electricity north west

Bringing energy to your door

Breakout Session 3.4
Active Network Management and Asset Monitoring

LCNI Conference
Thursday 7 December 2017

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www.enwl.co.uk

electricity north west

Bringing energy to your door

Celsius

Damien Coyle

Innovation Technical Engineer

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Celsius

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

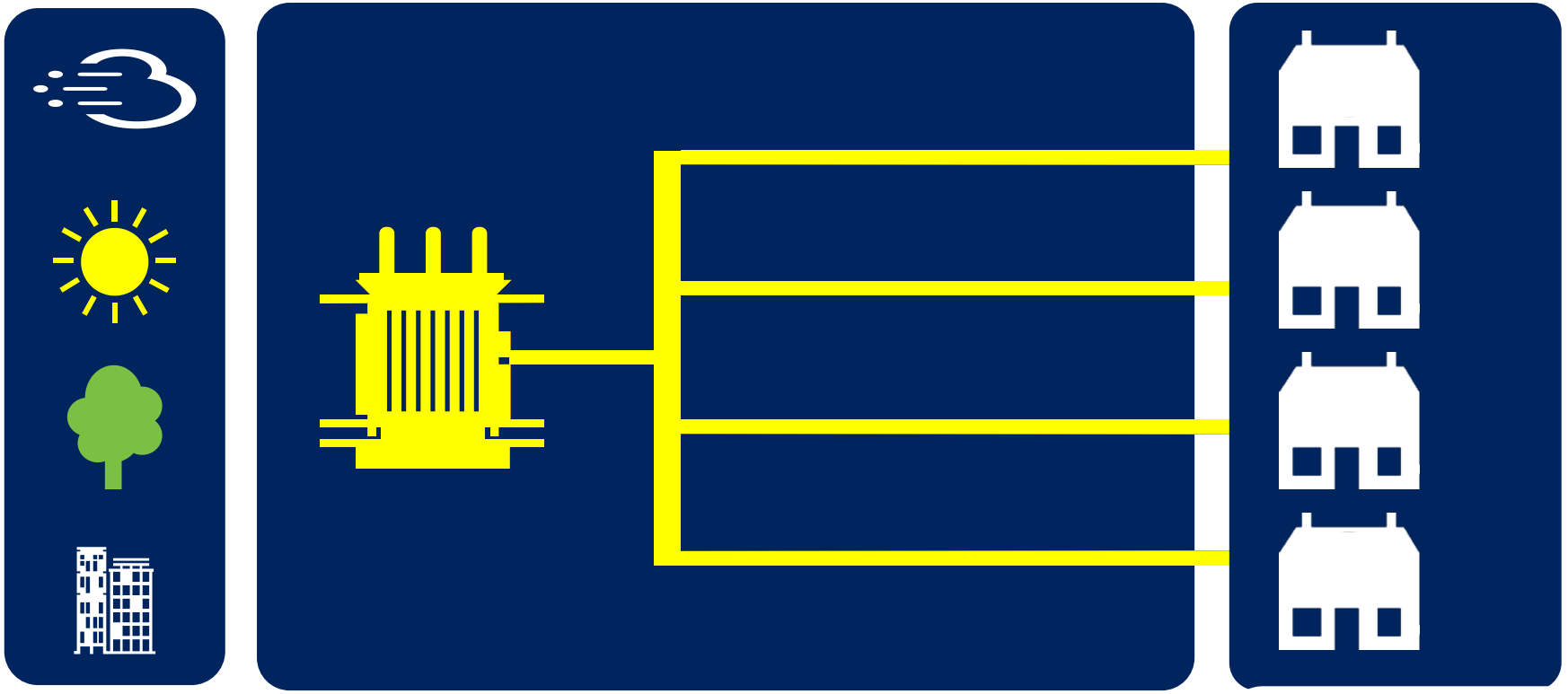
RICARDO-AEA

ASH
CREATIVE WIRELESS ELECTRONICS

Impact Research

UK Power Networks
Delivering your electricity

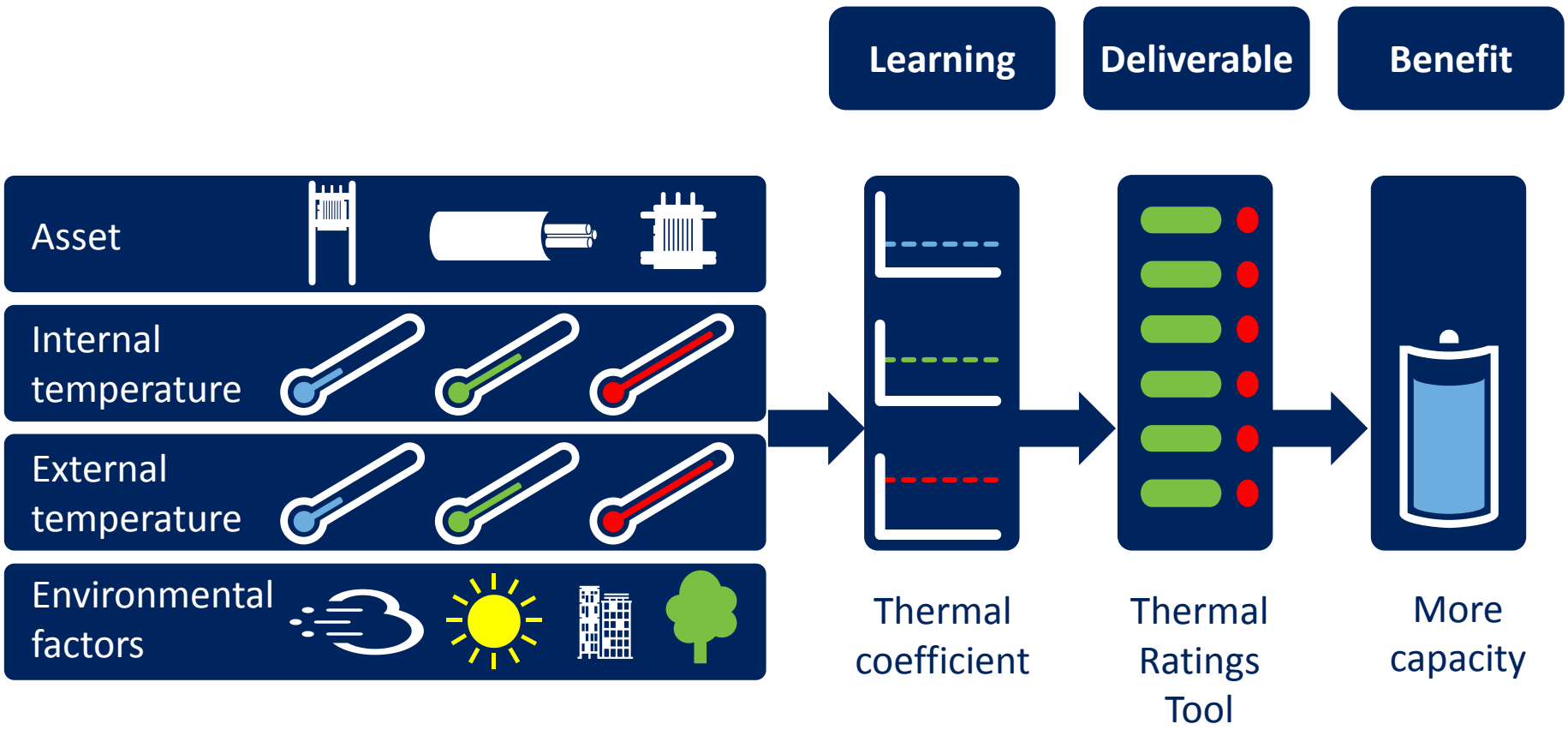
