachy McElholm
School of Computing, Engineering and Intelligent Systems
Ulster University, Co. Derry

Tuesday 26th April 2022

Background

Malachy McElholm

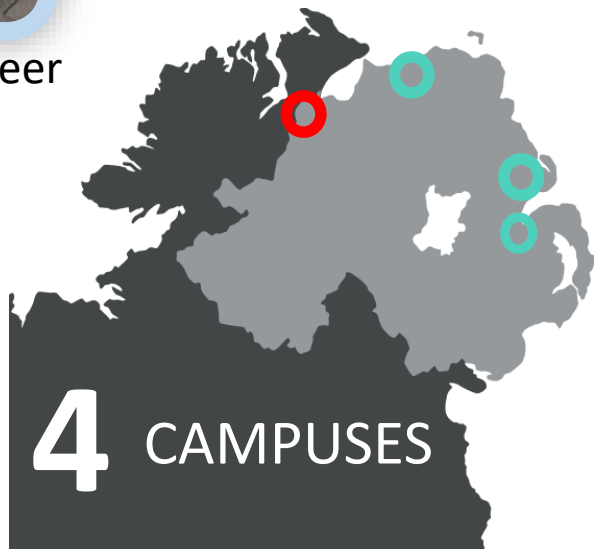
Jim Harkin



Ryan Beveridge

James McGreer

Intelligent Systems Research Centre (>90 researchers)



- **Competencies**
  - Embedded systems, employing AI based data analytics and optimisations.
- **Experience**
  - Initiated and developed **iTEMPO** with Cross-Border research funding (2012-16)
  - **Invest NI PoC** funding (2017-2018), **NxNW ICURe** programme (2019).

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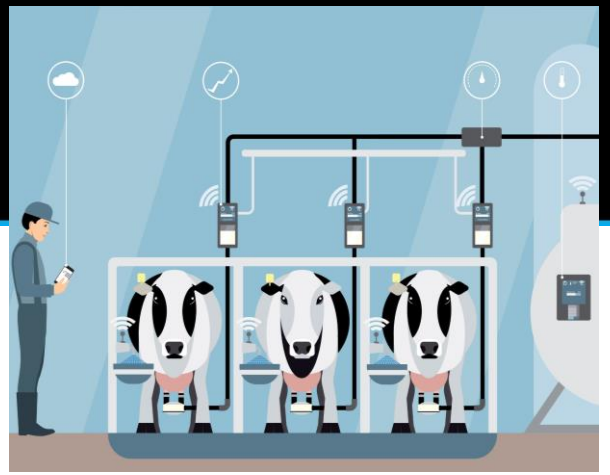
Piot Project: iTEMiD



- **Intelligent Total Energy Monitoring in Dairying (iTEMiD)**
  - ✓ **Six dairy farms in Northern Ireland** (traditional and robotic) Dec 2019 – June 2021
  - ✓ **Phase 1**: measuring, recording and visualising of Significant Energy Users (SEU)
  - ✓ **Phase 2**: measuring and analysis of on-farm renewable generation & exploitation.

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PROBLEM

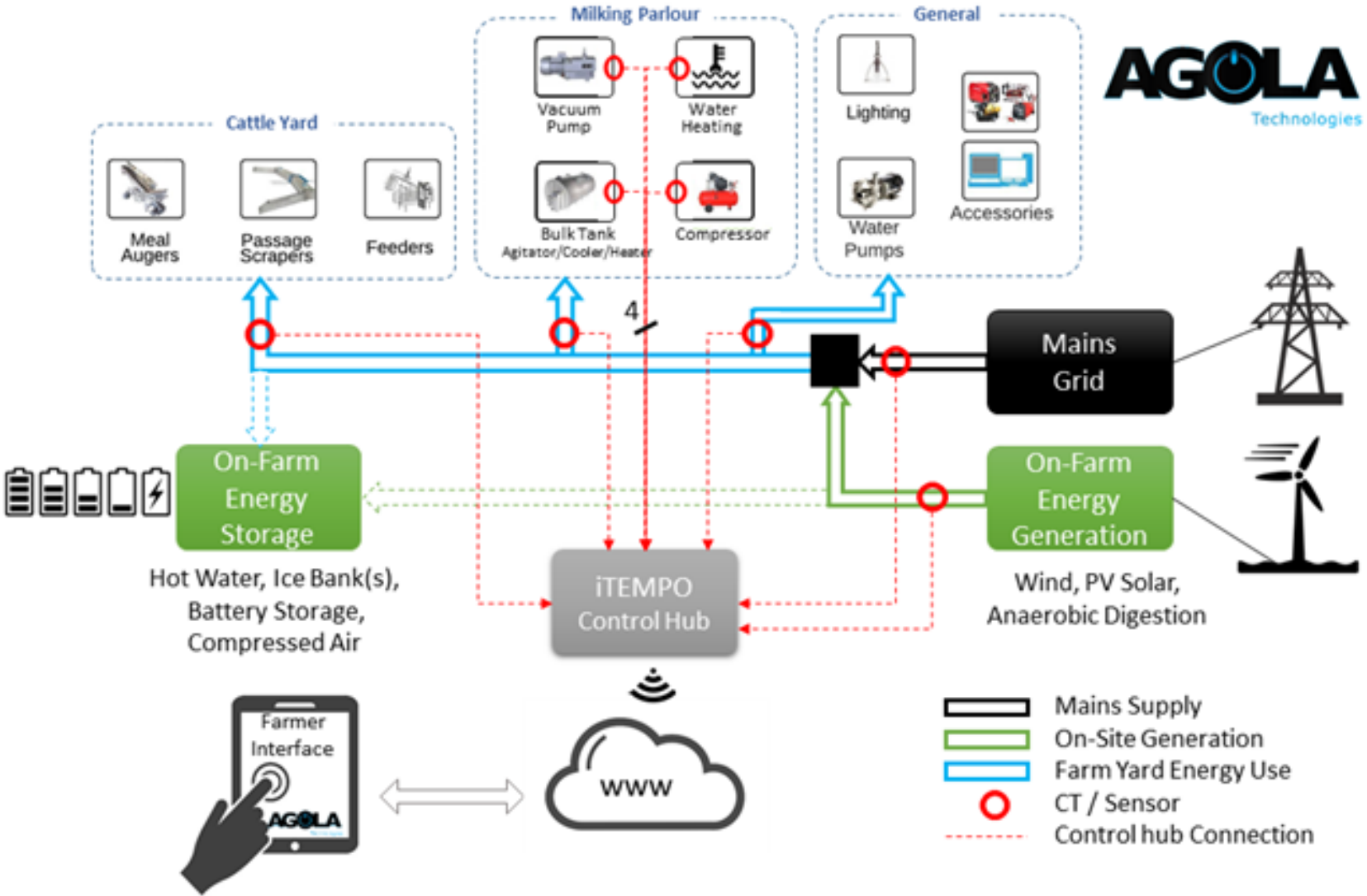
- High Energy **costs** for milk production
- No **visibility** into on farm Energy use
- Making best use of on farm **generation/renewables**
- Reducing **C02** emissions

