Open LV

The benefits of open source distributed intelligence

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

OpenLV - An Overview

The ground-breaking OpenLV project made local electricity data openly available to businesses, universities and community organisations, unleashing a wave of energy innovation across the Western Power Distribution (WPD) network in the Midlands, South West and Wales. During the now complete OpenLV trials, the project provided groups with the opportunity to develop their own apps, allowing them to leverage their local network data to directly benefit their communities.

OpenLV also provided a proprietary software platform to securely host and deploy these apps across the Low Voltage (LV) distribution network. As a result, an app could provide services to meet the needs of communities, while contributing to national ambitions to create a Net Zero carbon emissions future for every community.

The OpenLV software platform also provided Distribution Network Operators (DNOs) with a robust monitoring and network management tool, making network and asset data readily available. Using real time network data, accurate calculations and network control decisions were enabled on the LV distribution network at a local level, negating the need for central aggregation and removing dependence on communication networks for real-time network monitoring and control.

The OpenLV project not only provides benefits for network operators but also for the communities they serve. It's a win-win situation, powered by data and made possible by LV-CAP® - EA Technology's Low Voltage Common Application Platform.

An Introduction from WPD

OpenLV built on the learning generated from our previous innovation projects. Projects such as Smart Hooky, Community Energy Action, and SoLa Bristol showed that there was an appetite among community organisations to receive and use data about their energy usage from WPD substations. This project allowed us to explore their enthusiasm further, and to investigate how people from outside the electricity industry would use data about the electricity network in their locality. This is known as the Low Voltage, or LV, network. Hence the project name – OpenLV.

We at WPD strongly believe in Open Access to data. By actively sharing the findings of this project, and other relevant work, we have actively supported the work of the government's Energy Data Task Force as they work toward this ambition.

The focus of this project was to make data available locally. The data could be accessed by us, by organisations on behalf of their local communities, by academics or by companies who wanted to develop their own "Apps" either to support their own business initiatives or as a commercial operation.

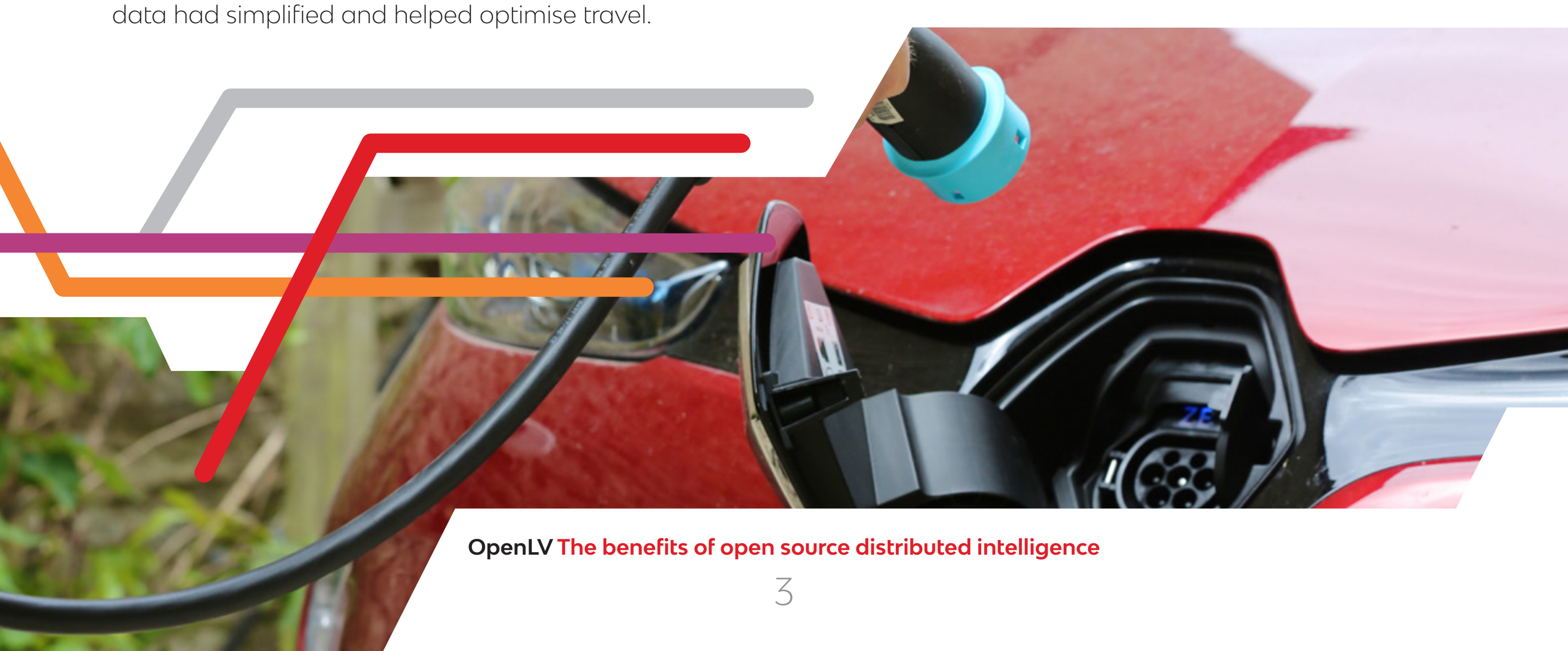
When our project team first conceived OpenLV, we found it difficult to convince some stakeholders of its merits (including some of Ofgem's expert panel who were deciding on whether to provide funding). The main concern was that they doubted that there would be any interest in LV network data outside the DNOs or that anyone would want to create apps to be hosted in substations. But we were convinced we were onto something and continued to make the case, drawing parallels with other sectors such as how train and bus data had simplified and helped optimise travel.

