"Teagasc" Workshop "*Digital Innovation for Dairy Industry*"

Dr James McGREER

On behalf of

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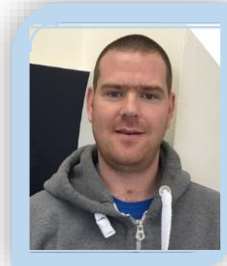
Ulster University, Co. Derry

Wednesday 23rd March 2022

Background

Prof. Jim Harkin   Malachy McElholm   Dr. Ryan Beveridge   Dr. James McGreer

Intelligent Systems Research Centre **(>90 researchers)**
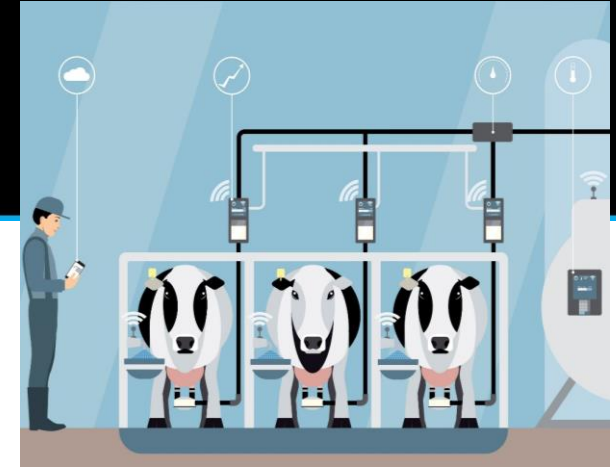
- **Competencies**

  - 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), **NW ICURe** programme (2019).

4 CAMPUSES
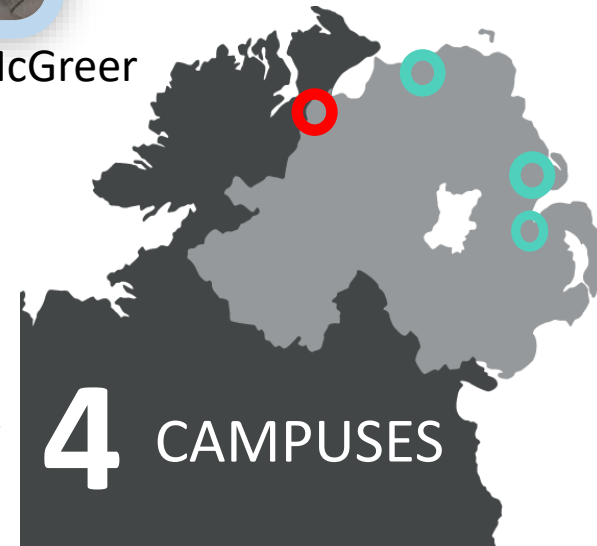
Piot Project: "iTEMiD"

- **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.

