ASH
■ CREATIVE WIRELESS ELECTRONICS ■

SMEs Innovating with the Networks

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MD of ASH Wireless

ASH Wireless:

- Electronics design consultancy
- Specialists in wireless, low power and sensors
- Most projects involve condition monitoring, IoT

Celsius ENW NIC project

Awarded: 9th December 2015

- Go live
- Monitoring installation Mar 2017
- Monitoring trial Mar 2018
- Thermal ratings tool stage 1 Oct 2018
- Retrofit cooling installation Jun 2018
- Cooling trial Jun 2019
- Thermal ratings tool stage 2 Jan 2020
- Closedown Mar 2020

Investment

£5.5 million

Up to £583m across GB by 2050

Financial benefits

electricity north west
Bringing energy to your door

RICARDO

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Impact Research

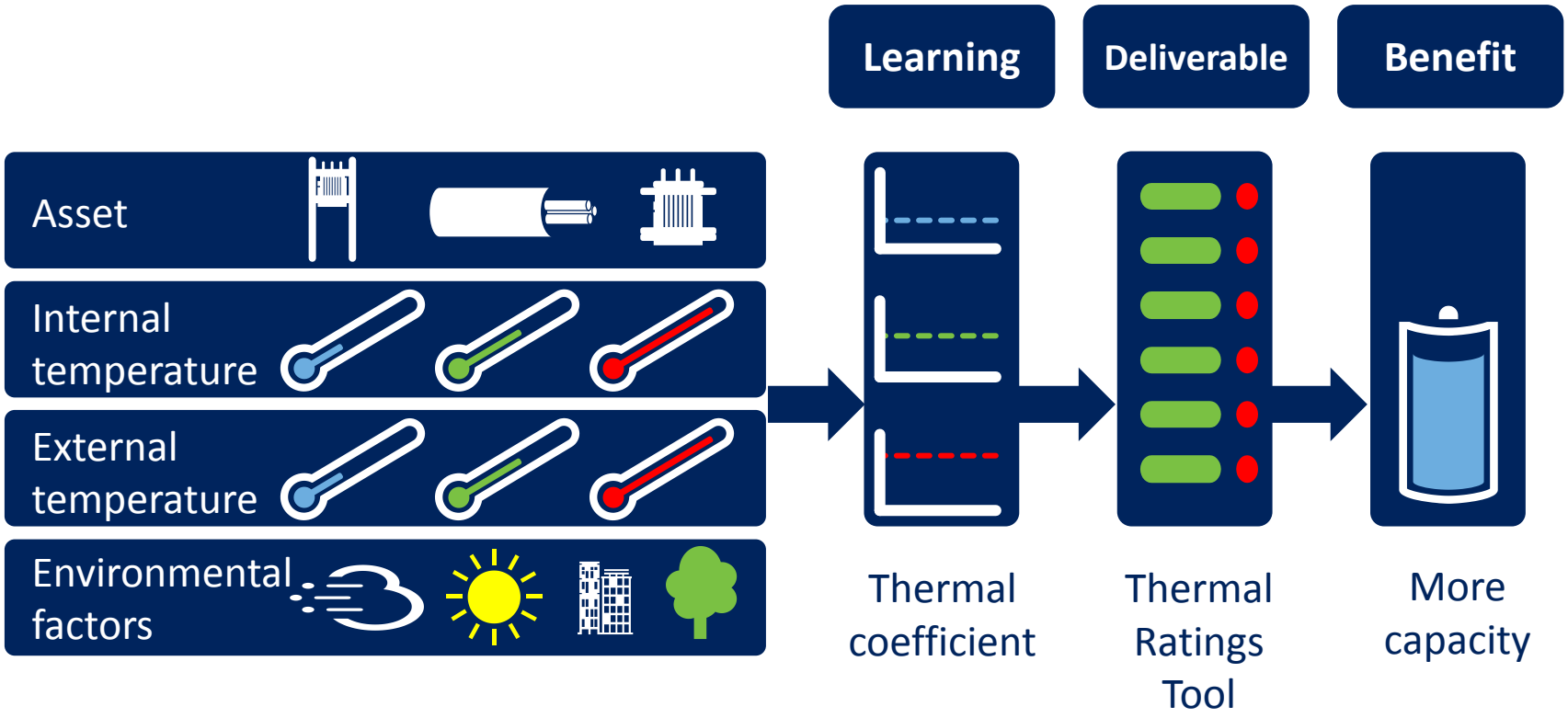
UK Power Networks
Delivering your electricity