This project has proved that there is a huge interest out there. The level of interest was, in fact, far higher than any of us could have hoped for. We would like to say a huge thanks to every organisation that submitted ideas to the project; we are just sorry we couldn't take them all forward.

The learning from this project has already informed our thinking at WPD. It has fed directly into our Data and Digitalisation Strategy which has the principle of Open Data at its core. Building on the project success, we have already begun the rollout of 1,000 of the next generation of OpenLV platforms. VisNets®, which utilise the LV-CAP® technology platform, will be deployed across our networks in areas with high levels of low carbon technology adoption (such as electric vehicles, battery storage and heat pumps) forming part of our day-to-day operations.

This positions WPD at the forefront of opening energy data, being able to use network data and apps in conjunction with community engagement to defer or avoid traditional LV infrastructure investment to support electrification of energy for heating and transportation. This is a key enabler of the green recovery and Net Zero and a glimpse into our sustainable future.

Roger Hey
DSO Systems & Projects Manager
Western Power Distribution



Foreword from EA Technology

The findings from the OpenLV trial are now more revelatory and relevant than ever before. As we emerge from the Covid-19 pandemic, the drive for a Net Zero future is likely to take precedence across every community as the priorities and plans for our planet inevitably change. But widespread decarbonisation presents challenges – where any changes must not only protect the wider world from an environmental perspective but also benefit all segments of our society to ensure their ongoing adoption, and achieved in a cost-effective way.

To achieve this balance and reach Net Zero, we need to increasingly rely on electricity to heat our homes, connect our businesses, and power our cars. We must not only change how and where we generate our electricity, but also how much we use. All of this has the potential to put additional strain on our existing electricity networks which were not designed to host low carbon technologies.