The problem



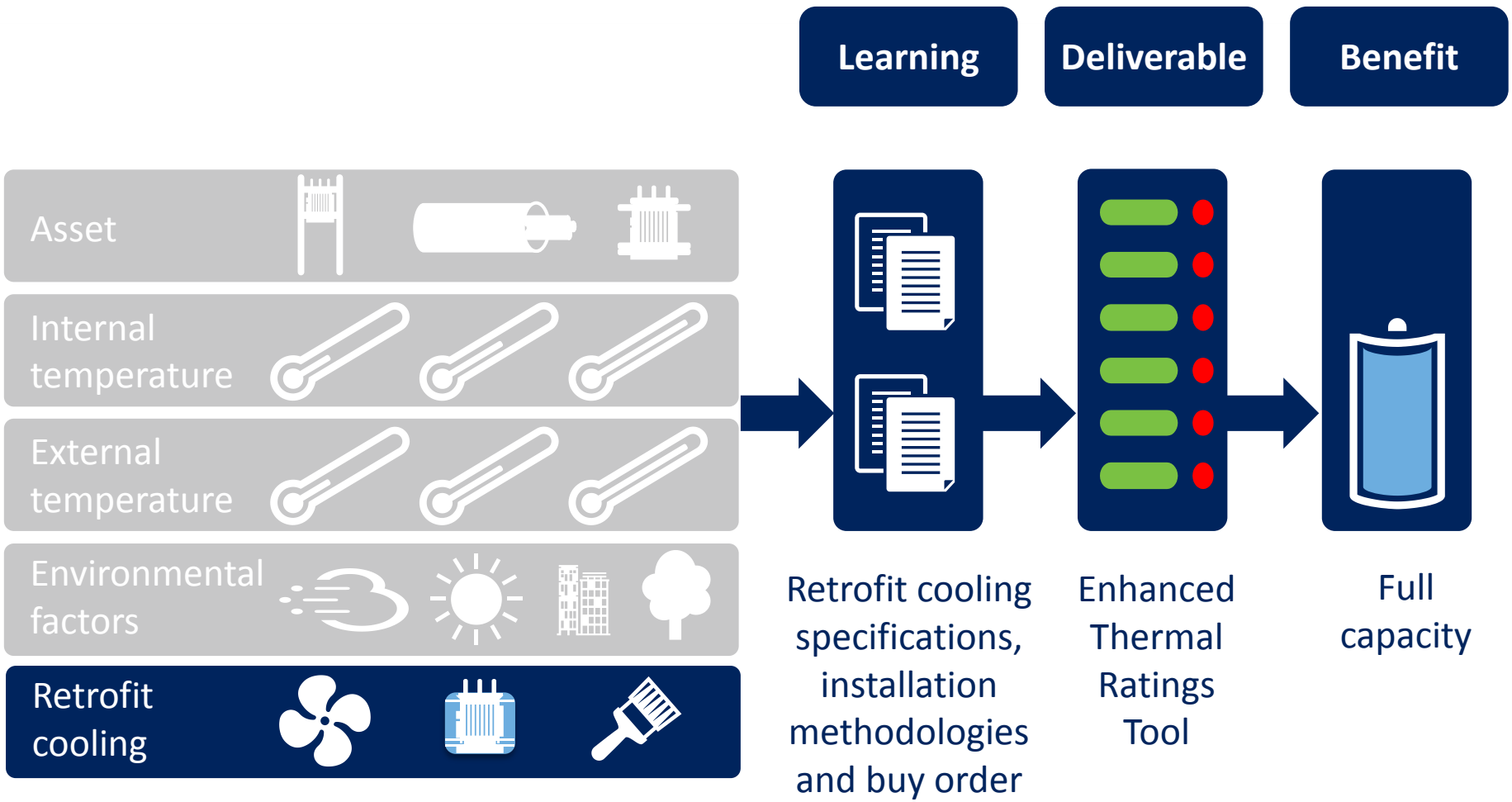
Distribution substation

Customers' LCTs

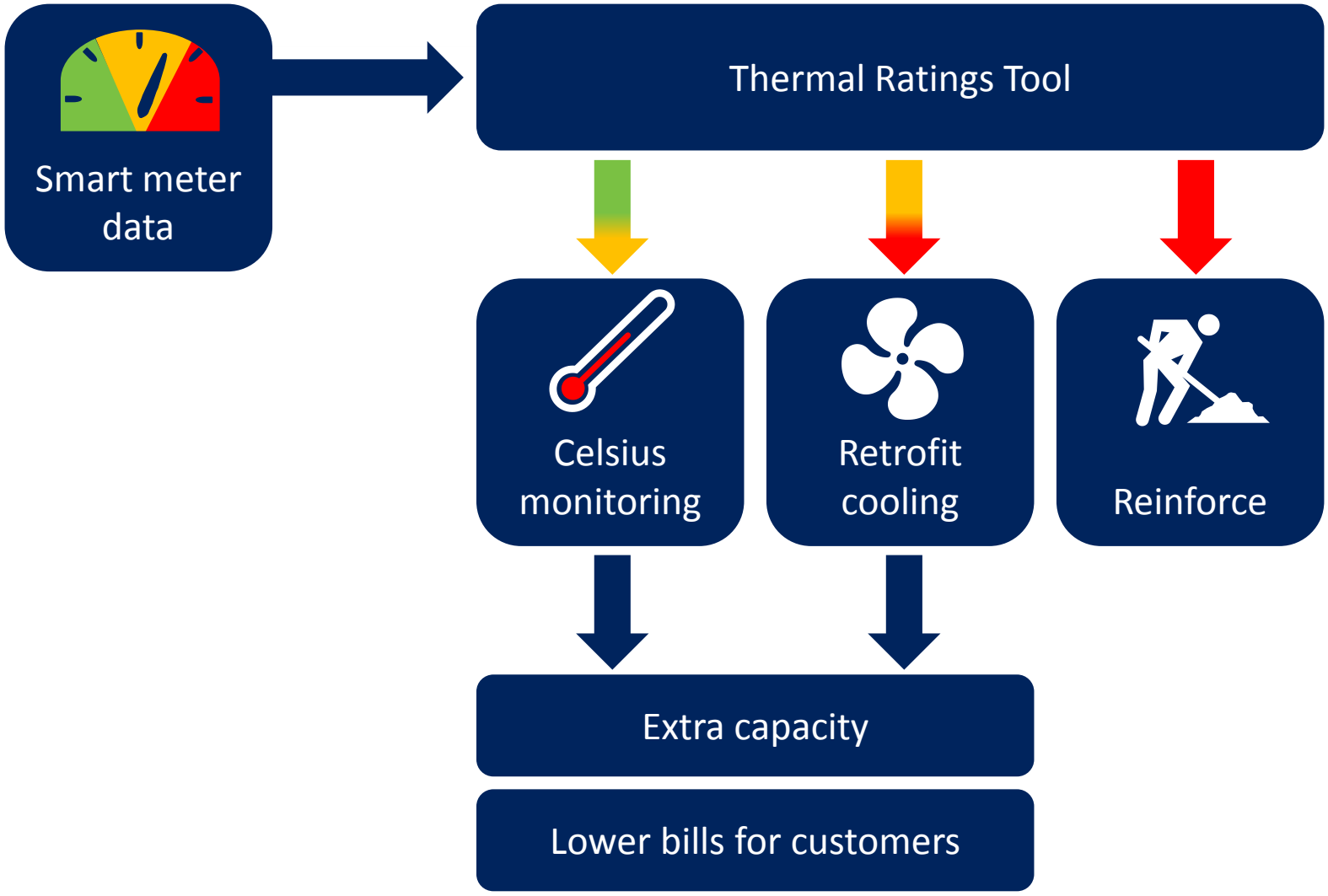
Step 1: Fit thermal monitoring



Step 2: Retrofit cooling



Celsius as part of the smart future

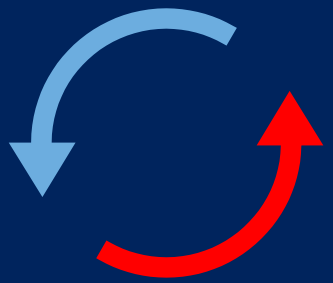


Celsius studies

Thermal analysis (step 1)