Partners and roles on ENW project

Project Lead = electricity north west — Bringing energy to your door

ASH	RICARDO	UK Power Networks	Impact Research	University of Southampton
Supply complete retrofit monitoring solution Provide ongoing support throughout installation, commissioning and operation of the retrofit thermal monitoring workstream	Analyse trial data Develop methodologies to understand relationship between asset temperature, load characteristics and surrounding environment Determine impact of cooling technologies Develop tool and spec for low cost temperature sensor Recommendations for BAU rollout	Work with ASH, Ricardo-AEA and Electricity North West to develop retrofit thermal monitoring solution Participate in evaluation and selection of retrofit cooling techniques	Facilitate customer focus groups Develop customer communication materials Lead the customer survey engagement	Peer review of the analysis methodology of the retrofit temperature sensor part of the project An investigative study on the impact of Celsius on the lifetime health of network assets

Step 1: Fit thermal monitoring



Trial Site map

electricity north west
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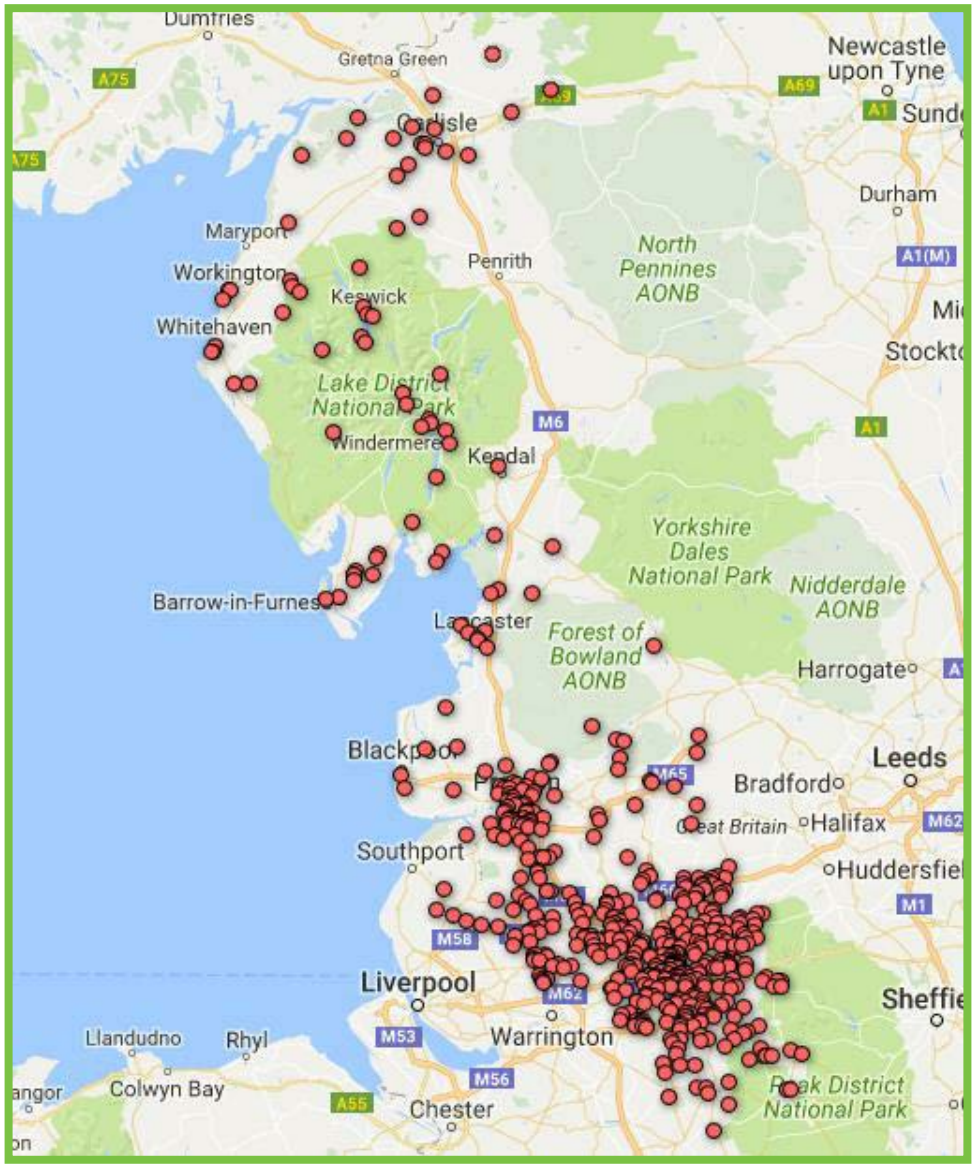