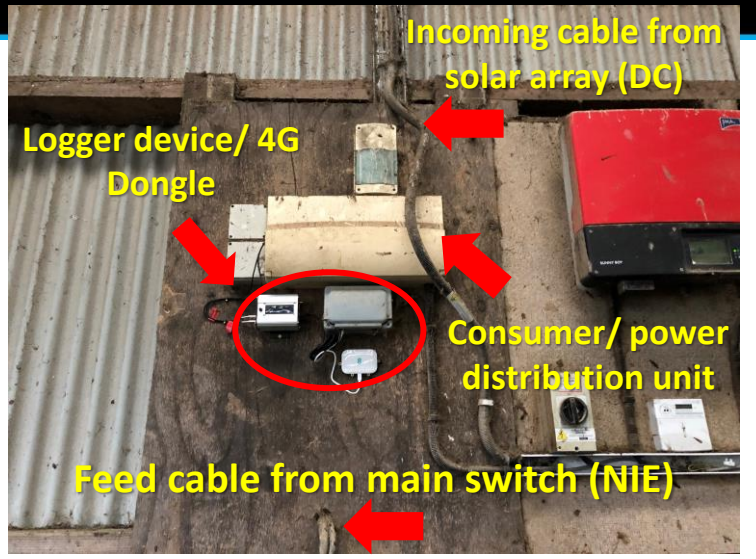
Annual energy cost for on-farm production of liquid milk can range from £7K to £12K for the average (180 cows) dairy herd.