Internal asset temperature = Thermal coefficient × External asset temperature

Thermal flow study (steps 1 & 2)



Research into heat and air flows for optimal substation design

Asset health study (steps 1 & 2)

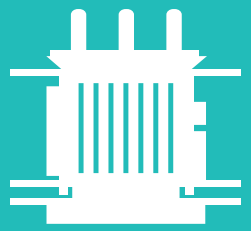
Examines effects of increased load and cooling techniques on assets

Thermal flow study

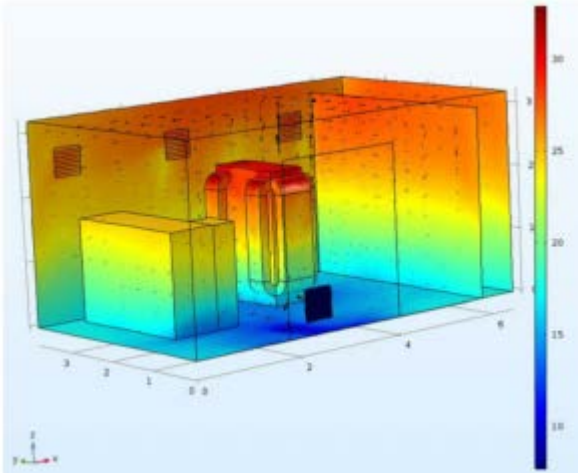
Step 1 report published on Celsius Website www.enwl.co.uk/celsius

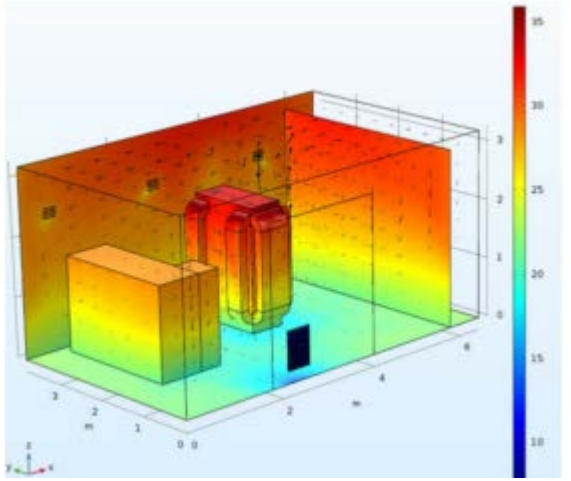
NPL National Physical Laboratory

Six trial substations modelled



Validated with monitoring data





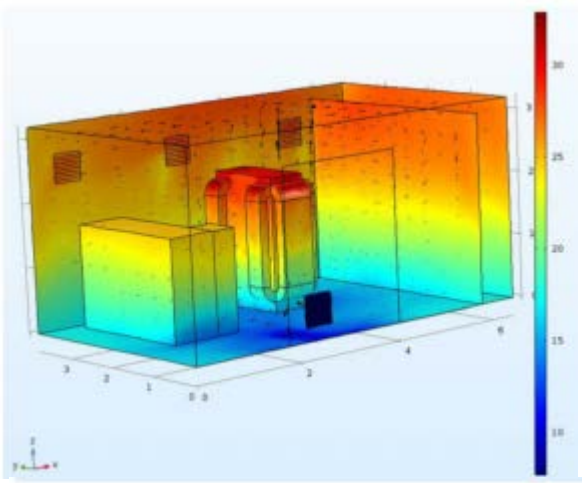
TFS - Outcome

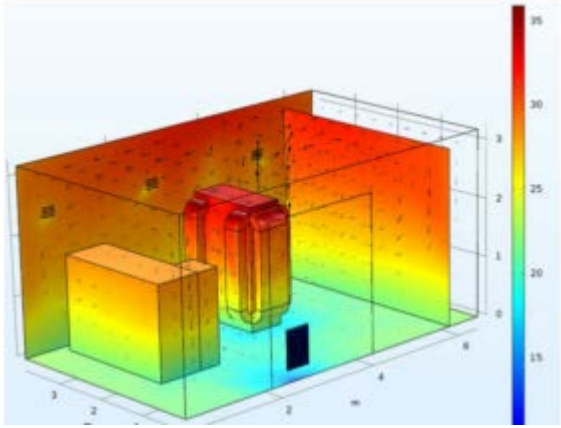
Changes to ENW Substation Policy implemented

Step 2 Application of cooling to models underway

Step 2 Optimise cooling trial installation

National Physical Laboratory





Key deliverables to date

ENA P15 & P17 Review
Feb 2017

Cooling workshops & selection May/July 2017

Customer focus groups
July 2017

Raw data published
July 2017

Monitoring equipment specifications and installation report Sep 17

Thermal flow study Step 1 Nov 2017

All publications and learning can be found in the library section of the Celsius website: www.enwl.co.uk/celsius

Progress and next steps

January – June 2017	July – December 2017	January – June 2018	July – December 2018
Data capture	Monitoring installation report	Baseline customer survey	Asset temperature behaviour report
Thermal flow study	Cooling installation plan	Thermal flow study part 2	Asset health study report
ENA cooling workshop	Thermal flow study report	Cooling technology installation	Thermal Ratings Tool step 1
Customer focus groups			

