



Open 

What we've achieved

The ground-breaking project that's making local electricity data openly available



LV-CAP™ is an open source low cost software platform that can monitor substation performance and electricity demand. It is designed to integrate with third party products to enable network control and automation, and increase customer participation in network management.

The OpenLV Project has installed LV-CAP™ devices in 80 low voltage substations across Western Power Distribution's four licence areas, including substations where automated network control trials have successfully been undertaken. The project is collecting over 14 million data points per day. This data is being used by community groups, businesses, universities and the project team for a wide variety of purposes. Participating organisations have created apps that have been uploaded remotely onto the LV-CAP™ devices, or they are accessing data – real time and historical – for the benefit of community projects, the environment and the electricity system.

Lucy Electric and Nortech provide key equipment and software systems as part of the OpenLV solution. Lucy Electric provides sensors to monitor low voltage fuse panels (GridKey) and cloud-based data server; Nortech provides control and management software platform (iHost).

Capacity Uplift Benefits

The Network Capacity Uplift element of the OpenLV Project is demonstrating how the LV-CAP™ platform can provide direct network benefits through:

- Monitoring LV Network assets
- Performing calculations on the monitored data on the platform to reduce data transmission requirements
- Calculating the current state of network assets in near real-time, providing up-to-date information on the available headroom within the local network
- Predicting the future network state based on previous performance
- Enacting changes to the local network in response to current and predicted network states.

Twenty-five pairs of LV substations were selected from across WPD's four licence areas for monitoring and feeder virtual meshing. A further five pairs were selected to trial actual automated load sharing between substations, using ALVIN Reclose™ units as controllable meshing switches.

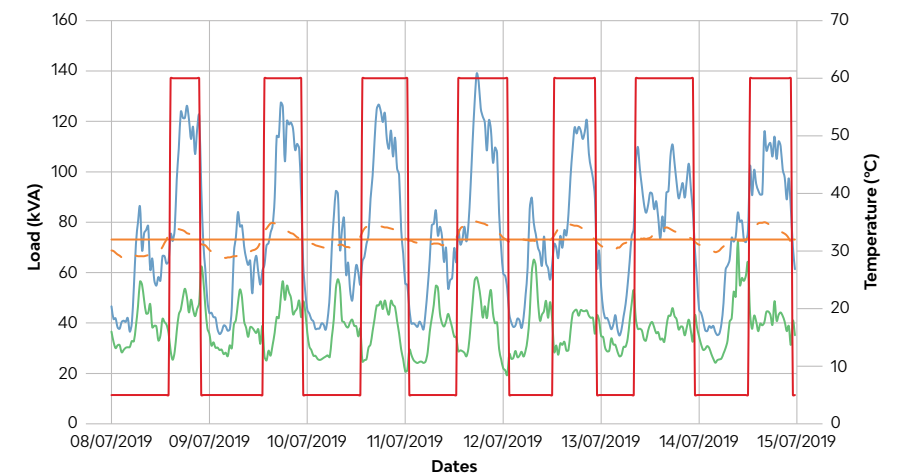
In each selected pair, one transformer experiences a greater proportional load in comparison to the transformer rating. The system is designed to share the interconnecting feeder's load between the two when appropriate.

The LV-CAP™ units in each substation record data relating to the network load and voltages, the temperature of the transformer and ambient conditions. An app on the unit uses the data to predict future network conditions, forecasting when an interconnection will be required.

The OpenLV project has successfully demonstrated the LV-CAP™ platform's capability to record, process and act on network conditions. The plot below shows that following the closing of the ALVIN Reclose™ switch at one substation, the transformer load at the supported substation (in this case St. Bartholomews illustrated by the green line) drops substantially.

Pair22 Overall Switching Output Week starting 8th July 2019

The graph shows that when the predicted hot spot temperature at the supported substation reaches a predetermined threshold (shown in orange on the graph) then the LV-CAP™ logic initiates meshing with the paired substation as illustrated by the red square wave resulting in feeder load being shared between the two substations.



Controlled : RAVC Transformer Load (kVA)

Controlled : St. Bartholomews Transformer Load (kVA)

Supported Site : St. Bartholomews Threshold Temperature (°C)

Supported Site: St. Bartholomews Predicted Hot Spot Temperature (°C) (Open)

ALVIN Command Signal



Community Benefits

Seven community groups are taking part in the OpenLV project. Each is receiving data from LV-CAP™ devices installed in substation(s) within their communities.

Centre for Sustainable Energy (CSE), an organisation specialising in community engagement, is responsible for recruiting and liaising with each group. CSE has also produced a web app, which has been customised and is used by the participating groups, allowing them to access and display local electricity usage data.



Tamar Energy Community

Tamar has been using OpenLV data as part of its 'The Power is in Your Hands' project. The group has used data from its local substation in 'Eco Clubs' that it has organised in its local junior school to introduce 7 to 10 year-olds to concepts such as carbon emissions and energy efficiency. Members of Tamar Energy Community group used the data among the wider community to raise awareness about distributed energy resources, time-of-use tariffs and how they as individuals can have an impact on the energy system.



Exeter Community Energy

Exeter successfully developed a prototype smart phone app that it demonstrated to members of its community at a focus group meeting. The app is designed to provide users with information about energy usage at their local substation as well as data on local generation and national carbon intensity.



Owen Square Community Energy

The Owen Square Community Energy group has been using OpenLV data to support funding bids for its community heat project in Easton, Bristol. The group has used the data to run financial modelling and build a business case for the decarbonisation of heat projects. So far, the data has been used in three bids.



Rooftop Housing Association

Rooftop Housing Association is a charitable housing association that provides affordable housing for all household types and needs. The association is using the data to start conversations with its local community about their energy use.