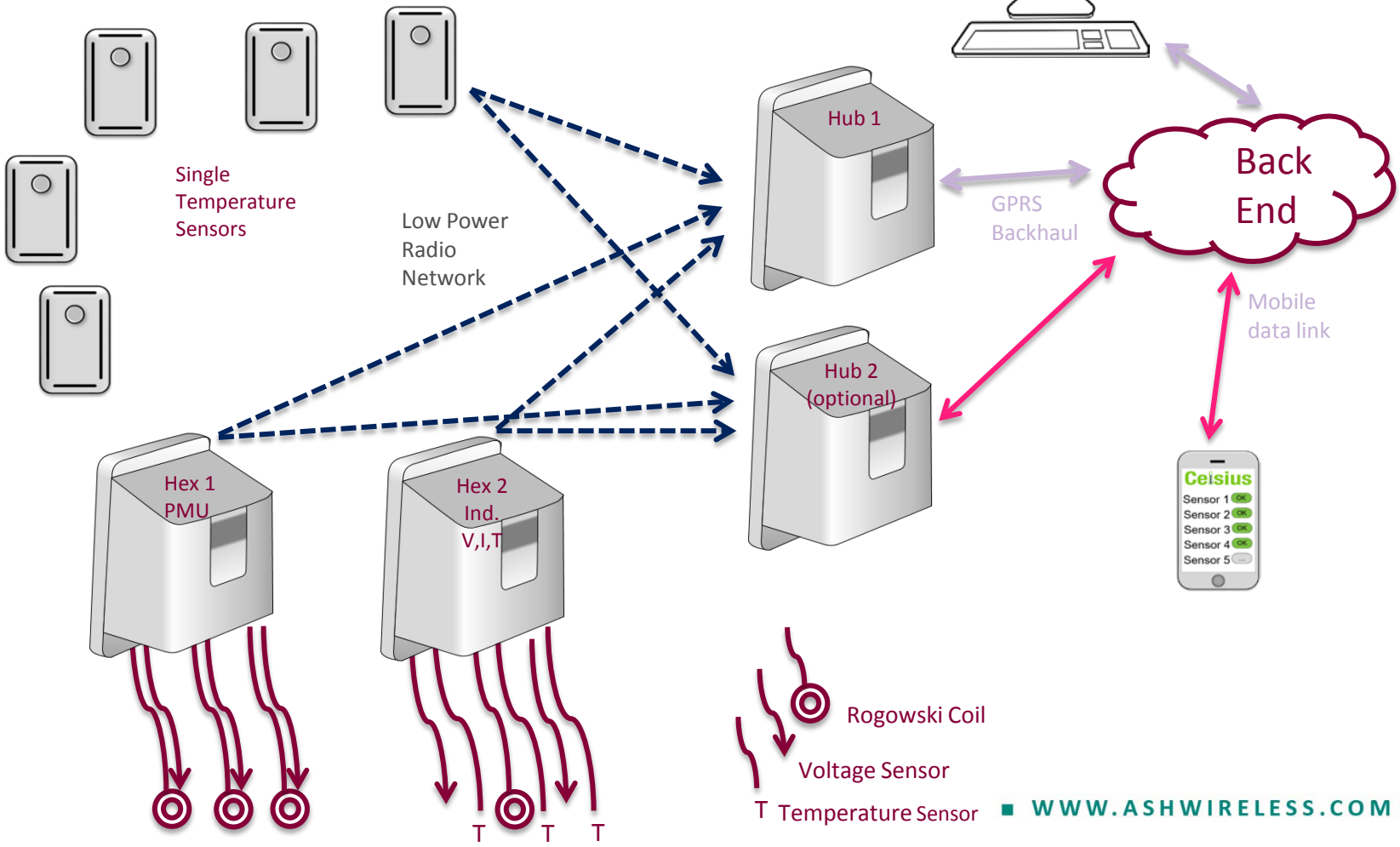
Celsius
- Design Requirements

- Monitoring system can be installed non-invasively;
- All equipment magnetic or cable-tie mounting;
- All equipment battery powered for duration of data gathering project (3.5 years).
- All equipment wireless, only leads are those required to actually take measurements.
- Daily reports to back end. 30 minute measurements of V, I, P, Q, THD, Temperature