Knowledge sharing and dissemination

Ricardo
Energy & Environment

Celsius – Data Analysis

Olivia Carpenter
Senior Consultant - Technical

Celsius: Dashboards

System health dashboards – allows tracking of installation and data quality across all sites, including overview, site summaries, and issue tracking

Celsius

SITES

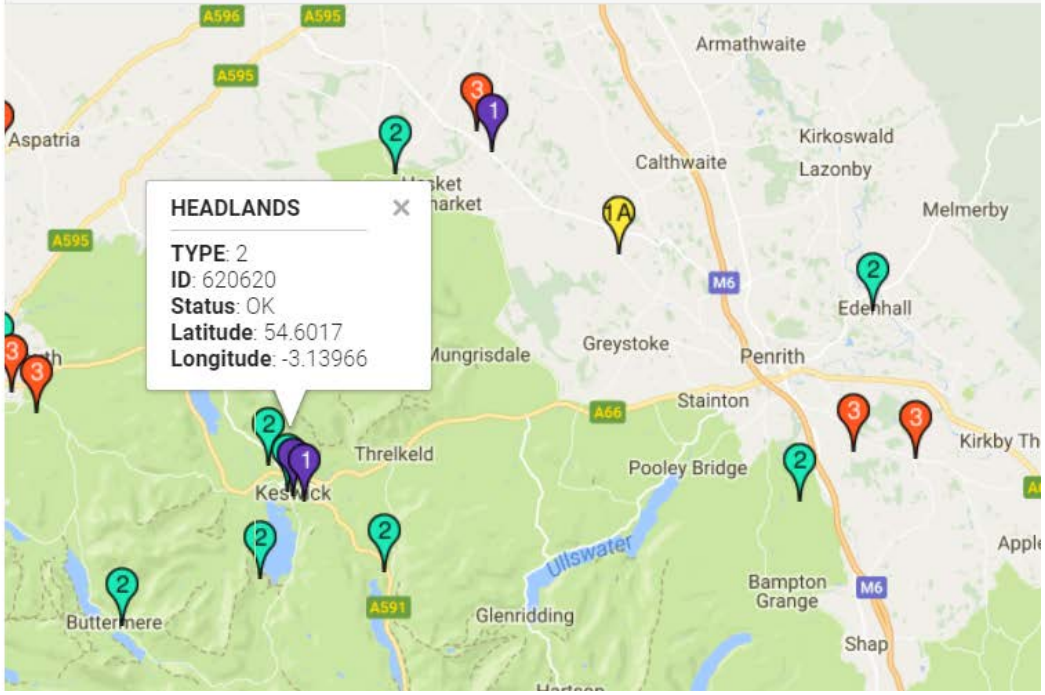
ALERTS

HUBS

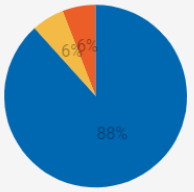
Health Check

Monitoring Type: Show All

Monitoring Status: Show All

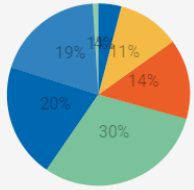


Site alerts



- No alerts (513 sites)
- Warnings (34 sites)
- Errors (34 sites)

Alert types



- Measurement out of range
- Miscellaneous
- Data gap
- Sensor malfunction
- No signal from site
- Installation concern
- Back end concern

Celsius: Dashboards

System health dashboards – allows tracking of installation progress and data quality across all sites, including overview, site summaries, and issue tracking

