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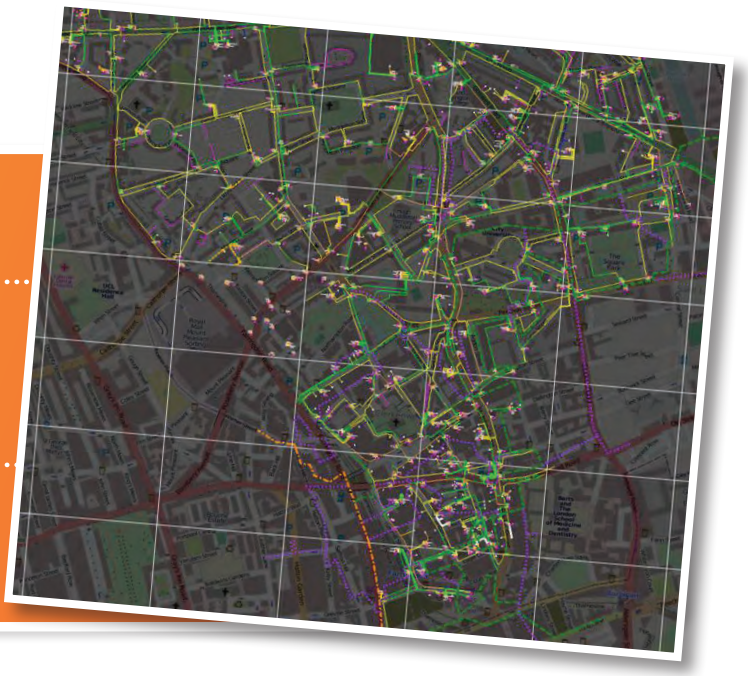
# Flexible Urban Networks Low Voltage



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| **Funding mechanism:** | LCNF Tier 2 |
| **Project budget:** | LCNF: £6.53m<br>UK Power Networks: £1.83m<br>Partners: £0.5m<br>Overall: £8.86m |
| **Status:** | Live<br>Start date: January 2014<br>End date: December 2016 |

## Project concept/overview/challenge

Efforts to decarbonise energy generation, heat and transport will place increasing demands on distribution networks. This is particularly so for the low voltage (LV) networks where distribution network operators (DNOs) have a legal obligation to supply electricity to customers within tightly defined voltage limits and at a sufficient quality (harmonics, sags, swells and flicker). Analysis, carried out by Imperial College London, to support our RIIO-ED1 business plan, predicted an increasing trend of voltage issues and demand rises that could potentially overload transformers and underground cables, requiring significant investment if reinforced using conventional methods.

This project is exploring how the use of power electronics can enable us to defer conventional reinforcement of the network whilst still being able to facilitate the connection of low carbon technologies and distributed generation in urban areas. We aim to optimise the capacity of the LV network through the meshing of existing networks which are not already meshed and by breaking down boundaries within existing meshed networks.

The project will provide the necessary models and templates to enable other distribution network operators to replicate the work.

## Stakeholder benefits

- Optimisation of the LV network capacity closest to customers in order to accommodate the forecasted growth in demand for electricity, making the network more flexible and resilient through capacity sharing between substations.
- Improvement in connection offers (time and cost) in urban areas by knowing where best to connect, and by managing voltage, power flows and fault current through the use of power electronics devices.
- Advancing the network architecture debate through the trial and cost benefit analysis of using power electronics applications on different parts of the LV network to provide configuration control in combination with remote switching.

## What we are doing/deliverables

The project is:

- monitoring candidate LV networks and identifying network issues
- assessing how these networks would have been reinforced conventionally in order to resolve issues
- identifying where power electronics solutions can be used as an alternative to resolve issues
- deploying and evaluating power electronics devices installed on the LV distribution network in London and Brighton.

The project will evaluate the relative benefits that the various functions of power electronics can provide, including:

- acting as 'soft open points' (SOPs) between distribution substations for capacity sharing and which, like a tap, can be fully open, fully closed, or at a setting between these limits
- controlling voltage on LV networks
- controlling fault levels.

## Progress to date

The project has identified, assessed and confirmed the suitability of the 36 sites that will be used to trial three types of power electronics devices. These three types include:

- remote controlled single phase circuit breakers and link box switches providing uncontrolled capacity sharing

- dual terminal power electronics device providing controlled sharing between two substations across boundaries that are not normally closed
- multi terminal power electronics device providing controlled capacity sharing between three substations.

Twelve of the sites are in Brighton, East Sussex and twenty four sites in London. The sites are split between radial and existing interconnected LV networks.

The London sites were selected using time series data collected from substations equipped with SCADA monitoring and remote control functionality. The data was visualised using the Distribution Network Visibility (DNV) tool, designed by a previous UK Power Networks project, and the sites with the required substation demand profiles were identified.

In Brighton, the project used temperature sensors (developed by project partner PPA Energy) connected to the substation transformer to gather temperature data. An algorithm translated the temperature readings into load profiles in order to identify suitable substations with differing load profiles.

We are working with suppliers, EA Technology Ltd (EATL) and Turbo Power Systems (TPS), to design and manufacture the power electronics devices that will be trialled during the project. The dual and multi-terminal power electronic devices, manufactured by TPS, will be tested externally at the University of Strathclyde's Power Networks Demonstration Centre (PNDC) to confirm they meet UK Power Networks specifications and are suitable for deployment on the LV distribution network.

A guidance document, outlining the planning considerations used by the project to select, design and install power electronics devices, will be published at the end of 2014.

## Next Steps

The power electronics devices will be installed and commissioned on the LV networks in Brighton and London during the first half of 2015 and the trials will then run for twelve months. The performance of the devices will be closely monitored during the trials and potential additional power quality benefits identified. The control algorithm that manages the capacity transfer will be enhanced to deliver these potential additional benefits and assessed during the last six months of the trials.

Following the trials, the project will undertake a detailed cost benefit analysis of using power electronics devices against the more traditional responses used to deal with load growth on the LV network.

## Partners

CGI GE Imperial College London PPA energy