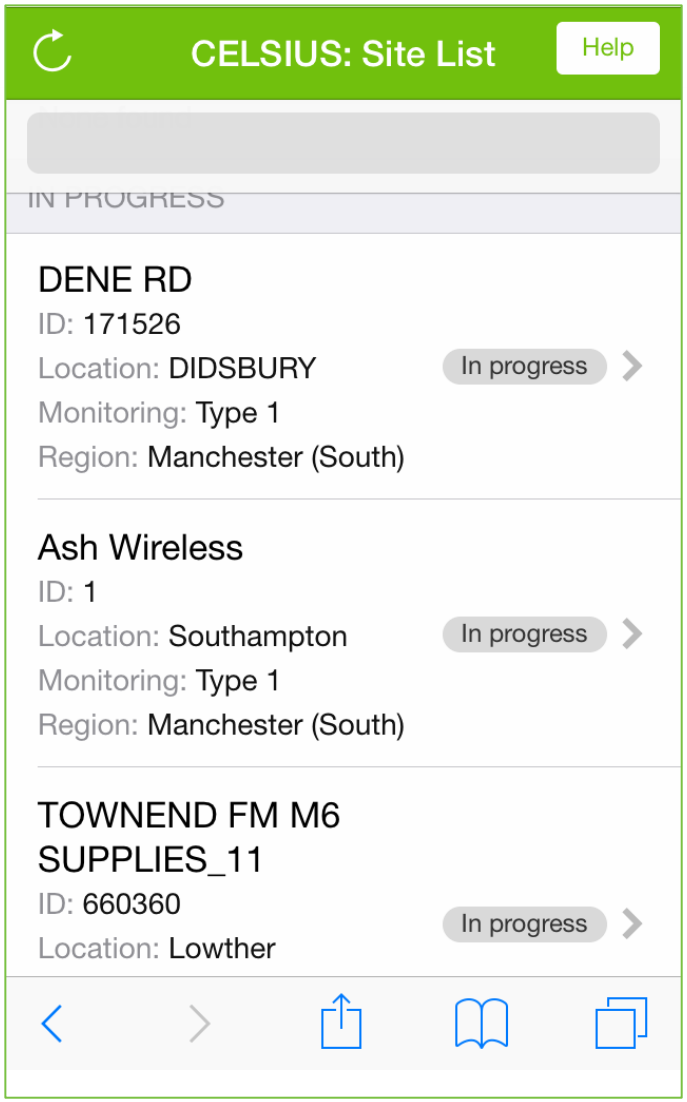
How to fit monitoring sensors when…

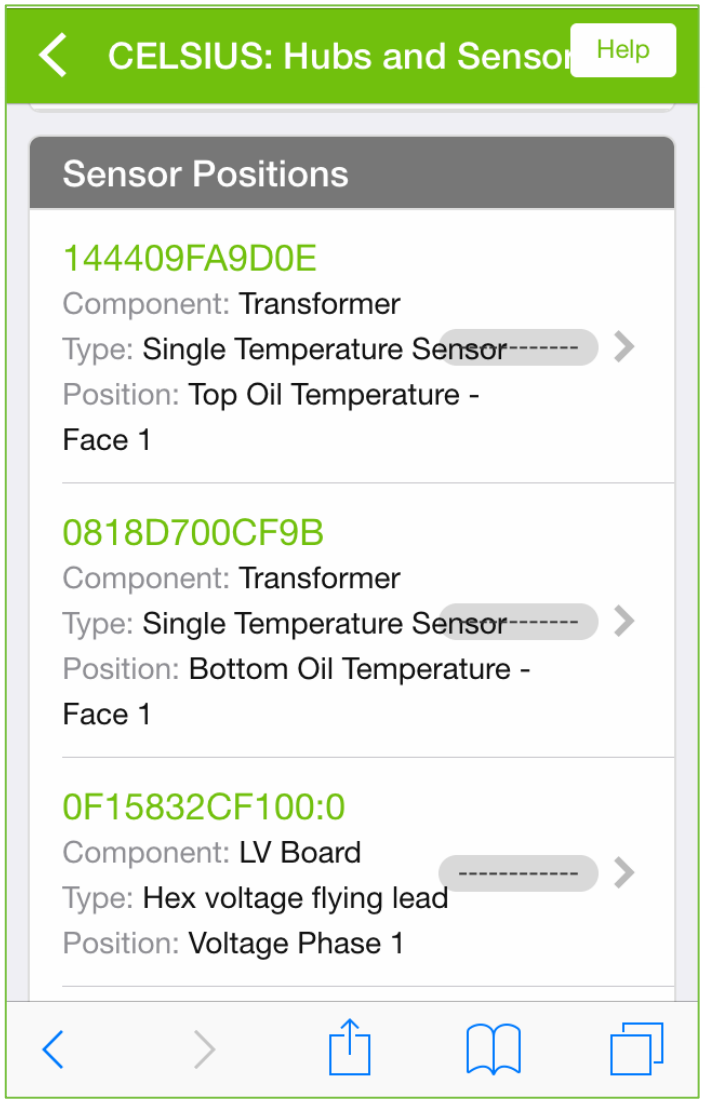
- No internet connection available
- No mains power available
- Can't install wiring, mount equipment, etc without intruding on critical operations
- Hostile RF environment for radio connections, indoor, multipath, multiple monitoring points needed
- Need to minimise worker presence for safety reasons