Celsius

SITES

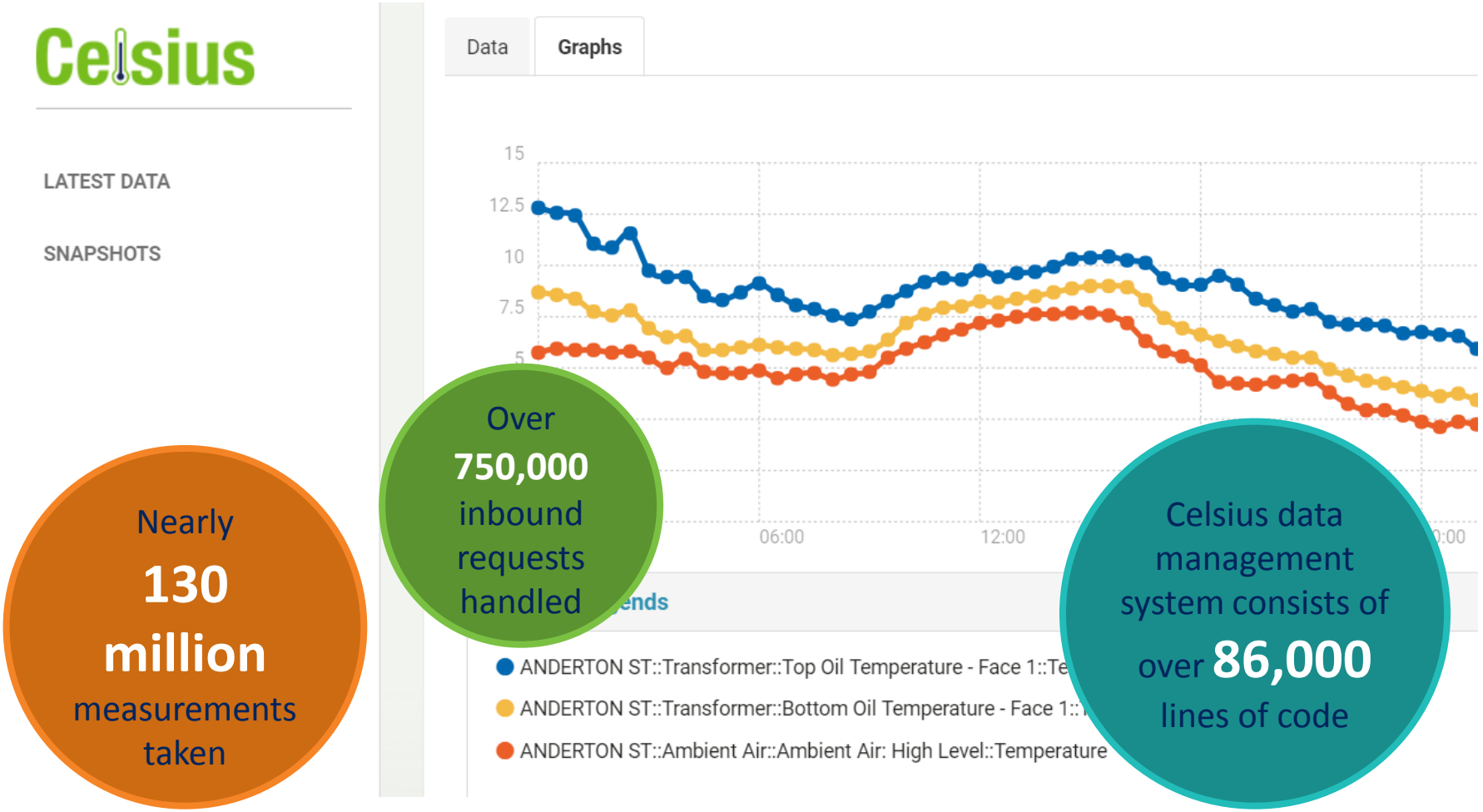
ALERTS

HUBS

Site	Code	Type	Status	Hubs	Sensor Positions	Measurements
ALBRIGHTON EST	415402	2	OK	C3E4B5B7319		85 % coverage
ALBRIGHTON RD	415599	2	OK	2045AC6E8B60		100 % coverage
ALDER AVE	212304	2	OK	10172469DA63		100 % coverage
ALEXANDRA RD S	171051	2	OK	2218AF88E894		98 % coverage
ALLITHWAITE	618166	1	OK	1E0882561604		100 % coverage
ALTRINCHAM FOOTBALL	171011	2	OK	14165694CF3F		100 % coverage

Celsius: Dashboards

Data Dashboards – allows visualisation and download of retrofit monitoring data across any site, sensor position and timescale



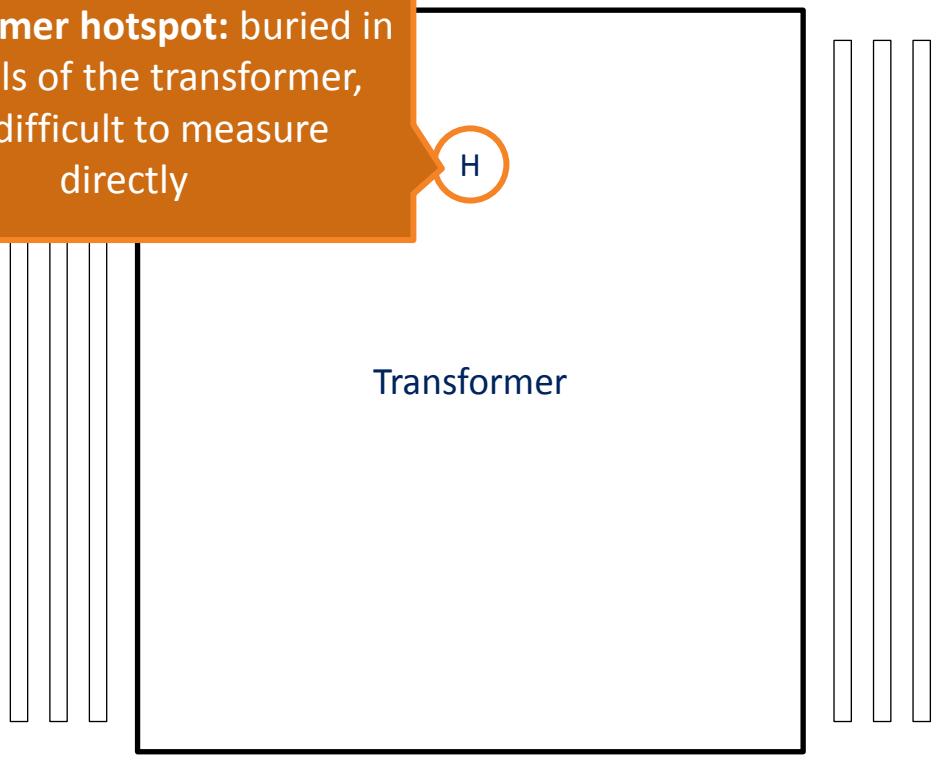
Nearly **130 million** measurements taken