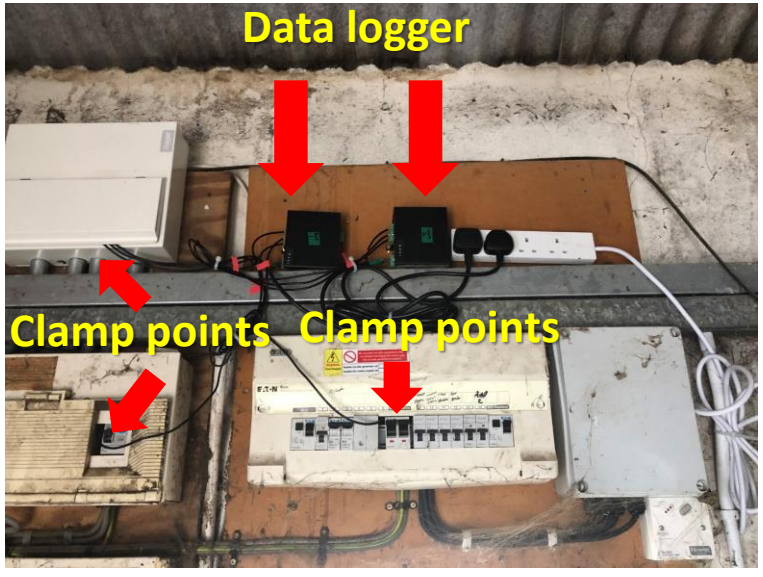
iTEMiD

Intelligent **T**otal **E**nergy **M**onitoring **i**n **D**airying

Pilot System Architecture

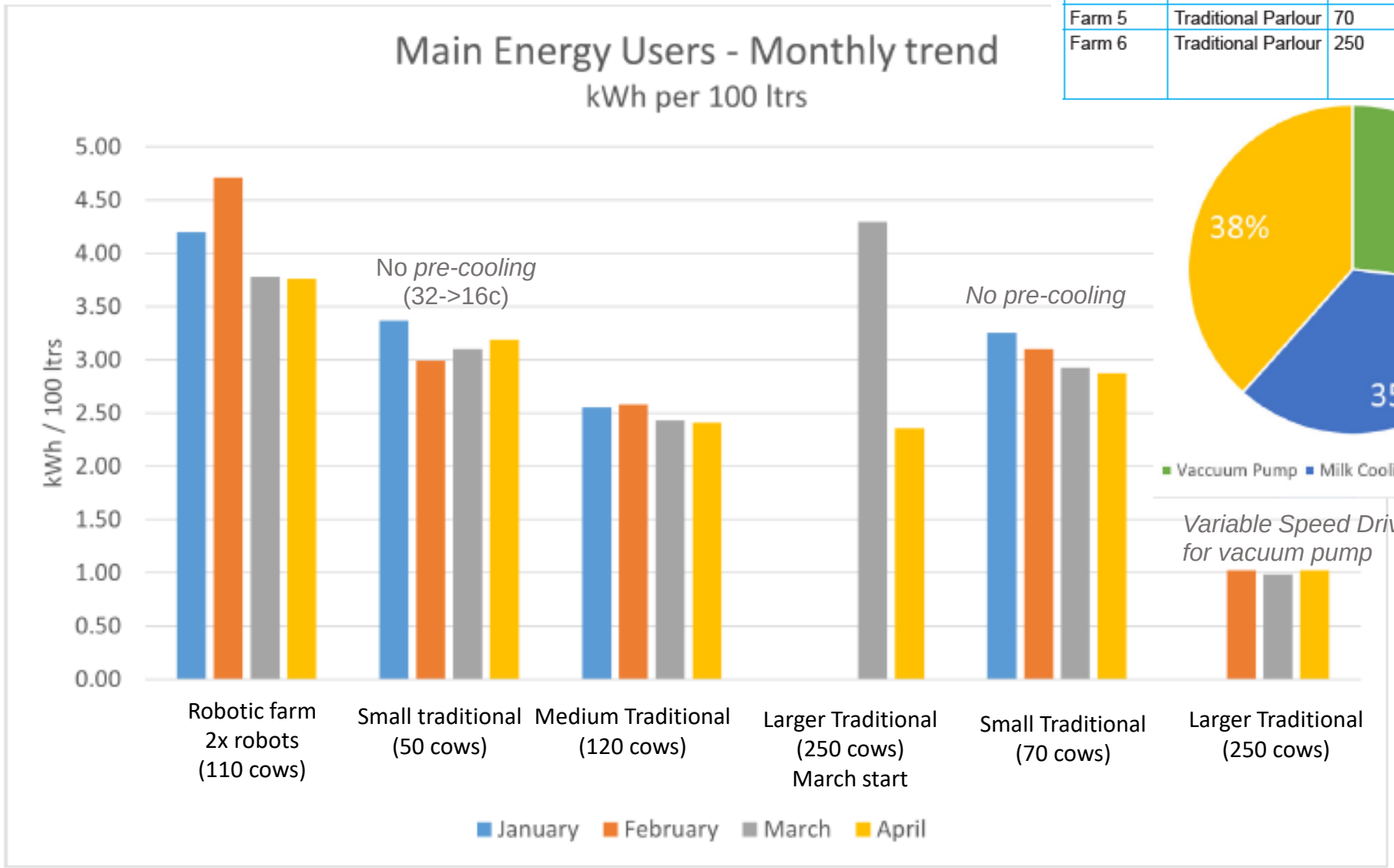






SEU: Farm Profiles

Farm Name	Farm Type	Herd Qty (approx.)	Notes
Farm 1	Robotic	110	2 x Lely Robots energy use recorded as 'Vacuum Pump' (see Figure 2a)
Farm 2	Traditional Parlour	50	Small convectional pump with old Milk Tank coolong system
Farm 3	Traditional Parlour	120	Solar PV on site generation
Farm 4	Traditonal Parlour	250	Milking cessation between Dec and Feb. Solar PV and Wind renewables on site
Farm 5	Traditional Parlour	70	
Farm 6	Traditional Parlour	250	Solar PV on site generation. Variable Speed Drive (VSD) controlled vaccum pun



Variable Speed Drive control for vacuum pump

Three main on farm energy processes (Vacuum Pumping, Milk Cooling & Water heating)

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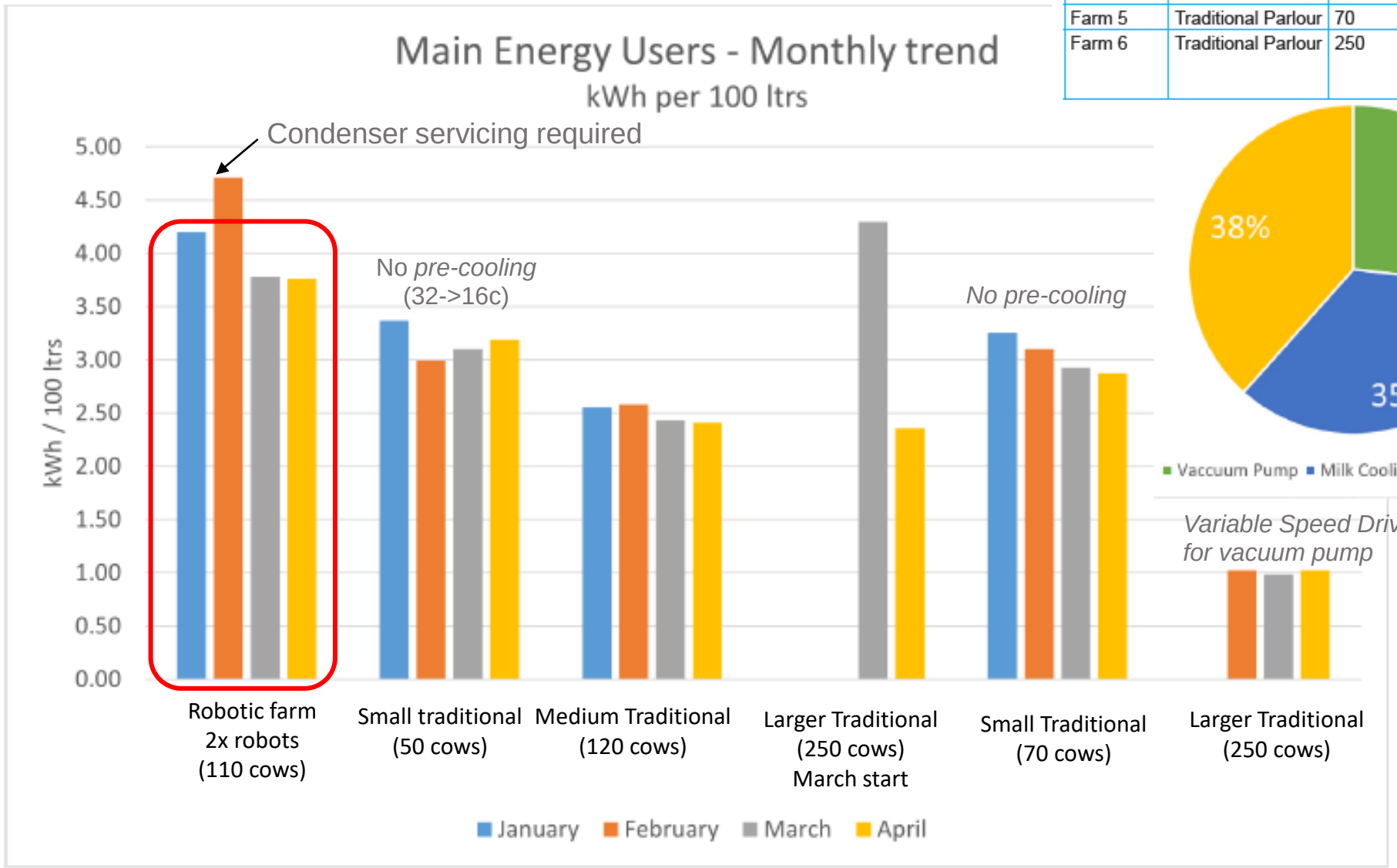

