

# Celsius

## Cooling down electricity substations could cut fuel bills

electricity  
north west

Bringing energy to your door



The first solution of its kind in Great Britain, the pioneering Celsius project has trialled a range of retrofit cooling techniques at 100 substations across the North West. The £5.5 million project is expected to release additional capacity, reduce long-term costs for customers and avoid early asset replacement.

Electricity North West is developing smart solutions to meet our future energy demands. As the regional electricity operator, the company is responsible for powering 2.3 million homes and businesses in the North West of England. It's also their job to plan for the future and look at smarter ways of meeting the expected increase in electricity demand, reducing reliance on fossil fuels and leading the way to zero carbon.

### Why do we need Celsius?

To meet the decarbonisation challenge, customers are being encouraged to adopt new low carbon technologies such as electric vehicles and heat pumps. Government forecasts suggest that there may be up to a 60% increase in total electricity demand in Great Britain by 2050.

This increase in load means an increase in the current flowing on the electricity network. The greater the amount of current flowing, the greater the heat generated and the hotter an asset becomes.

The expected increase in electrical load from low carbon technologies will lead to thermal 'pinch points' at distribution substations, where load could cause equipment to operate close to its maximum operating temperature.

### What is Celsius?

Celsius is a co-ordinated approach to managing the temperature of electrical assets in distribution substations. The four-year trial has utilised a two-step structured approach to gather data and increase understanding of thermal behaviour and ultimately release capacity to customers.

With greater knowledge of the behaviour of these assets, network operators will be able to support the connection of increasing numbers of low carbon technologies more quickly and at lower cost than deploying traditional solutions.

Celsius will enable the release of capacity at a fraction of the cost of traditional reinforcement, reducing costs for British customers by around £0.6 billion by 2050 and releasing 13GW of thermal capacity.

### Stage 1 - Thermal monitoring

The first stage of the project was to install monitoring equipment to record temperature and load measurements at 520 substation sites, selected to be representative of 80% of the national substation population. The installation was completed in 2017.

Data from the monitoring equipment was analysed by project partner Ricardo-AEA to develop a 'thermal ratings tool' which will enable network operators to understand what additional capacity can be released from their substations.

The project team also worked with the National Physical Laboratory on a 'thermal flow study' to analyse the heat and air flows in substations. This showed how the air flow in existing substations can be improved and can be used to influence the design of future substations.

### Stage 2 - Retrofit cooling techniques

Working in collaboration with other network operators, Electricity North West evaluated a number of retrofit cooling techniques for cables and transformers, some of which were deployed at 100 of the original 520 trial sites.

The benefits of passive techniques, such as painting transformers with reflective paint, new backfill material for cables, and active techniques such as fans in indoor substations, were quantified via an extended period of monitoring for a minimum of 12 months.

Analysis of the data from the monitoring period has successfully demonstrated the effectiveness of the different techniques. The learning from this work will now be incorporated into the thermal ratings tool which in turn will be adopted into business as usual processes. As well as providing a more accurate understanding of the thermal capacity of a substation's equipment, this enhanced thermal ratings tool will enable network operators to select an appropriate cooling technique for a particular substation depending on its equipment type, location, demand and environmental factors. This will allow the asset to be utilised to its full capacity.

### Engaging with customers

As the cooling techniques were deployed at substations close to where customers live and work, the company carried out two phases of customer research as part of the project to understand if customers found Celsius techniques as acceptable as traditional methods of network reinforcement.

The first phase was completed before the retrofit cooling techniques were installed, and the second after the 12-month trial to understand any audible or visual impact on customers.

The research successfully demonstrated that 89% of customers in the trial areas found the implementation of cooling techniques installed at their nearest substation acceptable, compared to 62% for traditional solutions. Only 15% of customers noticed any change associated with a cooling intervention at a local substation. Unsurprisingly, those nearest to substations were the most likely to notice. The company made some minor modifications to fan systems to mitigate potential acoustic impact for those in closest proximity, and customer feedback confirmed this increased overall acceptability of these systems.

*Celsius is funded by Ofgem's Network Innovation Competition. The project started in January 2016 and runs until March 2020.*



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