Over **750,000** inbound requests handled

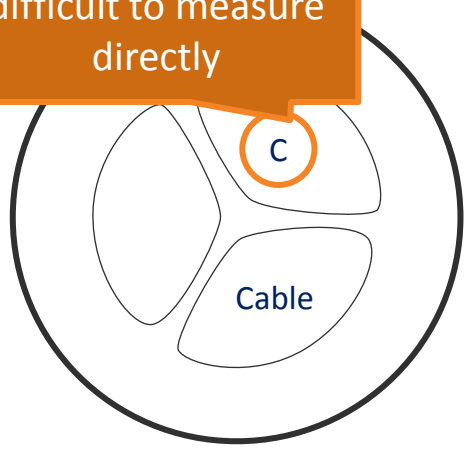
Celsius data management system consists of over **86,000** lines of code

Understanding operating temperature: The first step to developing improved thermal ratings

Transformer hotspot: buried in the coils of the transformer, and difficult to measure directly



Cable conductor temperature: difficult to measure directly



Therefore we need to understand maximum internal operating temperature from easily accessible measurements

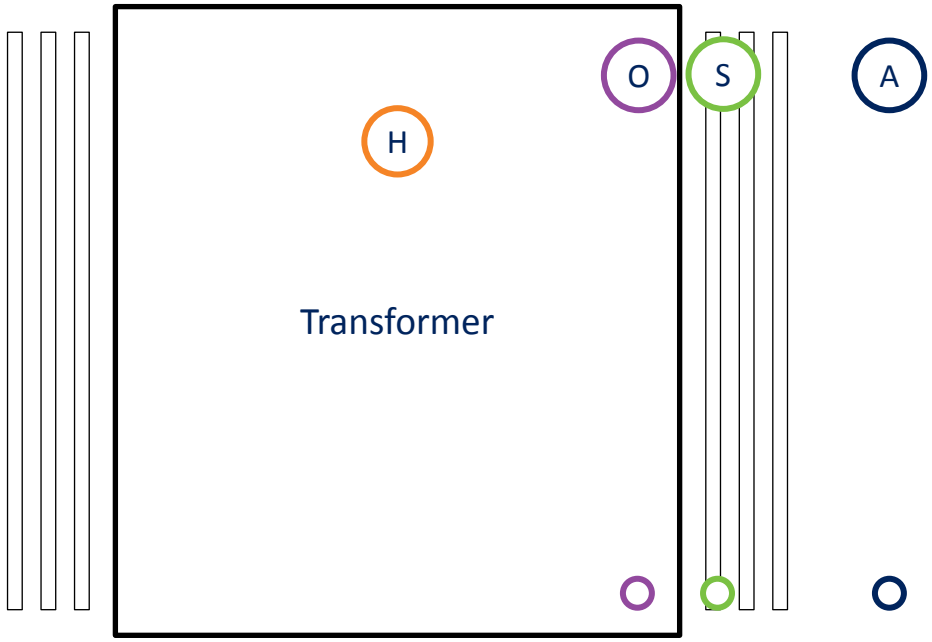
Celsius: Transformer hotspot study

Transformer hotspot study: Available data

Data available includes:

- **Over 500 transformers with surface and ambient measurements:** measuring a selection of transformers representative of the range across GB
- **About 20 transformers with oil measurements** in a range of transformer sizes, specifications, and ages.
- **5 'Smart' Transformers:** manufactured with sensors integrated (these transformers have oil, surface and ambient measurements as well)

As well transformer leading, and size, specification, and age information.



Ambient: high and low ambient levels, and ventilation

Surface: including top and bottom oil level

Oil: inside transformer tank, top and bottom oil level

Hotspot: at 50mm from top on coils B and C, HV and LV

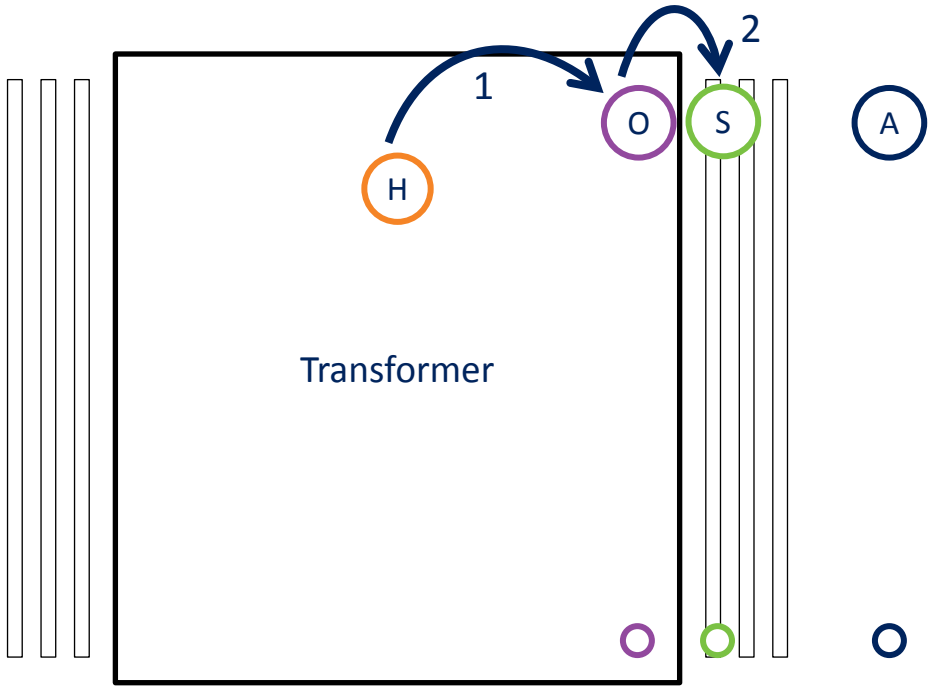
Celsius: Transformer hotspot study

Goal: To know the hotspot temperature from one external sensor

Approach Steps:

1. **Use 'Smart' Transformer data** to understand link between hotspot and internal oil
2. **Use oil measurements** to link between internal oil and surface measurements
3. **Develop a method to use surface measurements to estimate hotspot**

Taking into account the ambient conditions and characteristics of the transformer.