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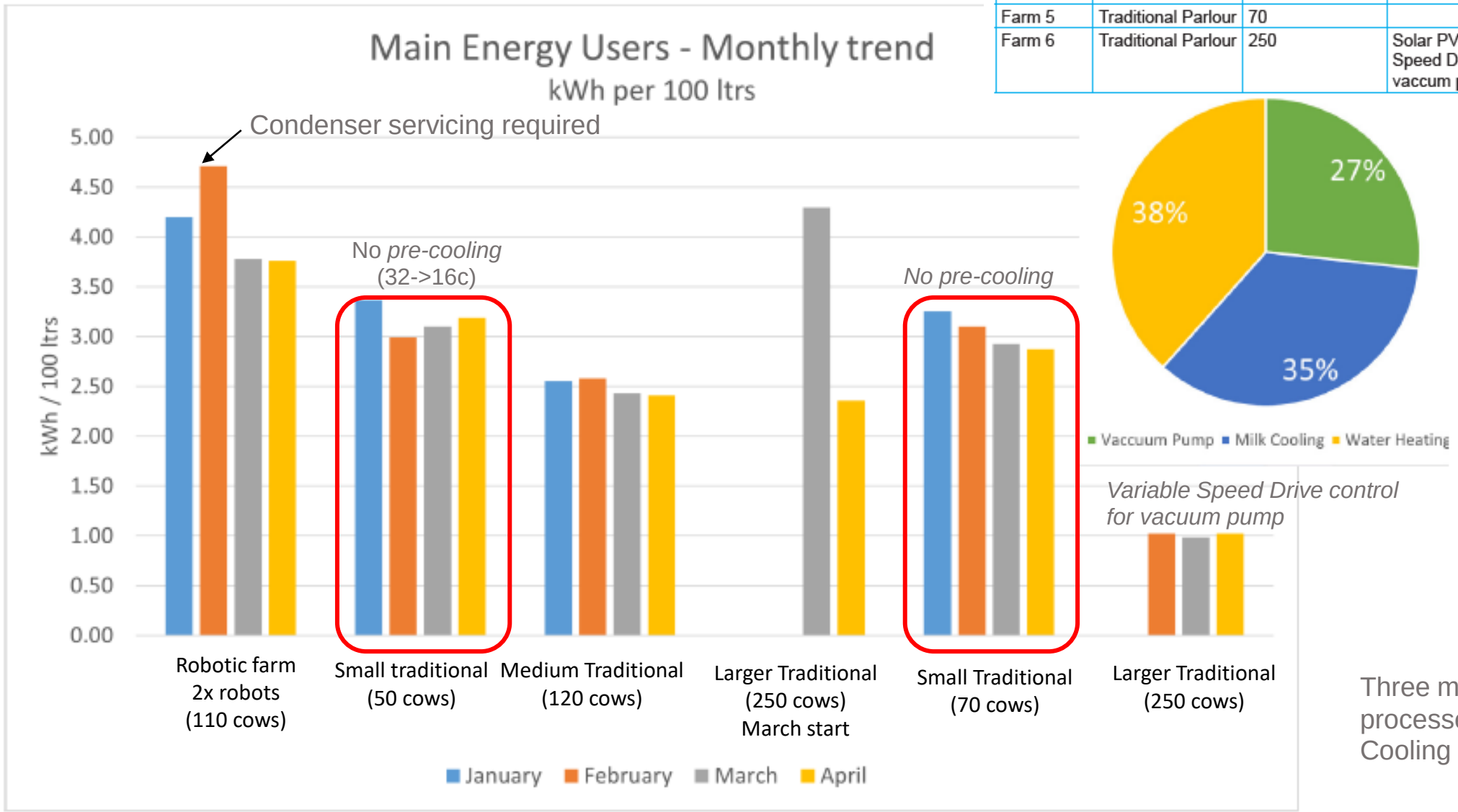

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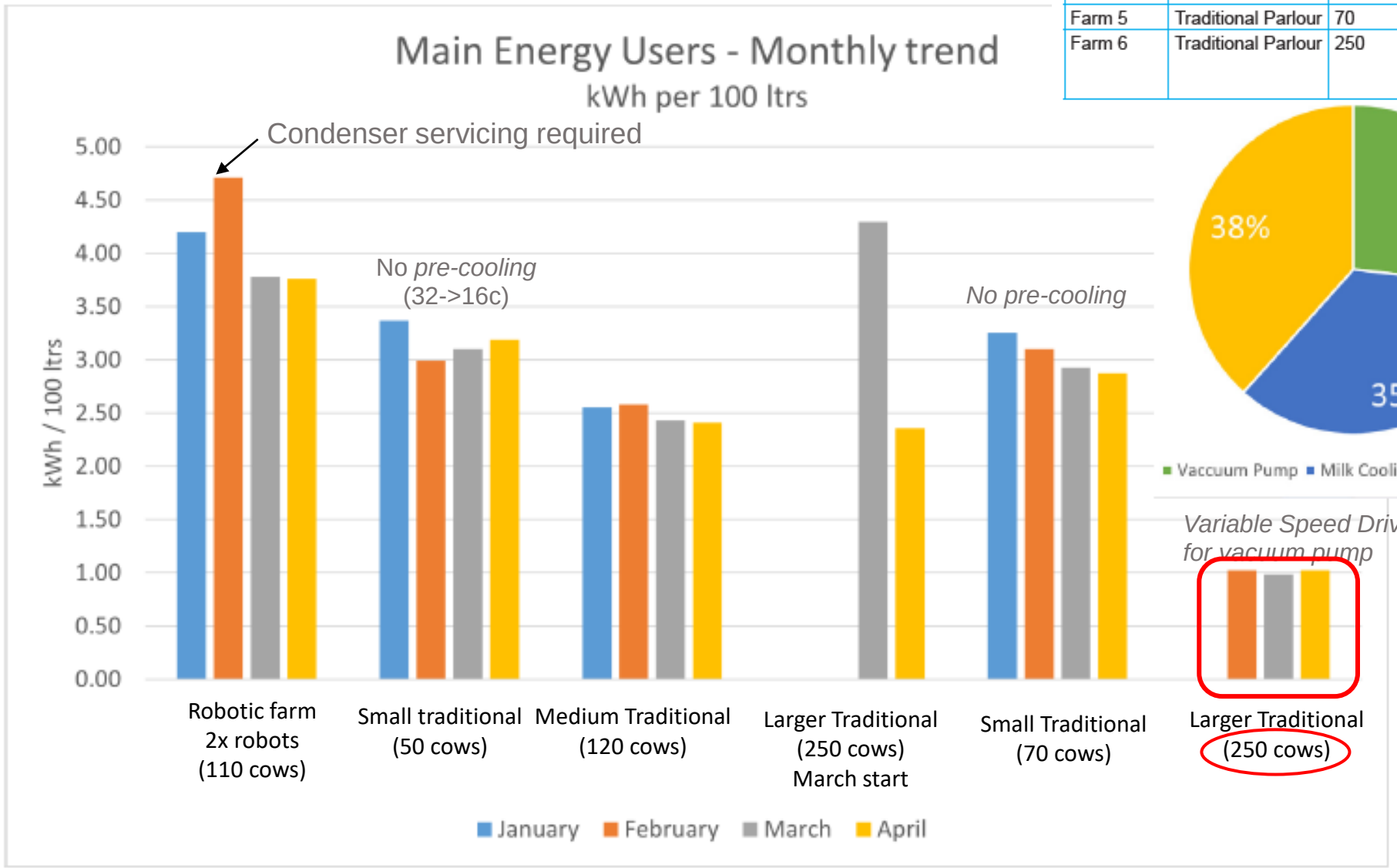

