Agenda

Introduction

Project overview

Progress and next steps

Questions & answers
Webinar format

30 minutes presentation

20 minutes questions & answers

Submit written questions online during the webinar
Q&A panel

Damien Coyle
Innovation Project Manager

Paul Turner
Innovation Delivery Manager

Kate Quigley
Innovation Customer Manager
Our smart grid development

Leading work on developing smart solutions

Deliver value from existing assets

Customer choice

Five flagship products (second tier/NIC)  £42 million

C2C  SMART STREET  Celsius  CLASS  RESPOND

LCN Fund Low Carbon Networks
Celsius

Awarded: 9 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

£5.5 million Investment
Up to £583m across GB by 2050

Financial benefits
## Partners and roles on project

<table>
<thead>
<tr>
<th>ASH</th>
<th>RICARDO</th>
<th>UK Power Networks</th>
<th>Impact Research</th>
<th>University of Southampton</th>
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</table>
### The problem

<table>
<thead>
<tr>
<th>HV network</th>
<th>LV network</th>
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#### Objective is to maximise power through transformer

<table>
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<tr>
<th>Assets have nominal thermal rating</th>
</tr>
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<tbody>
<tr>
<td>Ratings $= , ^\circ C$</td>
</tr>
<tr>
<td>Ratings $\neq$ amps</td>
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#### Diverse range of environments

- Small changes in environmental factors can result in very different actual ratings

#### Assumed thermal ratings can lead to capacity being under-utilised or unnecessary risk
Celsius as part of the smart future

Thermal Ratings Tool

- Celsius monitoring
- Retrofit cooling
- Reinforce

Extra capacity

Lower bills for customers
Step 1: Fit thermal monitoring

**Asset**
- Internal temperature
- External temperature
- Environmental factors

**Thermal coefficient**

**Thermal Ratings Tool**

**Benefits**
- More capacity
Step 2: Retrofit cooling

Retrofit cooling specifications, installation methodologies and buy order
Enhanced Thermal Ratings Tool
Full capacity
### Celsius studies

**Thermal analysis (step 1)**

- **Internal asset temperature** = \( \theta_{core} \)
- **External asset temperature** = \( \theta_{external} \)

**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
Monitoring site selection and timescales

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<tbody>
<tr>
<td>520 substations</td>
<td>100 cooling technique sites</td>
<td>Four year project</td>
</tr>
<tr>
<td>Enough substations to represent 80% of GB substation population</td>
<td>Subset of 520 substations – enough sites to adequately trial all techniques</td>
<td>To enable trials to take place during all seasons and to trial all cooling techniques</td>
</tr>
</tbody>
</table>
Site selection map
Site selection – rural and urban
Site selection

Number of substations in total population (Left Axis)

Number of substations in trial population (Right Axis)
### Sensor Positions

<table>
<thead>
<tr>
<th>Sensor ID</th>
<th>Component</th>
<th>Type</th>
<th>Position</th>
<th>Face</th>
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<tbody>
<tr>
<td>144409FA9D0E</td>
<td>Transformer</td>
<td>Single Temperature Sensor</td>
<td>Top Oil Temperature</td>
<td>1</td>
</tr>
<tr>
<td>0818D700CF9B</td>
<td>Transformer</td>
<td>Single Temperature Sensor</td>
<td>Bottom Oil Temperature</td>
<td>1</td>
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<tr>
<td>0F15832CF100:0</td>
<td>LV Board</td>
<td>Hex voltage flying lead</td>
<td>Voltage Phase 1</td>
<td></td>
</tr>
</tbody>
</table>

#### CELSIUS: Site List

**DENE RD**
- ID: 171526
- Location: DIDSBURY
- Monitoring: Type 1
- Region: Manchester (South)

**Ash Wireless**
- ID: 1
- Location: Southampton
- Monitoring: Type 1
- Region: Manchester (South)

**TOWNEND FM M6 SUPPLIES_11**
- ID: 660360
- Location: Lowther

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[Image of CELSIUS app interface]
Celsius technology