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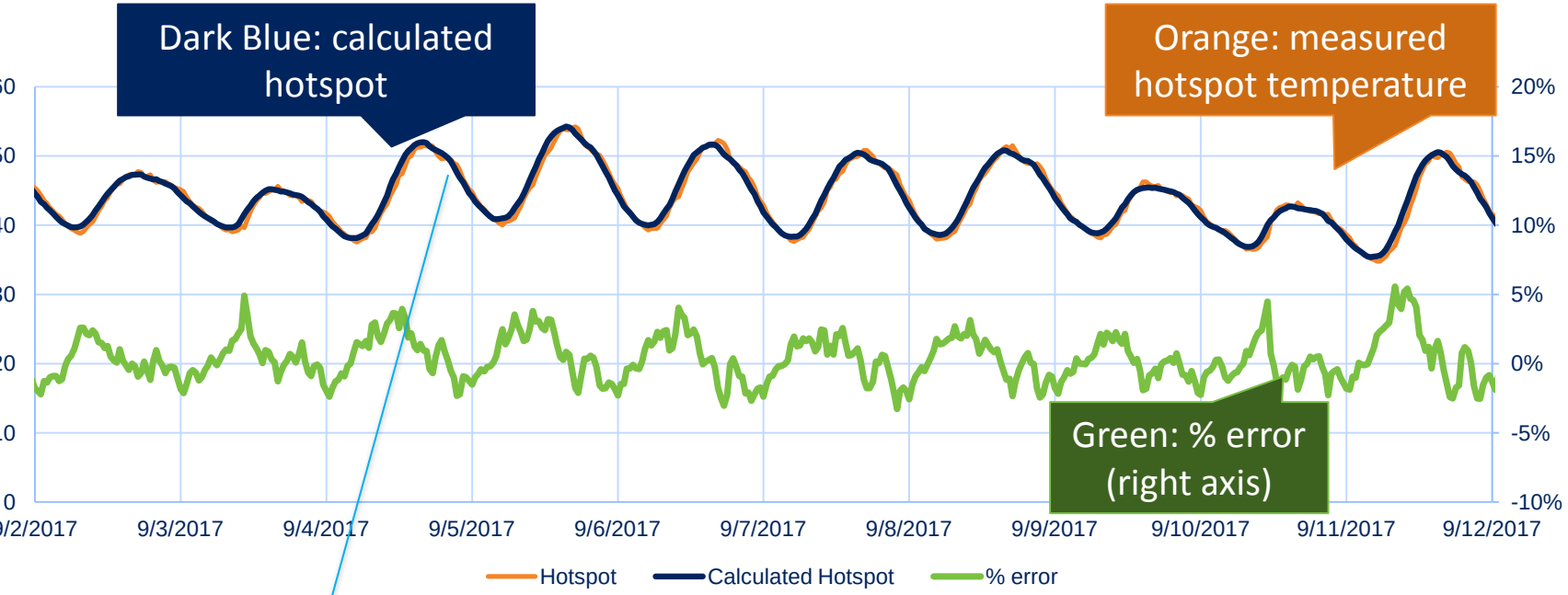
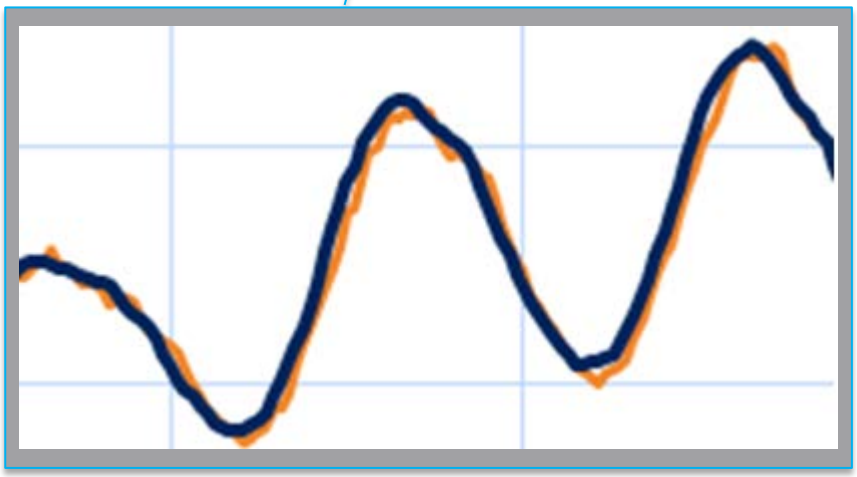
Celsius: Transformer hotspot study





Early analysis supports the case for single sensor hotspot calculation that could be rapidly deployed to BAU and at low-cost

For more information

	www.enwl.co.uk/innovation
	innovation@enwl.co.uk
	0800 195 4141
	@ElecNW_News
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