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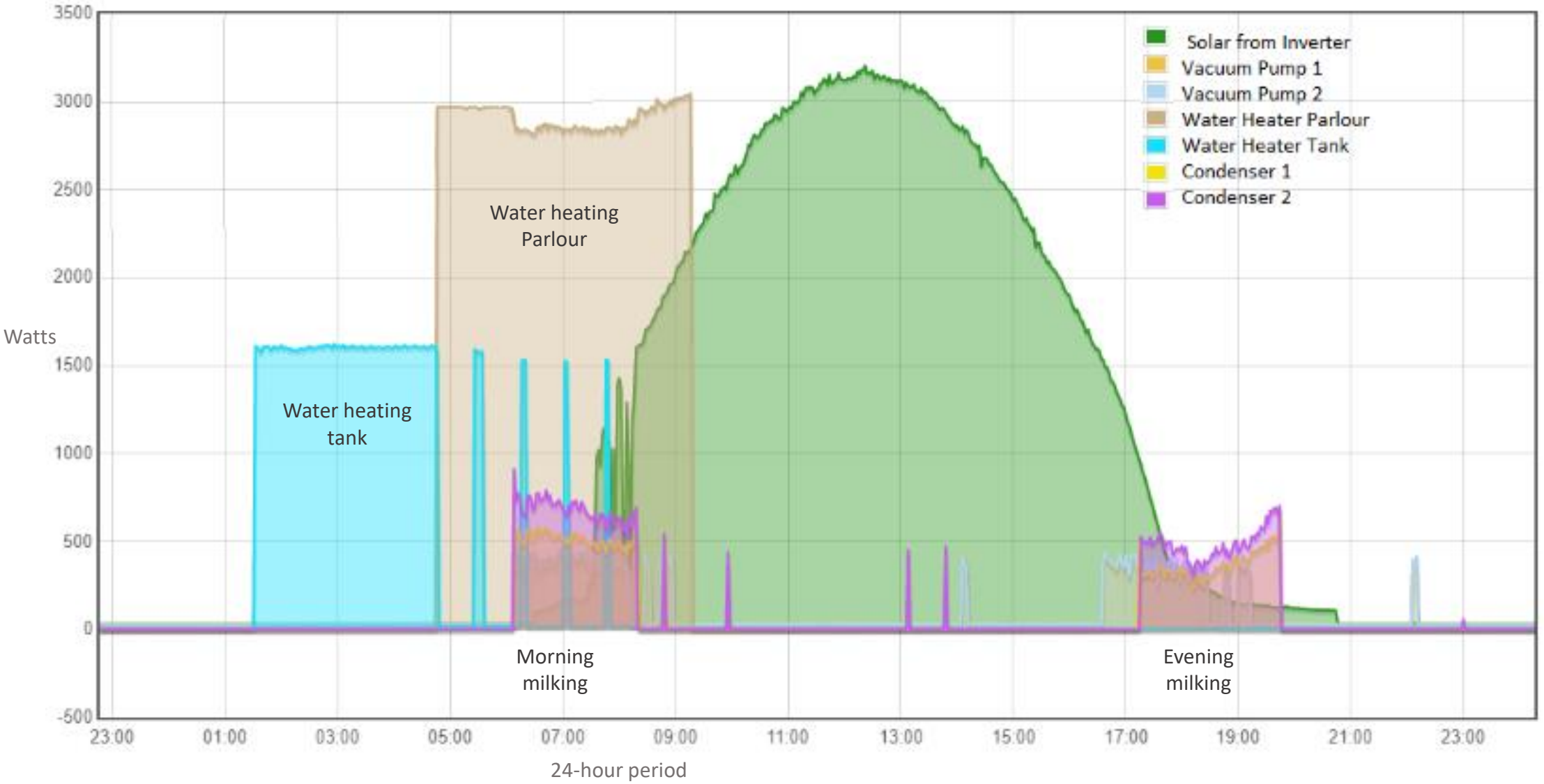
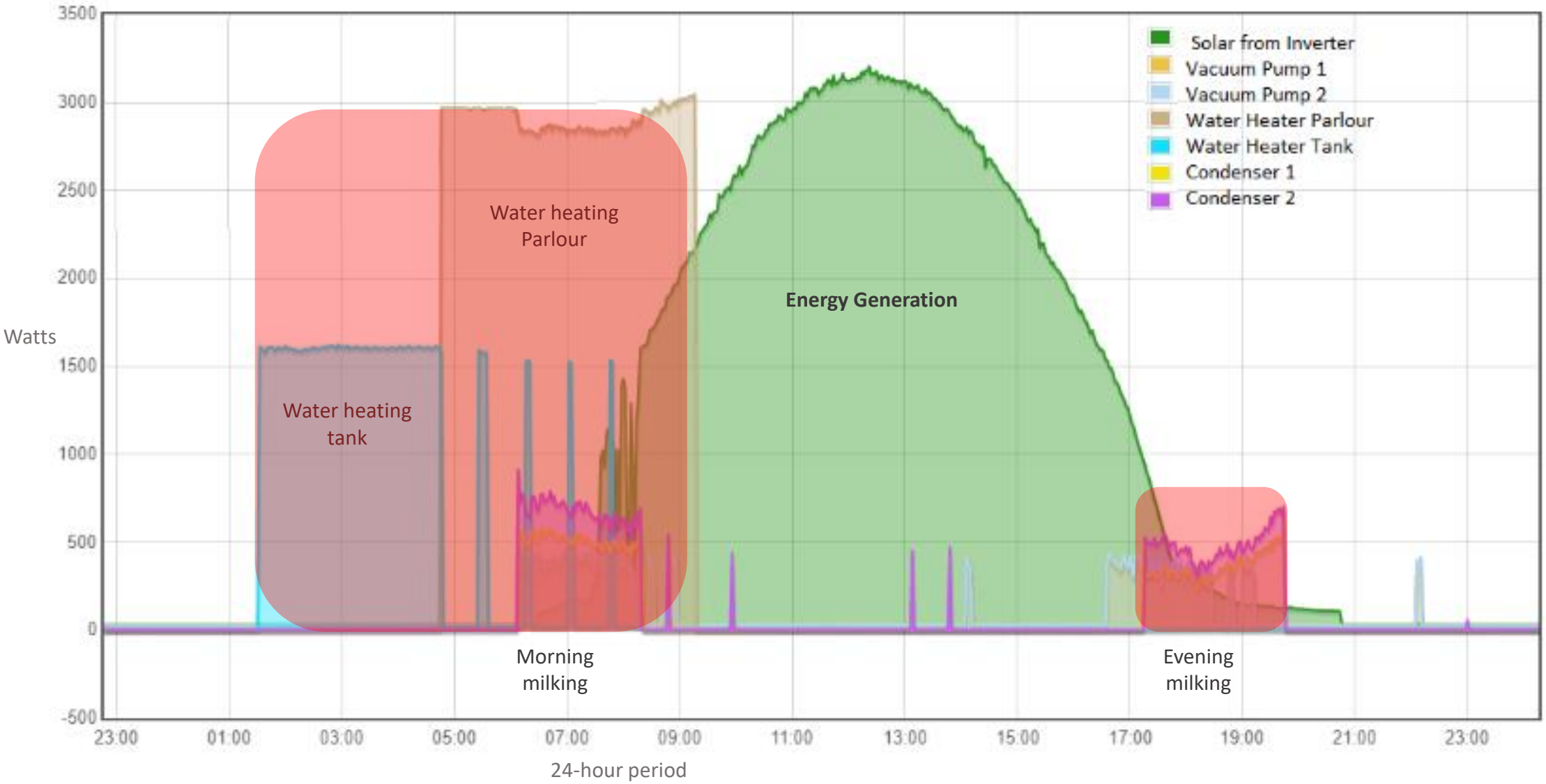
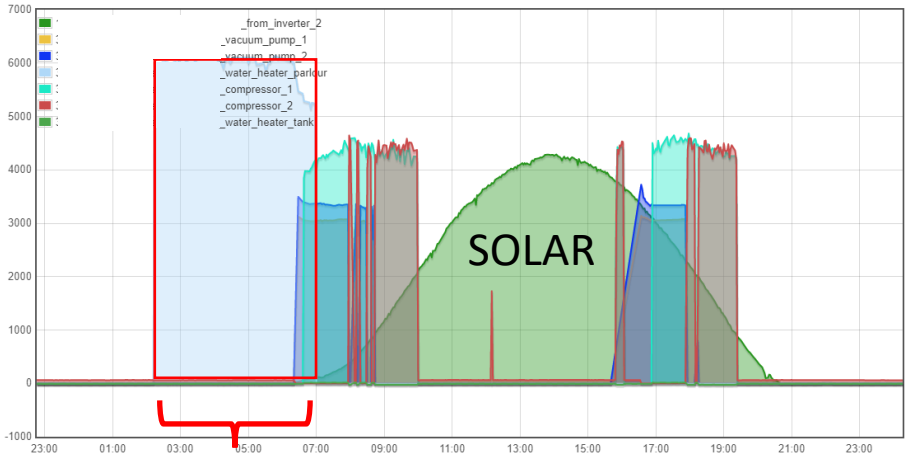
Solar Generation and SEU Profiles