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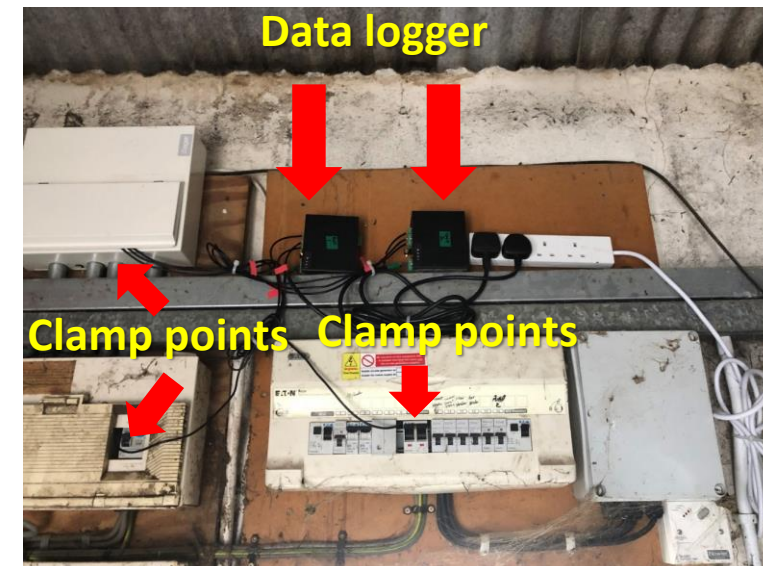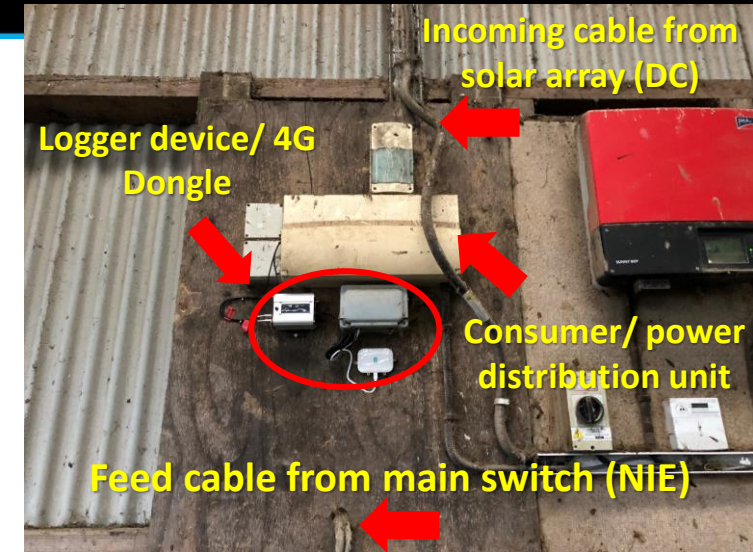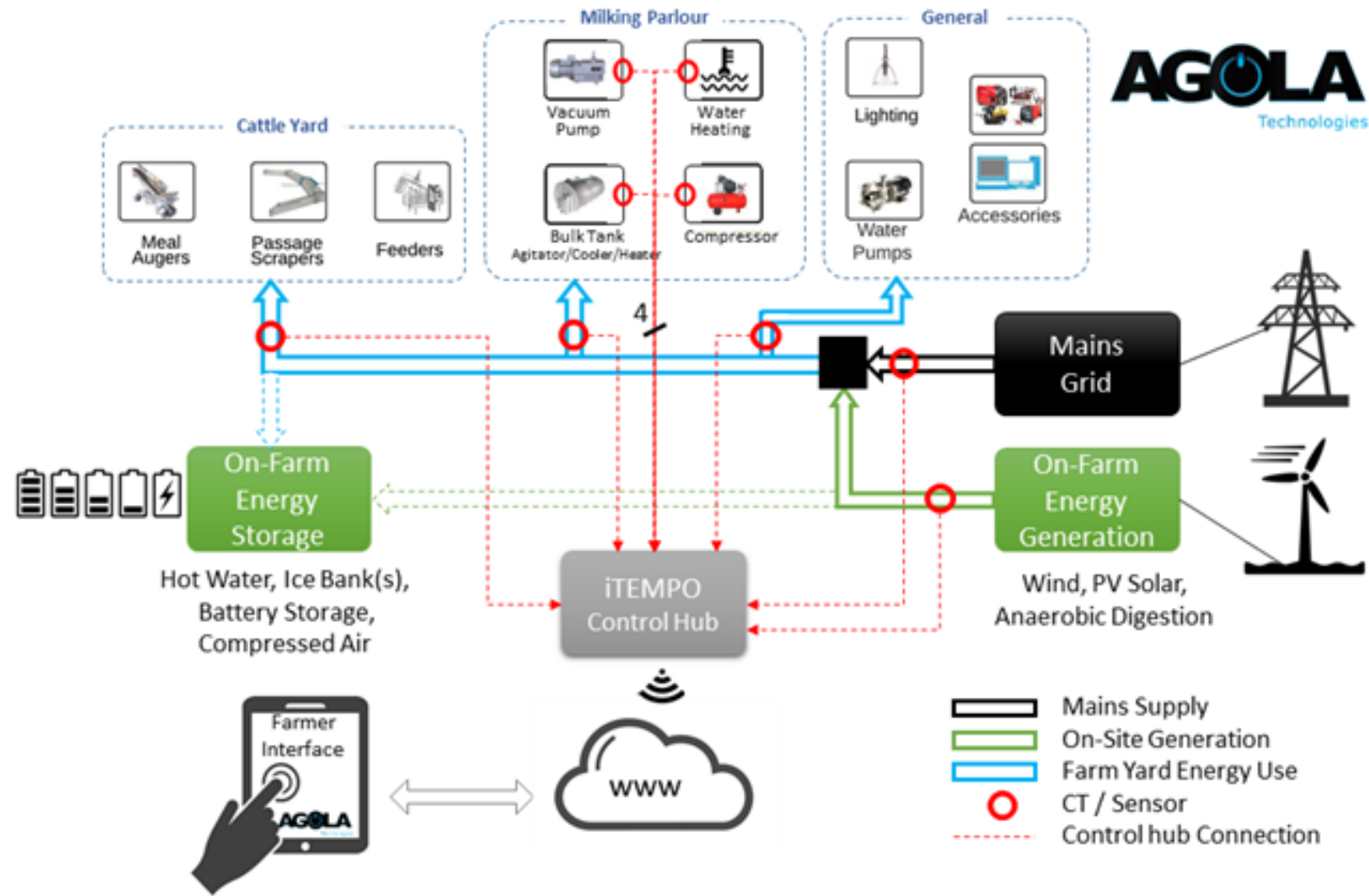
Annual energy cost for on-farm production of liquid milk can range from £7K to £12K for the average (180 cows) dairy herd.

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

Main Energy Users - Monthly trend
kWh per 100 ltrs

No *pre-cooling* (32->16c)

No pre-cooling

Variable Speed Drive control for vacuum pump

kWh / 100 ltrs

Robotic farm 2x robots (110 cows)
Small traditional (50 cows)
Medium Traditional (120 cows)
Larger Traditional (250 cows) March start
Small Traditional (70 cows)
Larger Traditional (250 cows)