Hub

Wireless sensor
Celsius technology – trial fit

LV board with three sensors
Celsius technology – trial fit

Transformer singles
Celsius technology – trial fit

Ventilation
Celsius technology – trial fit

Transformer
<table>
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<tr>
<th></th>
<th>Traditional</th>
<th>Celsius</th>
</tr>
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<tbody>
<tr>
<td>£</td>
<td>Traditional replacement of ground-mounted</td>
<td>Low cost options to release capacity as and when</td>
</tr>
<tr>
<td></td>
<td>transformer is expensive</td>
<td>required</td>
</tr>
<tr>
<td><img src="clock.png" alt="Clock" /></td>
<td>Complex and time-consuming</td>
<td>Simple and quick to deploy</td>
</tr>
<tr>
<td><img src="hammer.png" alt="Hammer" /></td>
<td>Highly disruptive</td>
<td>Minimal or no disruption to customers</td>
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Customer engagement

Customers in the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement.

Customers who are educated as to the need for and benefits of Celsius are significantly more likely to find it acceptable.
Customer engagement

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Customers who are educated as to the need for and benefits of Celsius are significantly more likely to find it acceptable.

- Customer engagement plan
- Baseline survey
- Test survey
- Focus groups
- Website
- Video/podcasts
- Customer mailing
- Social media
Progress and next steps

January – June 2016
- Project mobilised
- Partner contracts awarded
- Customer engagement plan
- Data privacy statement

July - September 2016
- Website live
- Monitoring site selection
- Monitoring equipment build
- Monitoring commissioning tool
- Back end system

October – December 2016
- Commence monitoring installation
- Data capture
- ENA ER P15 & P17 review workshop

January – March 2017
- Thermal flow study
- Complete monitoring install
- Investigate cooling technology

Knowledge sharing and dissemination
Questions & answers

Submit written questions online

Damien Coyle
Innovation Project Manager

Paul Turner
Innovation Delivery Manager

Kate Quigley
Innovation Customer Manager
# Post event feedback

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Slightly disagree</th>
<th>Neutral</th>
<th>Slightly agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Today's webinar was successful in raising my understanding of the Celsius project</td>
<td></td>
<td></td>
<td>57%</td>
<td>43%</td>
</tr>
<tr>
<td>Webinars are suitable channels for communicating innovation project outcomes and are more convenient than attending an event in person.</td>
<td></td>
<td></td>
<td>14%</td>
<td>86%</td>
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<tr>
<td>I will take part in other webinars organised by Electricity North West to discuss low carbon projects.</td>
<td></td>
<td></td>
<td>29%</td>
<td>71%</td>
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<tr>
<td>Do you have any comments or suggestions about how we could have improved today’s webinar?</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1. Have you considered increasing noise levels by installing fans? 2. Have you considered Air handling units? 3. The project may release some capacity in the transformer but that suggest cables will be stressed by increased load. Will there be any monitoring of thermal impact on cables. 4. Experience suggests temperature raise in the core of transformer can not be monitored by top and bottom sensors. How will you monitor that?</td>
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For more information

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<td><img src="image" alt="Icon" /></td>
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<tr>
<td><img src="image" alt="Icon" /></td>
<td><a href="mailto:futurenetworks@enwl.co.uk">futurenetworks@enwl.co.uk</a></td>
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<td><img src="image" alt="Icon" /></td>
<td>0800 195 4141</td>
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<td><img src="image" alt="Icon" /></td>
<td>@ElecNW_News</td>
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<td><img src="image" alt="Icon" /></td>
<td>linkedin.com/company/electricity-north-west</td>
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<td>youtube.com/ElectricityNorthWest</td>
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Please contact us if you have any questions or would like to arrange a one-to-one briefing about our innovation projects.