Solar and SEU Profiles



Optimising Water Heating Energy with Renewables



2am – 7am = 6kWh x 5 hours = **30 kWh** total

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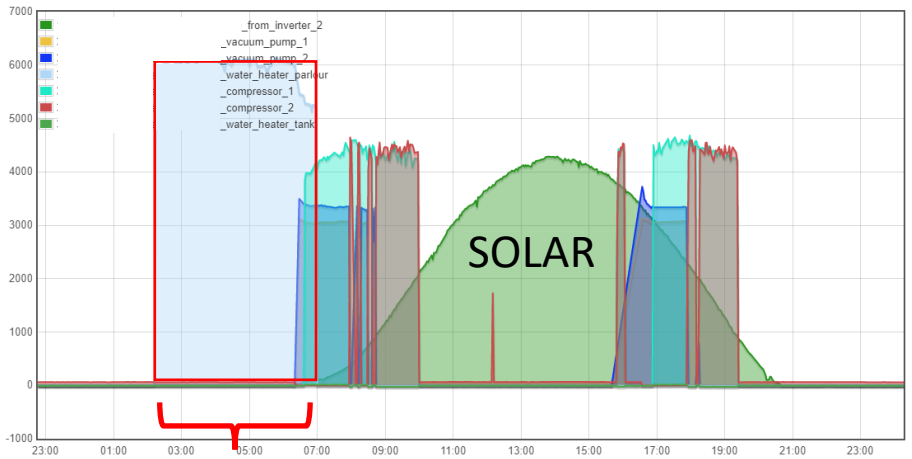