■ January ■ February ■ March ■ April

Pie chart: Vaccum Pump 27%, Milk Cooling 35%, Water Heating 38%
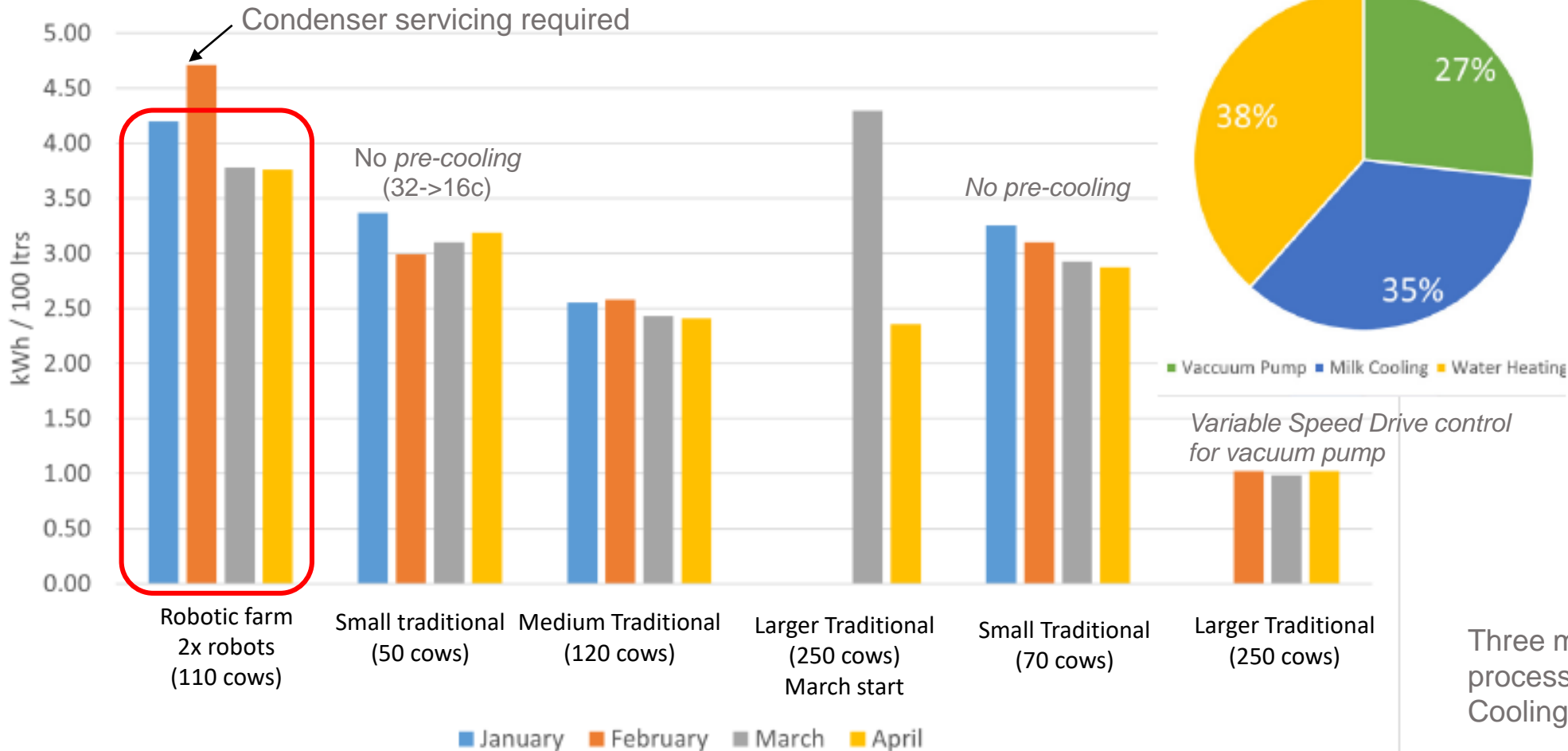■ Vaccum Pump ■ Milk Cooling ■ Water Heating

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

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Pie chart: 27% Vaccum Pump (green), 35% Milk Cooling (blue), 38% Water Heating (yellow)

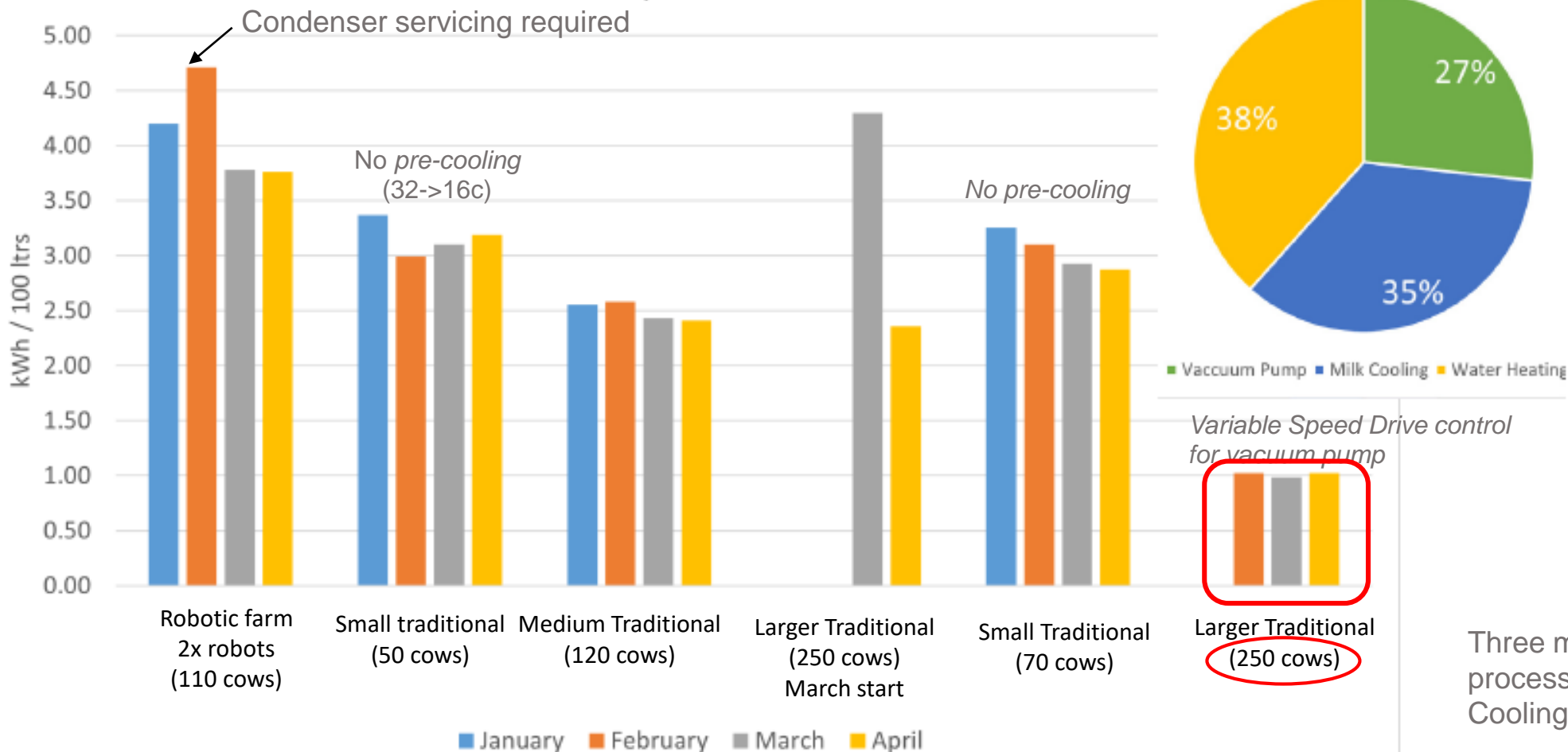■ Vaccuum Pump ■ Milk Cooling ■ Water Heating