KeLVN
- Substation Monitoring



Commissioning app

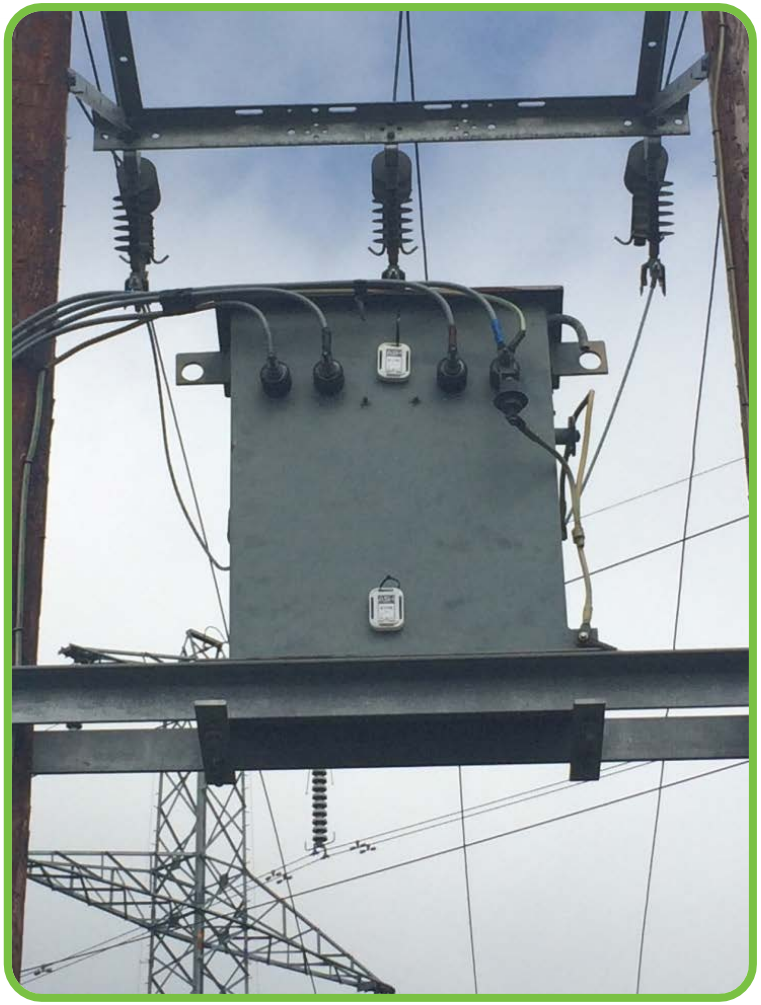




Celsius technology

KeLVN Hub

KeLVN Wireless sensor



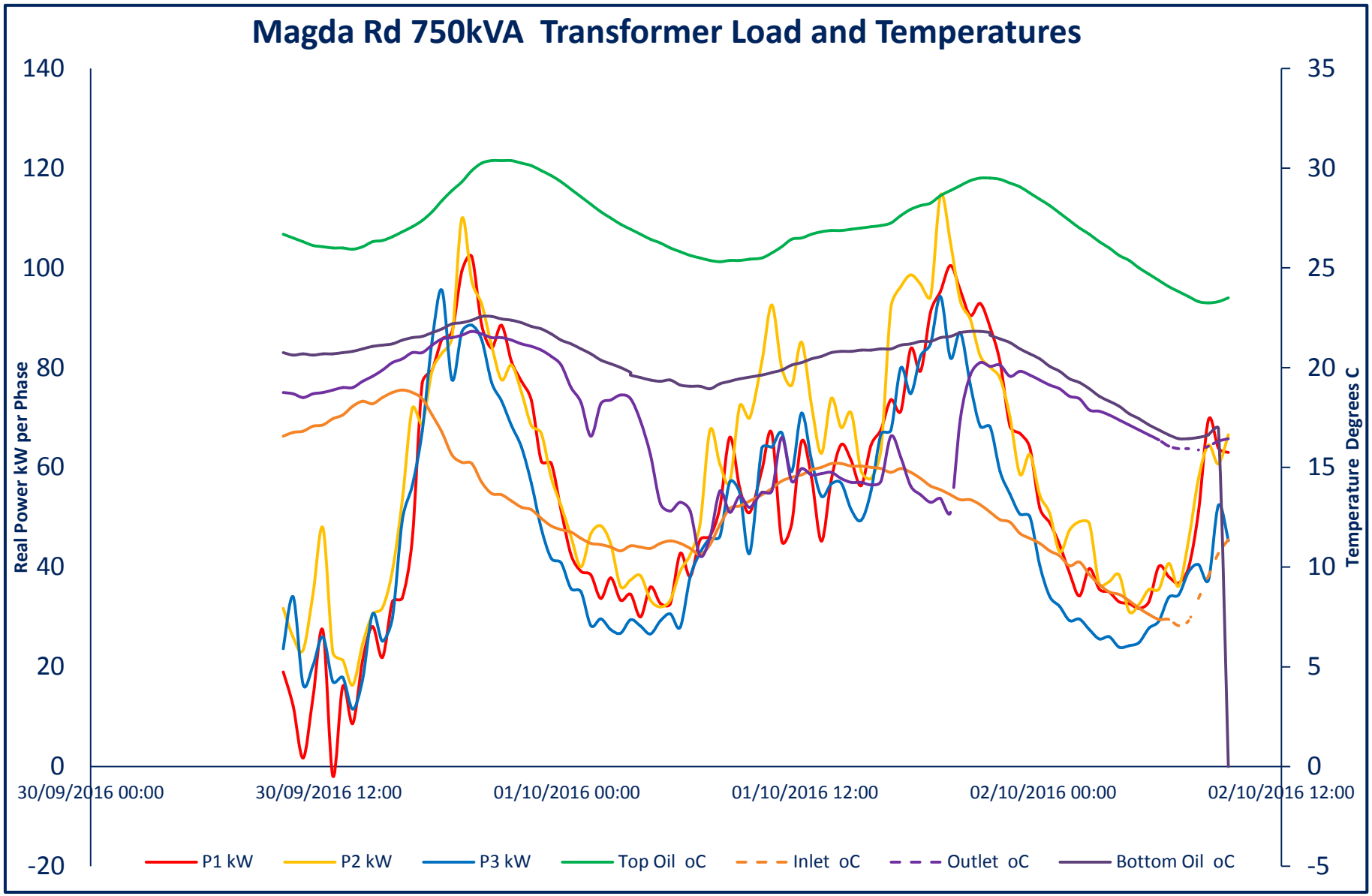
Celsius technology – trial fit

LV board with three sensors

Celsius technology – trial fit

Transformer

Trial site data



Battery Life

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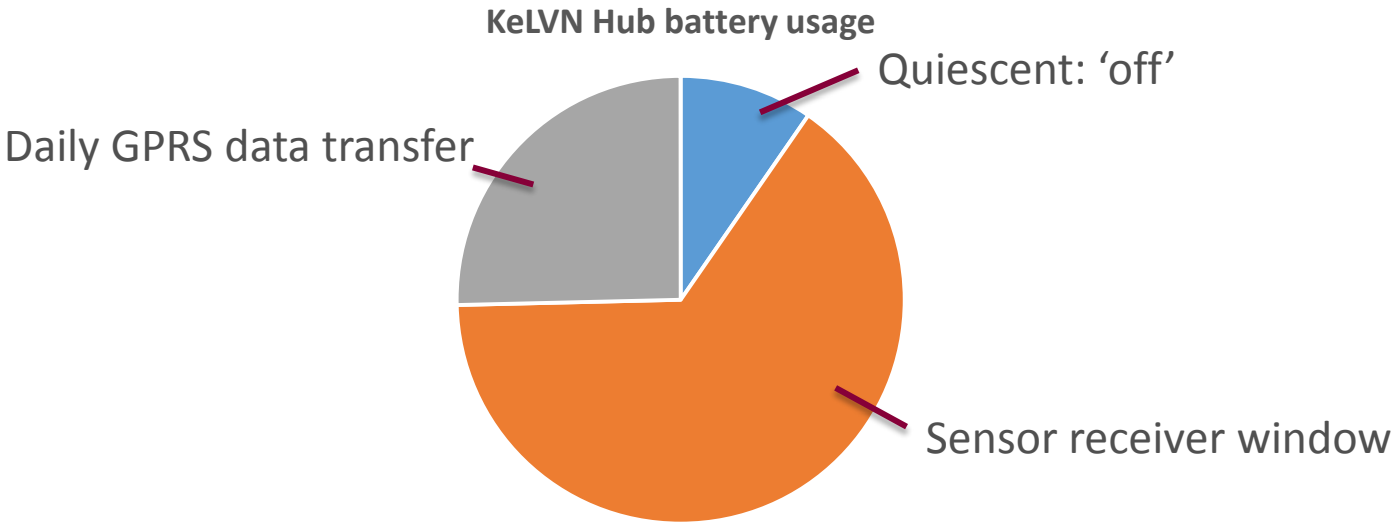
The Hub is an interesting challenge:

- **Lithium D-cell, 10AH**
- **Over 3.5 years life**
- **Distribution of where the capacity is used:**



Key learning points

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The installation and environment defines

- Equipment design (e.g. magnetic mounting)
- Protocol (e.g. multiple hubs allowed)
- installation procedure (fast, non-invasive)

GPRS modem auto-connect modes are not reliable, process needs detailed design

Alarms

- Not required in Celsius
- Low latency for alarms is managed with a hub software extension, and external power to the hub

Summary