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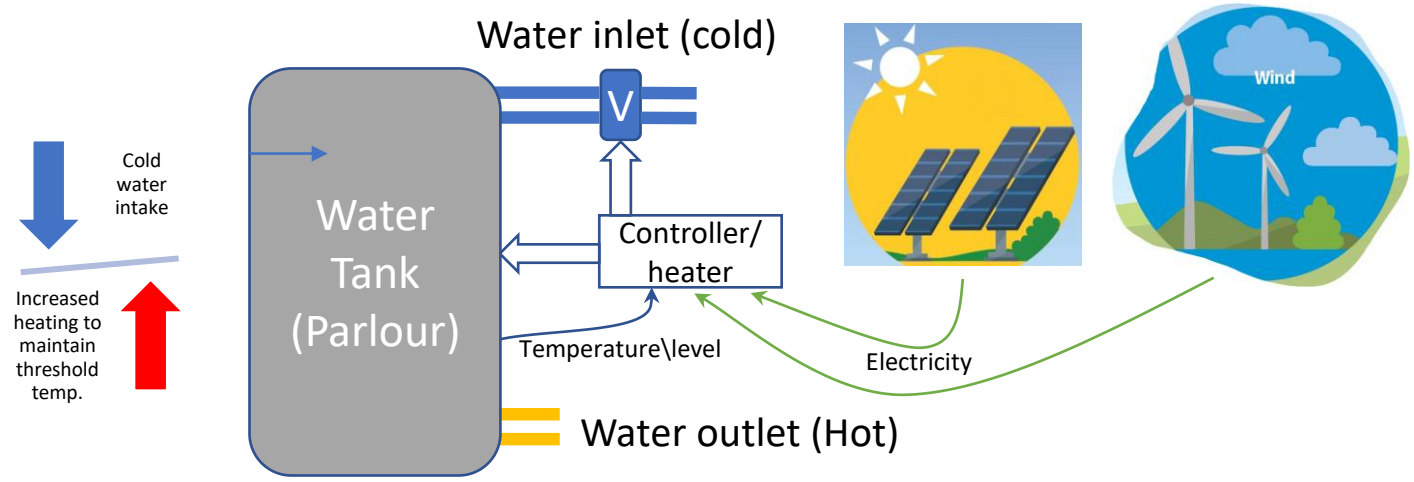
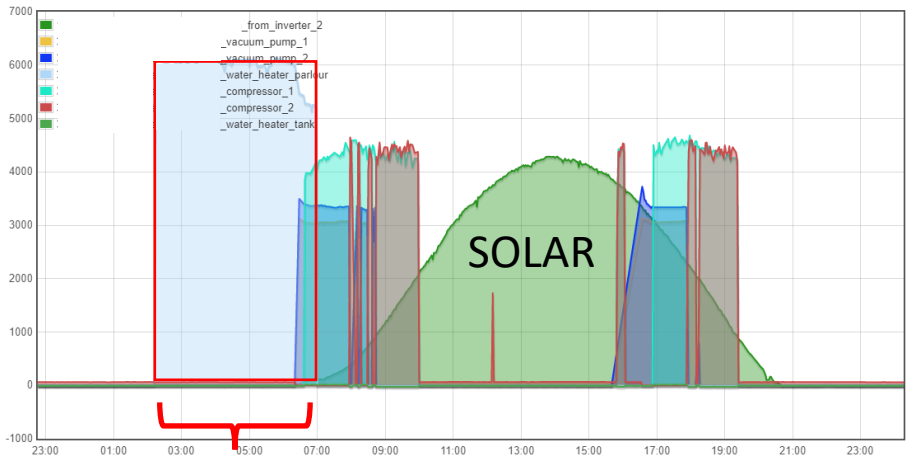


6kw Heater, 450L Cotswold

Optimising Water Heating Energy with Renewables



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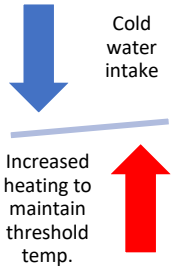
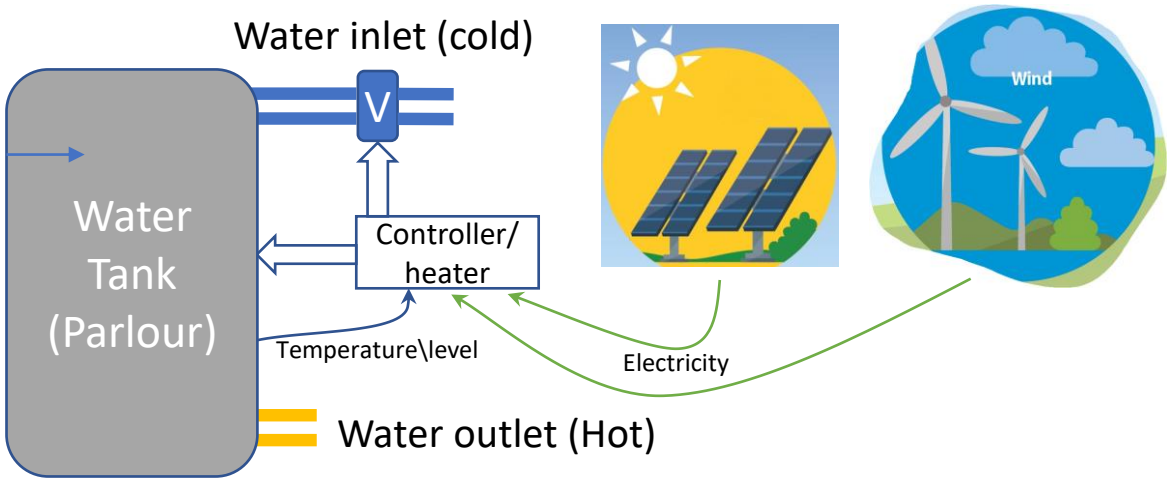
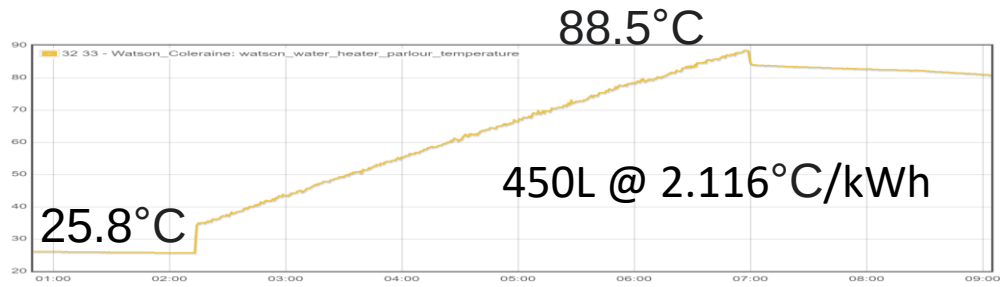
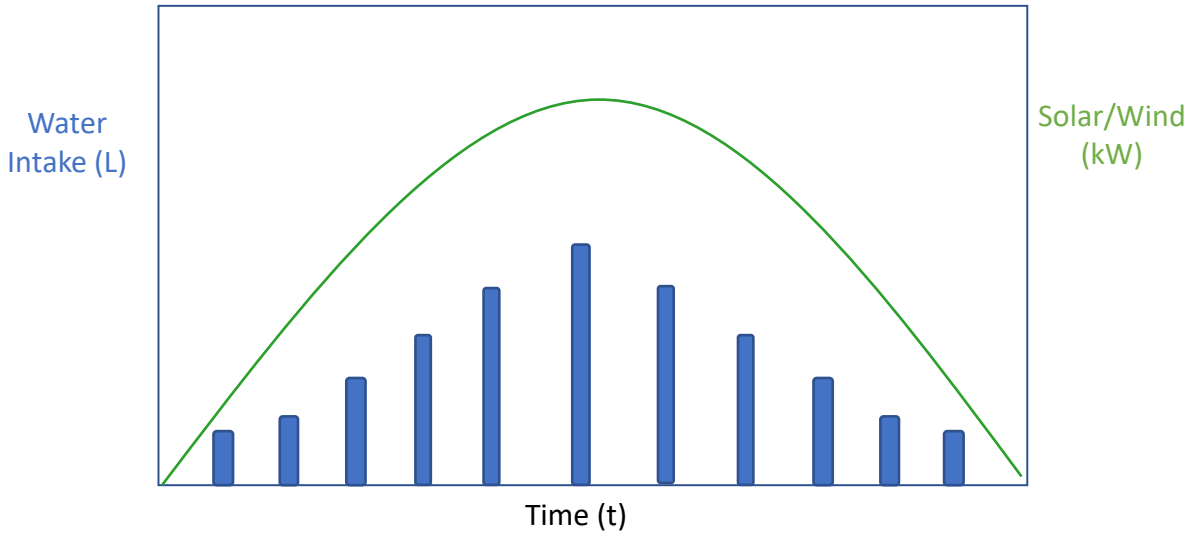