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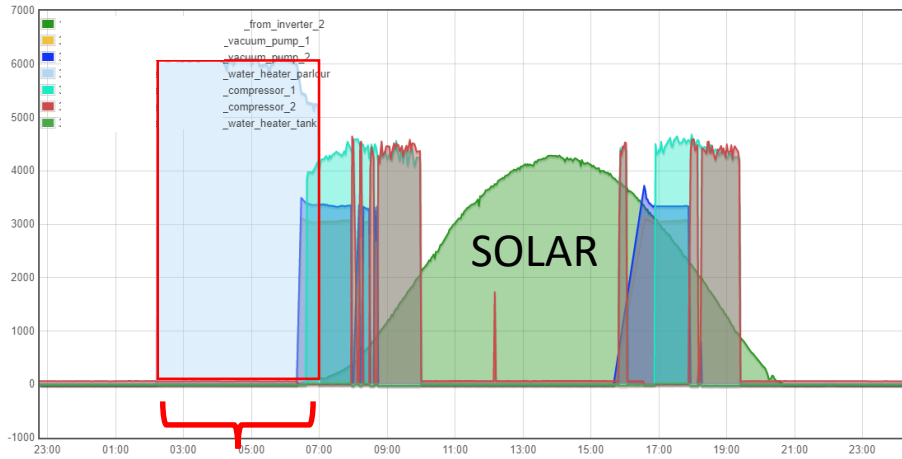
Solar Generation and SEU Profiles
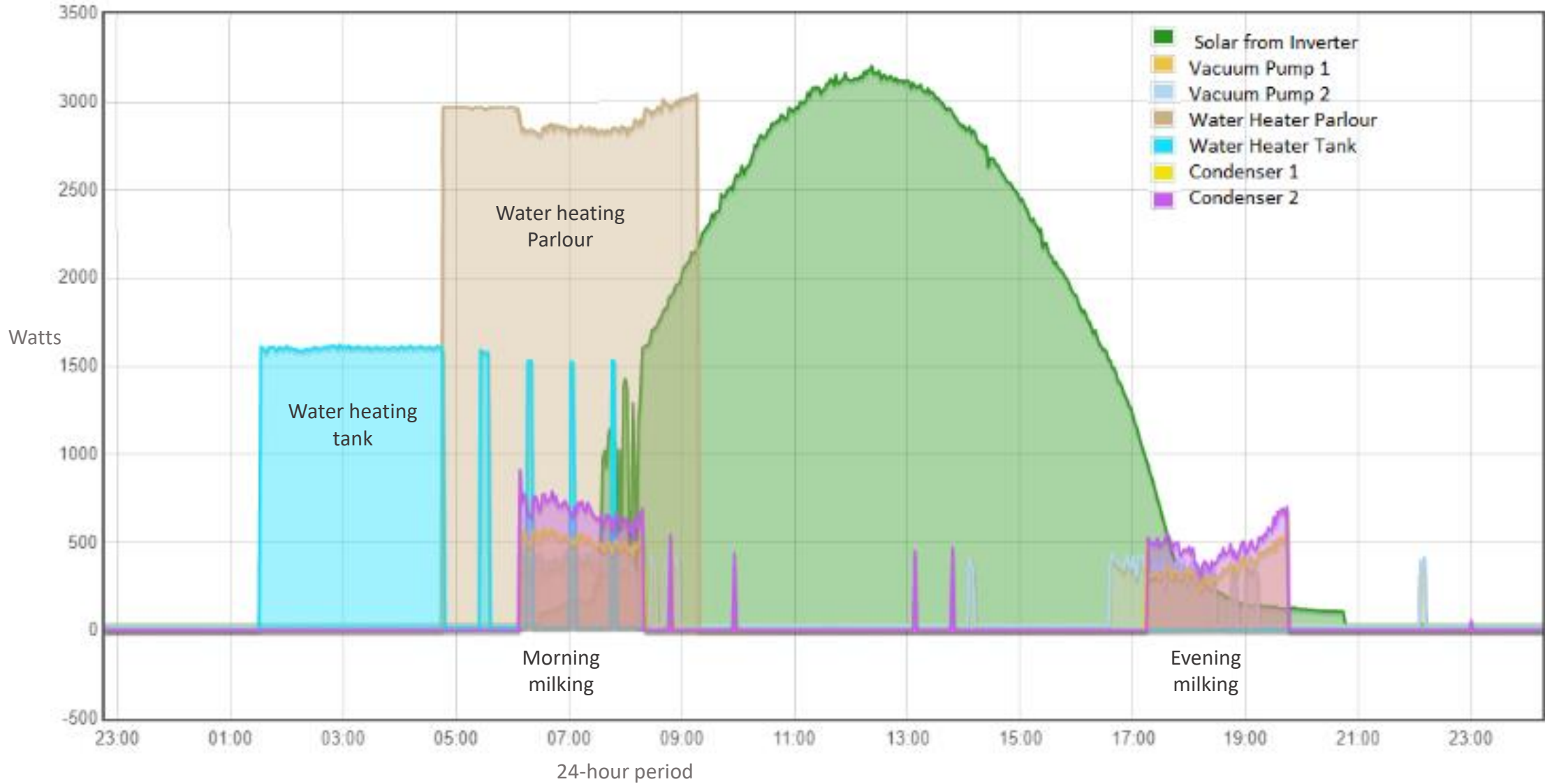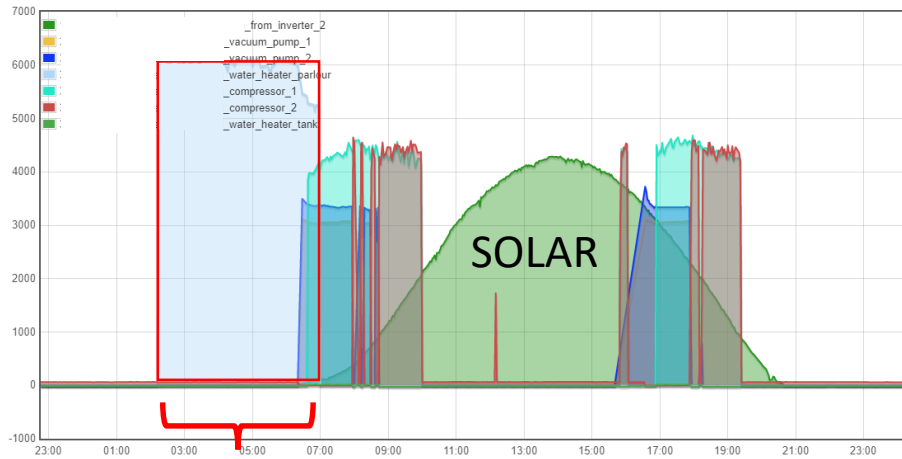