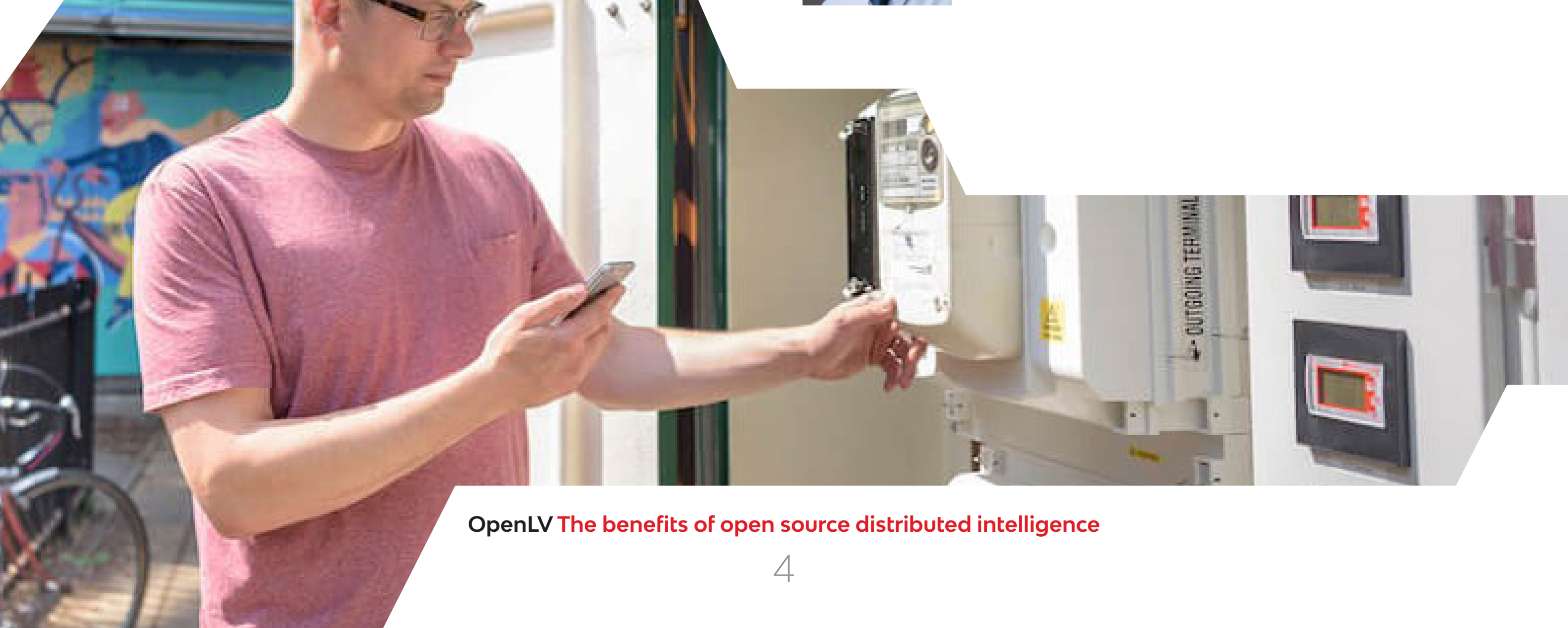
To reduce this risk and meet these growing decarbonisation demands, network operators require visibility across their Low Voltage networks, a capability that has been historically lacking for many such organisations. This is where the OpenLV project can help. The technology proven during our recent OpenLV trials provides network operators with LV network visibility, allowing them to focus on locations requiring intervention.

This seamless visibility allows operators to uncover and optimise cost saving opportunities, using data to drive the right network decisions, at the right time.

This technology does not just provide data – it completes local calculations, sends alerts when alarms are triggered, and activates local network management protocols. This reduces the volume of information network operators need to transmit to central data hubs, reduces data transmission costs, and removes unnecessary delays when responding to changing network conditions. From the outset, the OpenLV platform was conceived as a low-cost, value-added solution, which could be installed at every substation across Great Britain and Northern Ireland. This technology doesn't just help network operators. It can provide data and alerts to community organisations, makes data available to academic researchers, and allows businesses to develop and deploy apps securely across our open platform, which can provide services to a broad range of user groups and communities. This all has a knock-on effect, helping communities better understand their local electricity network, operate local renewable or other low carbon technologies more efficiently, and allowing the whole of society to benefit from the data-driven technologies now transforming the electricity sector.

This document provides a summary of the recent achievements of the OpenLV project, revealing how this solution can expedite a Net Zero future.

David Russell
OpenLV Project Manager
EA Technology



The enabling technology

THE LOW VOLTAGE COMMON APPLICATION PLATFORM

During its recent trials, the OpenLV project introduced the Low Voltage Common Application Platform or 'LV-CAP®'. This platform provides a low cost, robust substation monitoring and management system and also allows manufacturers, developers and academics to develop apps using an API which EA Technology made publicly available in the project. This is in a similar vein to the Google Android and Apple iOS operating systems. LV-CAP securely hosts these apps, while allowing the seamless transfer of data across its systems and to external parties. As a result, new network management ideas can be trialled and tested on LV-CAP, without installing any new substation equipment. This provides the industry with a robust and future proofed data-driven solution, which can adapt to the demands of the rapidly evolving energy sector.