6kw Heater, 450L Cotswold

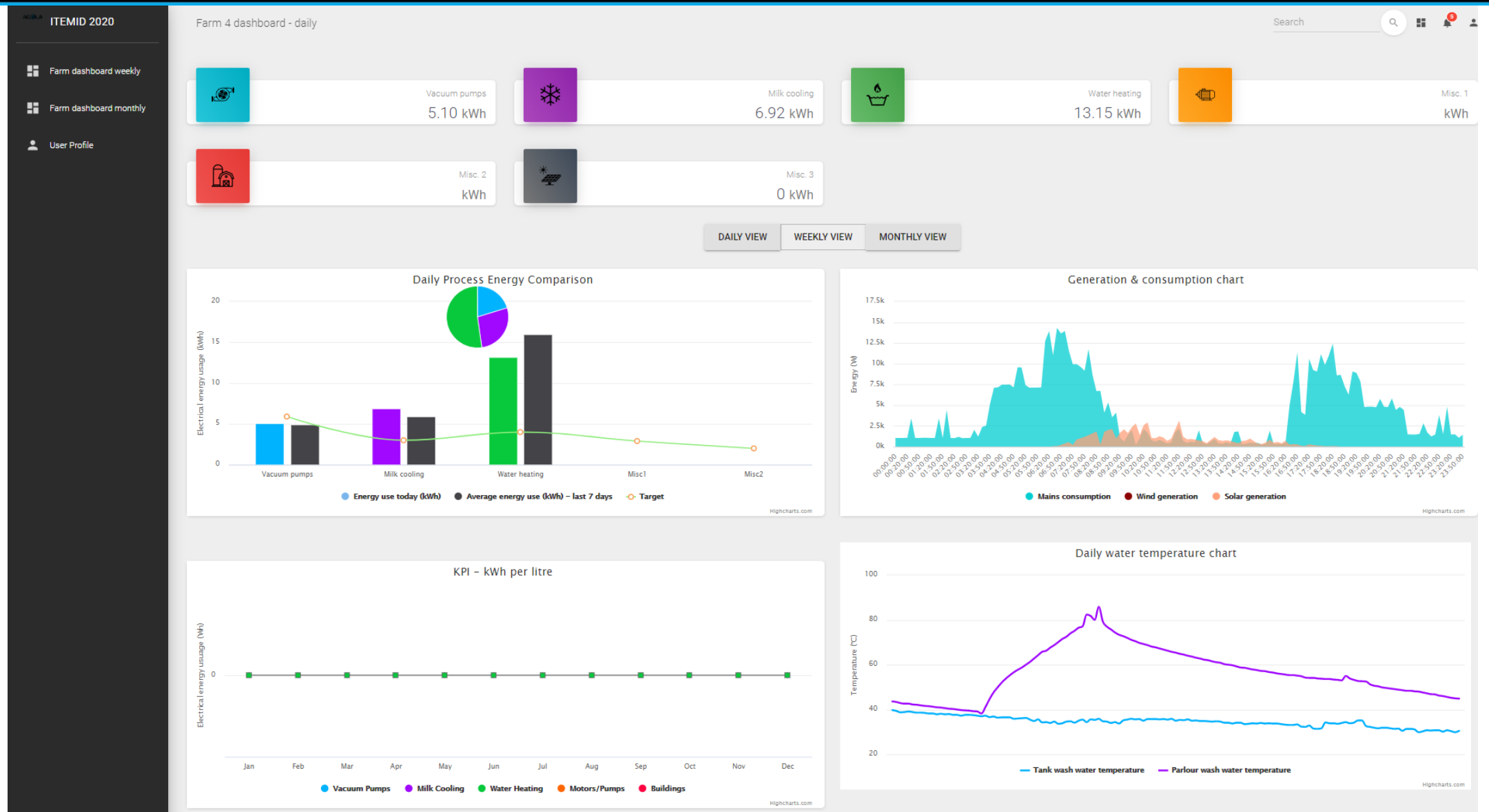
	Time	Duration (Hrs)	Average generated per Hour (kWh)	Generated (kWh)	Temperature change (°C)
Solar morning	9.00am – 11.00am	2	1.5kWh	3	6.34
Solar mid-day	11.00am – 5pm	6	3.5kWh	21	44.43
Solar afternoon	5.00pm-7.00pm	2	1.5kWh	3	6.34
				27 (total)	





Given electricity tariff (£0.15/kWh), total weekly saving in using the renewable energy to heat the water = ~£22.

System Dashboard



Summary

Digital technology affords:

- Data collection with valuable real time **insight** into **electricity consumption for SEU**.
- **Highlights energy reduction approaches** of e.g. pre-cooling, VSD based Vacuum pumps.
- Provides **evidence** of the opportunity for on farm renewables
- **Automation** using AI to analyse and provide interventions

Thank You

iTEMiD

Track | Analyse | Optimise

Jason Rankin (AgriSearch), Neville Graham, Gary Watson and Andrew Graham (Dale Farm), James McGreer (McGreer Consulting), Martin Mulholland and Stephen Gilkinson (CAFRE, Greenmount Campus), and Christopher Osborne (Ulster Farmers Union).

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