Solar and SEU Profiles
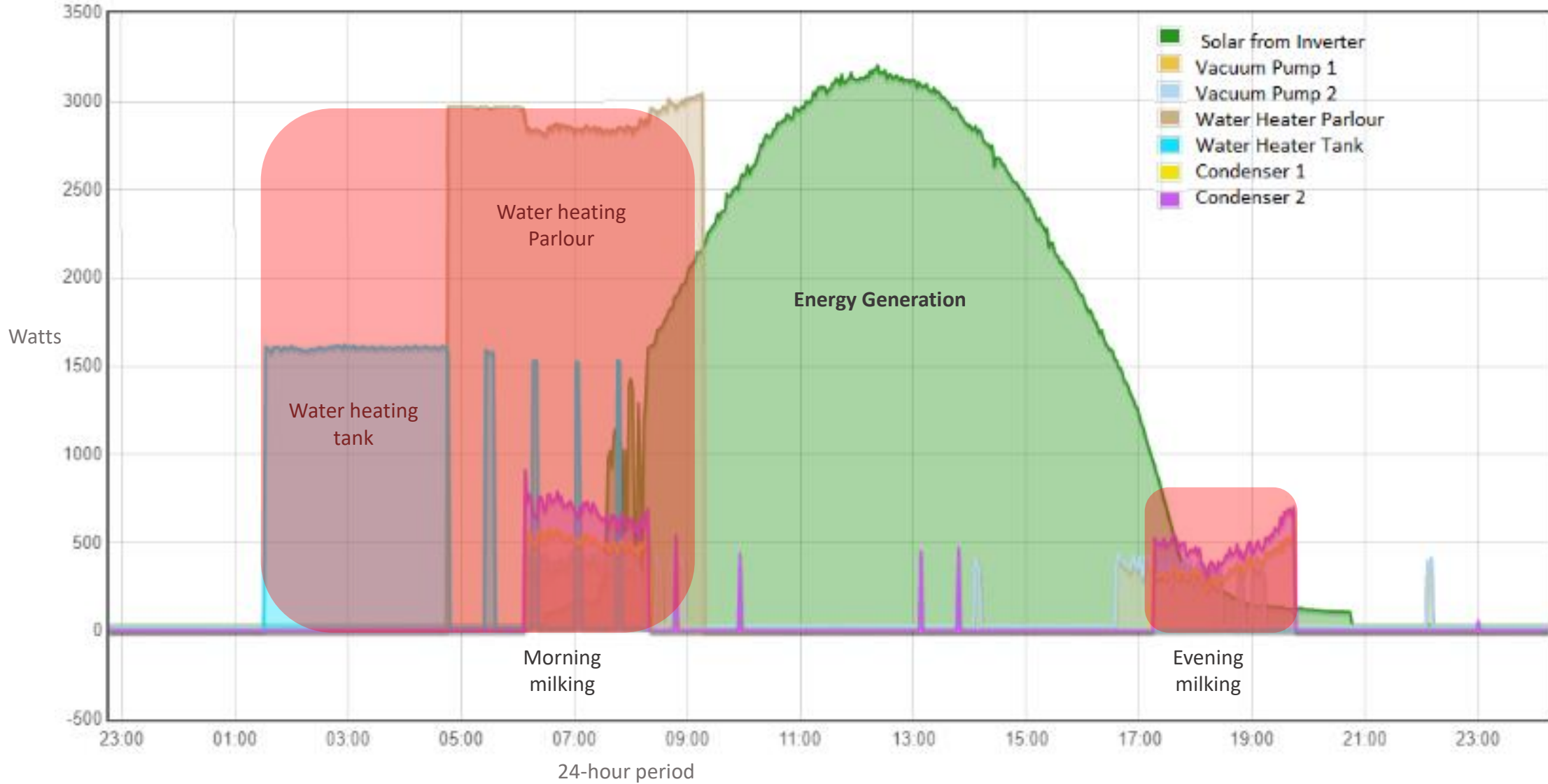
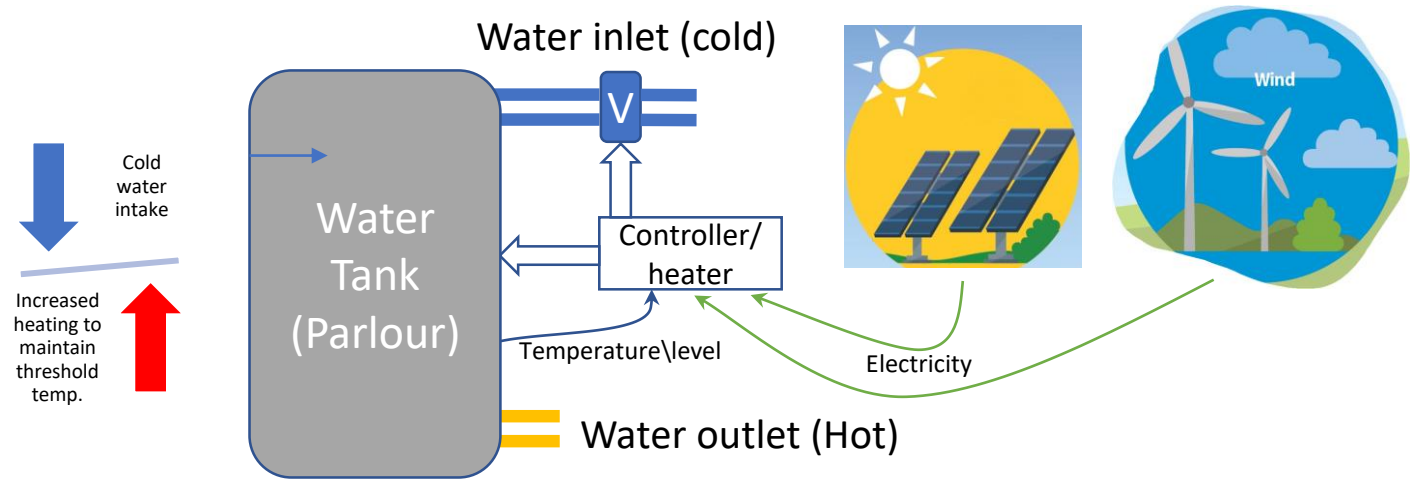# Optimising Water Heating Energy with Renewables