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Retrofitting monitoring equipment to legacy assets:

- **Ease of installation is primary consideration**
- **Use of a local wireless sensor network eases installation**
- **Optimise air interface to manage trade off between latency, data rate, battery life**
- **Installation tool helpful to make sure equipment in operation/commissioned before team leaves site**

Success of the project lay in focusing design & process on installation challenges.

Further development of monitoring solution

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Explored with another DNO:

- **Adding alarm capability to KeLVN**
- **Adding additional sensor types**
  - **Air Flow**
  - **Flood Level detect**
  - **Movement/Infrared detection**
  - **Smoke detection**
- **Back end limit/alarms**

Adding Alarm capability to Logging
KeLVN RT

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Normal Operation

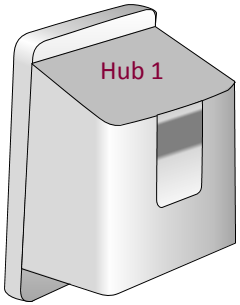
a) Add snapshot measurement every 30 sec

Sensors

30 sec periodic transmission
12 x 30 mins readings

Listening window of
1 minute every 6 hrs

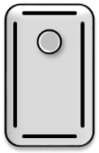
b) Retain 6 hour logging window.
Always on listen for alarms

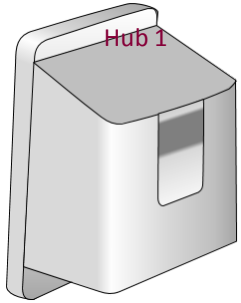


Standard report
Once per day

c) Every 6 hours report logging calls
Add alarm reports on triggering threshold ,
command to request snapshot of all telemetry.

Reverse Channel





d) Add settings of alarm
Thresholds per sensor

Low Power
Radio
Network

GPRS
Backhaul

“Hot Substation” scenario

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Play out fictional scenario, based loosely on UKPN Castle Square fire brigade call out.

Sequence of events leading to overheated/damaged transformer.

1. Ventilation failure
2. Power step change on major event (ice rink switch on) but in cold weather
3. Power step change following year, but in warm weather
4. Overheat, smoke, damage leading to reduced life

“Hot Substation” scenario

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