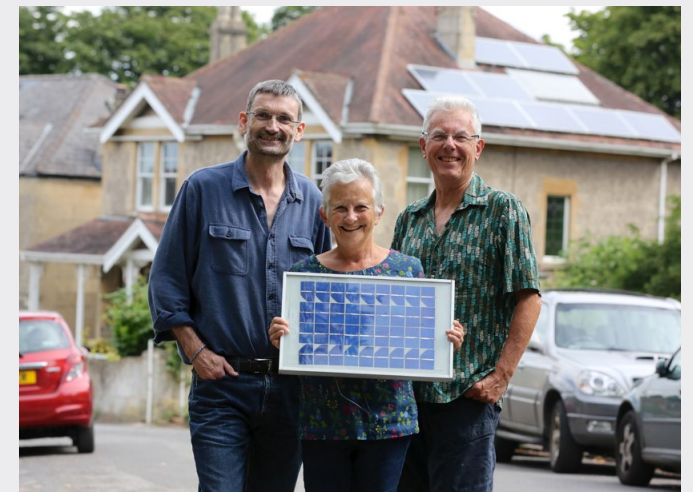
Yealm Community Energy

Yealm Community Energy group joined the project at a late stage. The community group has recently completed the purchase of the Newton Downs solar farm. Data from the solar farm will be displayed alongside data from a local substation to engage the community in issues such as local energy consumption, local generation and carbon intensity. The group also aims to help people understand the link between domestic energy consumption, substation activity and local renewable generation.



Marshfield Energy Group

The OpenLV project is monitoring all four substations in the village of Marshfield. This is allowing the group to develop a village-wide energy strategy. This will help the group understand the potential in the village to increase renewable generation, facilitate the uptake of electric vehicles (EVs) and understand local network constraints.



Bath and West Community Energy

Bath and West is using OpenLV data in conjunction with the Solar Streets project. The community group is installing PV and battery systems in houses and then measuring their impact using data from the local substation. This data will be used to build a business case for future installations. Data from the OpenLV project is also being used to inform a series of demand reduction and peak shifting campaigns, facilitated by local engagement such as drop-in sessions in the local pub.



Sustainable energy expert Regen has been commissioned to monitor and assess the community benefits enabled through access to this new source of electricity data.





Opportunities for Businesses and Universities

The OpenLV project team has engaged with over 20 organisations from business and academia. These organisations are pursuing a variety of different opportunities, accessing OpenLV data via an on-platform app, in real time via the cloud or using off-line stored data. A selection of projects are summarised below:



IBM

IBM is developing an app that can respond to network congestion and control the charging rate of an EV. This trial demonstrates whether it is feasible for a developer to write apps that can bridge between the LV-CAP™ environment and EV manufacturers' proprietary car charging management apps.

DEPsys

DEPsys is developing an app that considers the effect of loading cycles on the asset condition of the secondary substation transformer.

Haysys

Rather than developing an app, Haysys has developed an LV monitoring station that is compliant with the LV-CAP™ platform. This trial demonstrates that the LV-CAP™ platform has wide appeal not only to app developers but also to hardware manufacturers.



Egnida

Egnida is managing an innovative scheme to introduce smart energy technology into social housing. The 'smart energy fuel poverty initiative' is an existing project, which is a test bed of real homes acting under real conditions. Six homes are currently configured with technology including solar PV, battery storage and smart heating systems.



Energeo

Energeo has integrated the data obtained from OpenLV into its data platform to enable users to obtain an insight into the energy usage patterns in local areas.



Orxa Grid

Orxa Grid has developed an app that predicts which feeders of a particular substation are likely to exceed statutory voltage limits.



Nortech

Nortech has developed two apps that demonstrate the willingness of manufacturers to create apps that can be placed in substations. The first is a smart Maximum Demand Indicator, which enables users to rapidly understand network congestion. Secondly, Nortech has developed an app that enables the LV-CAP™ to gather telemetry from additional network devices which communicate using the Distributed Network Protocol.



Equiwatt

Equiwatt has developed an app that rewards households for allowing electrical appliances to be automatically managed according to smart grid requirements. This app sends signals that implement action from connected households' loads in response to network needs.



Lucy Electric

Lucy Electric has developed an app that uses the OpenLV API to control a car charger.



Data from the OpenLV project has also enabled research from the following academic institutions: Cardiff University, Imperial College, London Business School, Swansea University, University of Bristol and University of Strathclyde.

Cyber Security

Assessments of any cyber security risks posed by distributed intelligence and automated network control have been undertaken at different stages of the OpenLV project by a company specialising in international cyber security expertise.

An initial evaluation of the planned software architecture and outline system was undertaken and confirmed that for the purpose of LV Network monitoring there were "no cyber security risks to Power Distribution Operators and their operations" by the LV-CAP™ technology.

Full penetration testing was then undertaken before implementation of automated control functionality to determine any vulnerabilities. Where necessary, recommendations were implemented before deployment of the ALVIN ReClose™ circuit breakers.

The project is now moving on to consider existing industry cyber security standards and guidance. It will be recommending improvements and refinements to accommodate distributed intelligence devices and automated network control whilst maintaining the security of key system assets.



Next Steps

OpenLV trials end in winter 2019, with decommissioning of equipment in spring 2020. There will be detailed analysis on the data, extrapolating across the WPD licence areas and then across Britain.

A cost benefit analysis will be undertaken across the project's methods using EA Technology's industry leading techno-economic Transform modelling tool. Workshops will be held to gather industry views to inform development of business as usual cyber security recommendations for deployment of distributed intelligence in substations. In-depth reporting of trial activity will be completed by summer 2020.

For the latest information visit openlv.net

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