2am – 7am = 6kWh x 5 hours = **30 kWh** total
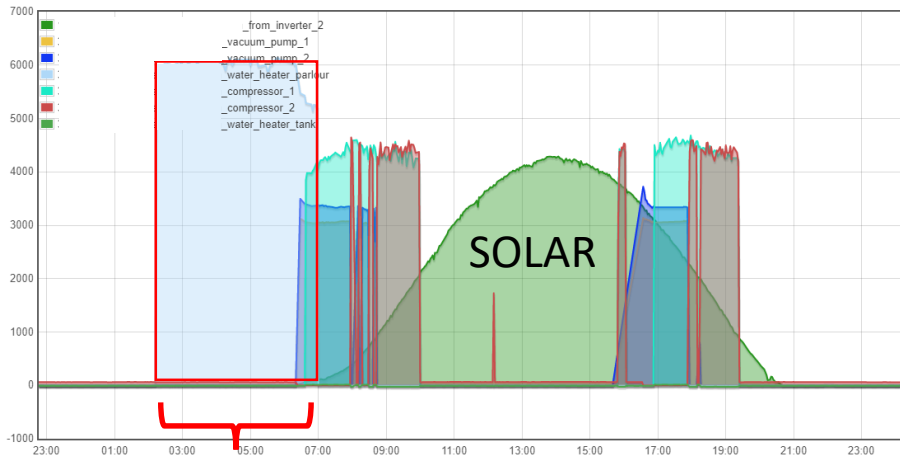
Optimising Water Heating Energy with Renewables
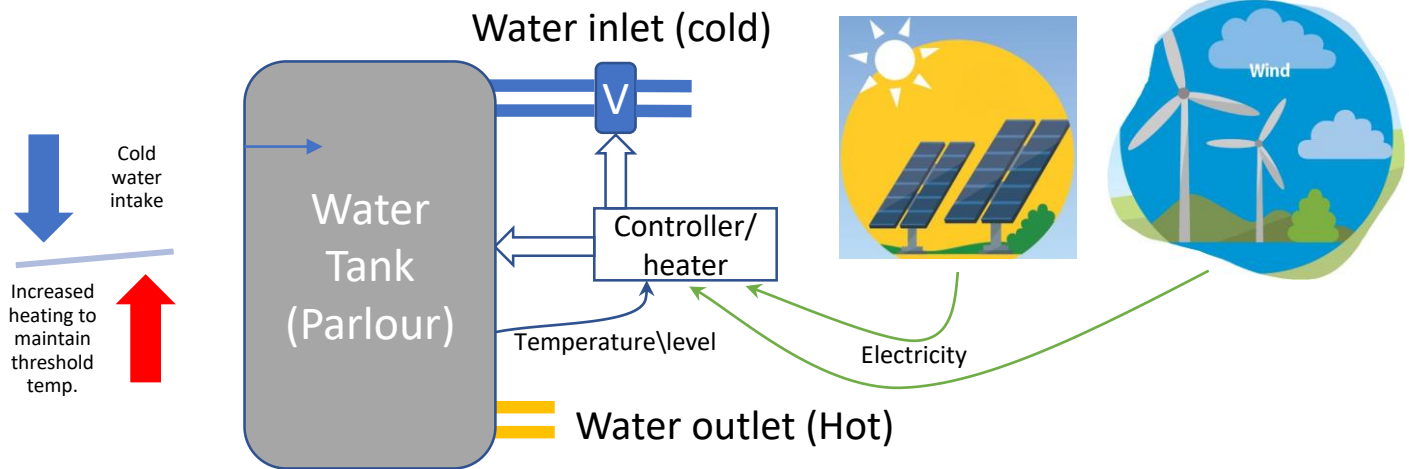

2am – 7am = 6kWh x 5 hours = **30 kWh** total

Water inlet (cold)

Cold water intake

Increased heating to maintain threshold temp.

Water Tank (Parlour)

Controller/ heater

Temperature\level

Electricity

Wind

Water outlet (Hot)

6kw Heater, 450L Cotswold

Optimising Water Heating Energy with Renewables

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	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)	

88.5°C

450L @ 2.116°C/kWh

25.8°C

Water Intake (L)

Solar/Wind (kW)

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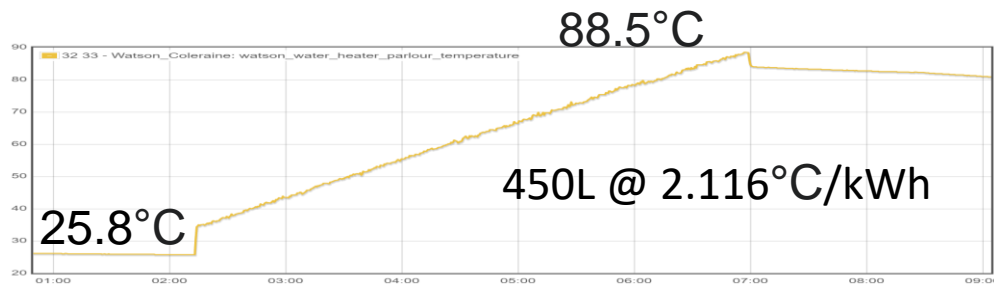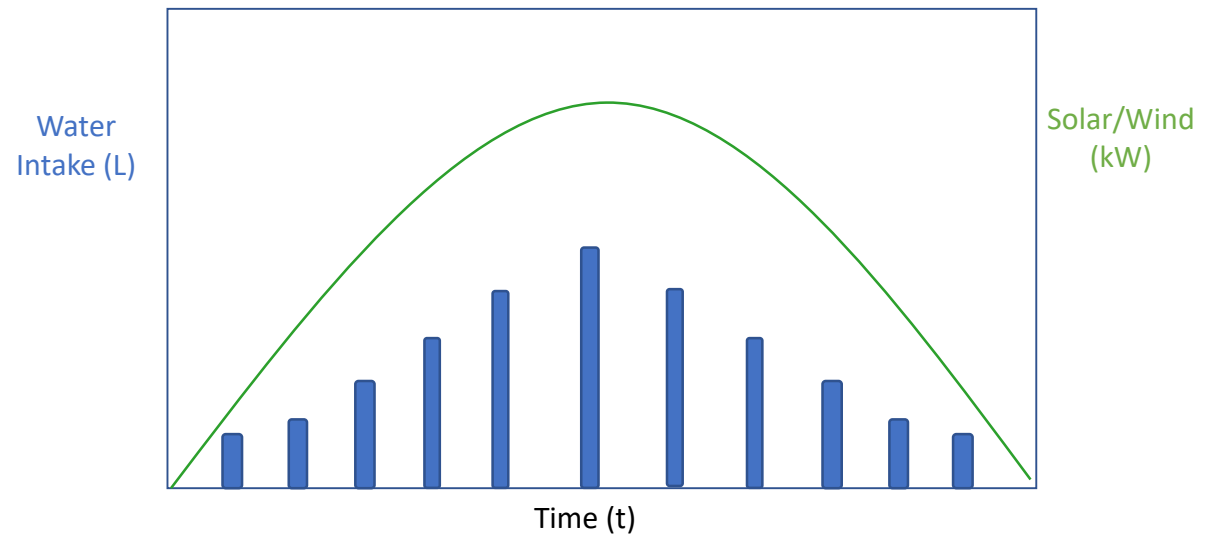
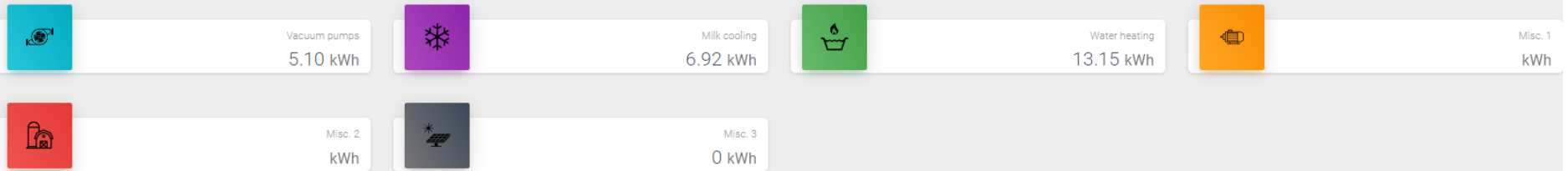Given electricity tariff (£0.15/kWh), total weekly saving in using the renewable energy to heat the water = ~£22.

System Dashboard
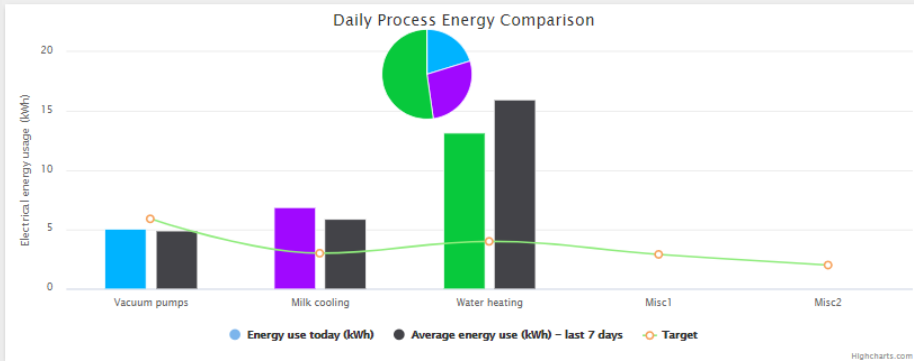
Summary
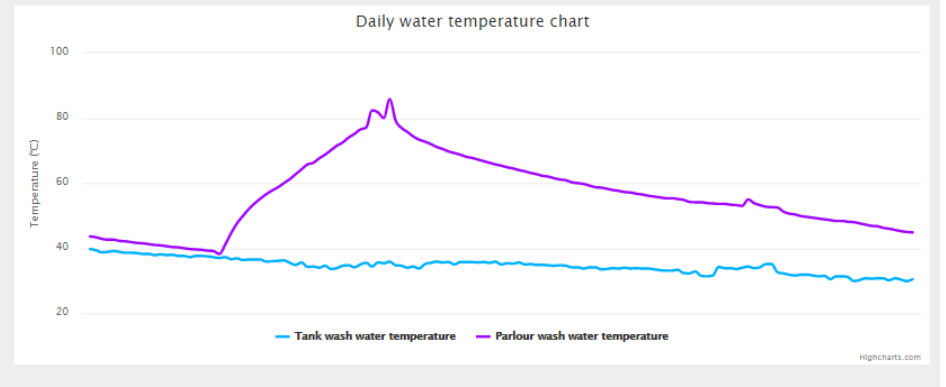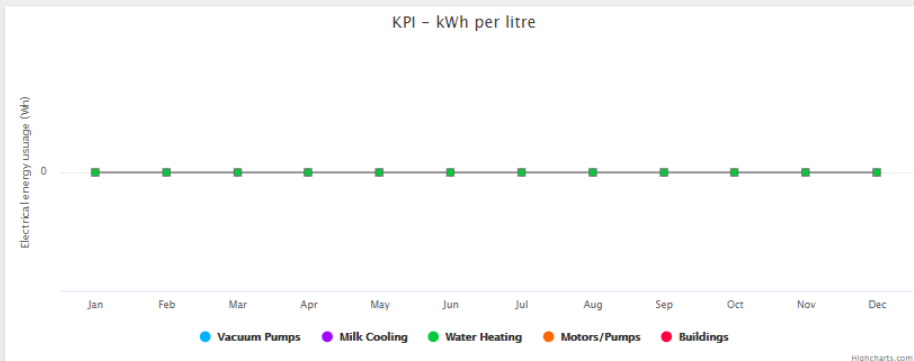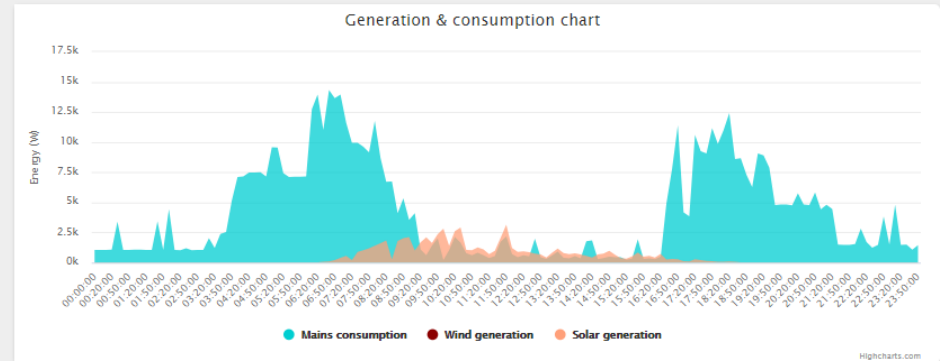
Impacts of Digital Analytics in Dairy Technology :

- [ ] Data collection with valuable real time **Insight** into **Electricity Consumption for SEU**.

- [ ] **Highlights Energy Reduction Opportunities** 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

- [ ] Identifies Additional **Opportunities** for Data Collection /Analytics

Thank You & Any Questions

(Collaboration in Next Phase planned Q-4 2020 ?)

"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).