LV-CAP was initially developed as part of an Innovate UK project in collaboration with EA Technology, Nortech and the University of Manchester.

EA Technology then further refined LV-CAP and deployed it to hardware for the project and beyond.

During the recent trials, the capabilities of LV-CAP were demonstrated across a range of real-world scenarios. This highlighted the wider benefits of the platform not only to network operators, but also to businesses, academia and community organisations across the UK.

These benefits were possible thanks to the platform's strong data foundation.

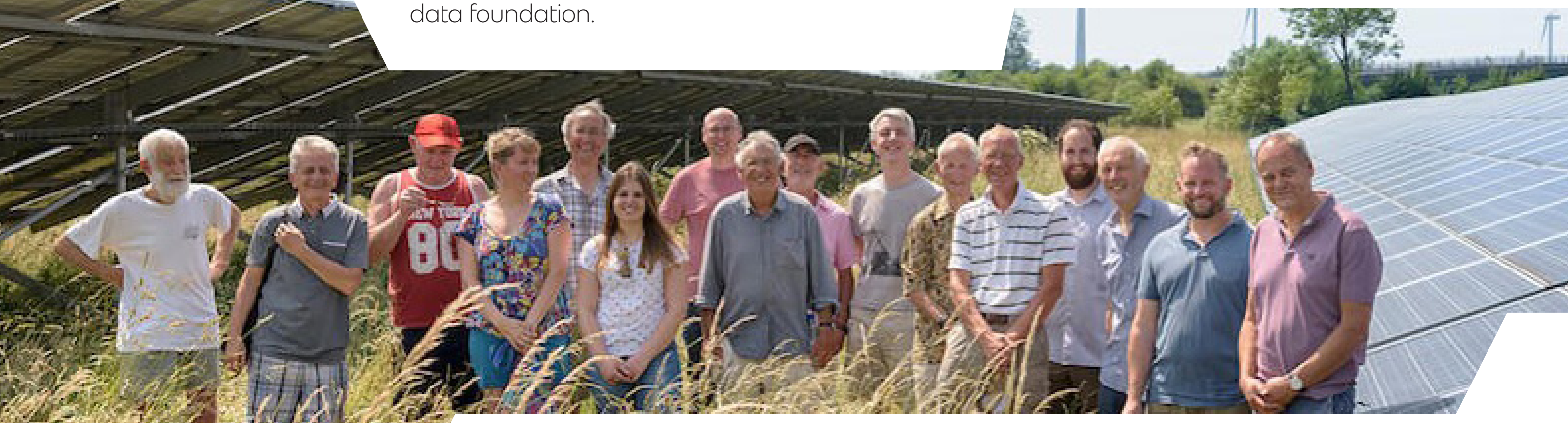
Data was gathered from each substation and processed by these apps within the platform. Data was then shared between the apps, and calculations were made using this data, enabling autonomous network decisions to be made and implemented locally, reducing reaction times and decreasing the amount of data requiring transmission to central aggregation servers. The apps can also be remotely deployed to and updated on LV-CAP, reducing the number of substation visits for DNO staff.

LV-CAP is intuitive, with supporting documentation available to reduce the barriers of entry for app designers. Such seamless accessibility and usability democratise this platform further, allowing its apps to reflect the interests and aspirations of the community that a specific substation serves, the loads fed by it, the generation attached to it, or the requirements of the DNO that maintains it.

The trials utilised the Lucy GridKey MCU520 LV Monitoring system to provide voltage and current measurements and distribute the collected data to the trial unit (for processing and upload) and servers (for data storage). This data was passed to LV-CAP through an ethernet connection and a publicly accessible cloud-based server was also used to make data from the units available to businesses, universities and community groups, making LV-CAP available across different user groups.

Finally, Nortech's iHost server was used as a 'Monitoring and Control Server' to monitor the deployed units and manage the deployment and operation of the applications on each unit. It was also used to store data from all the deployed units, providing an additional backup for the project.

[1] It is noted that the LV-CAP platform is not limited to certain hardware manufacturers. This was demonstrated during the trials with one unit being interfaced with another LV network monitoring device.

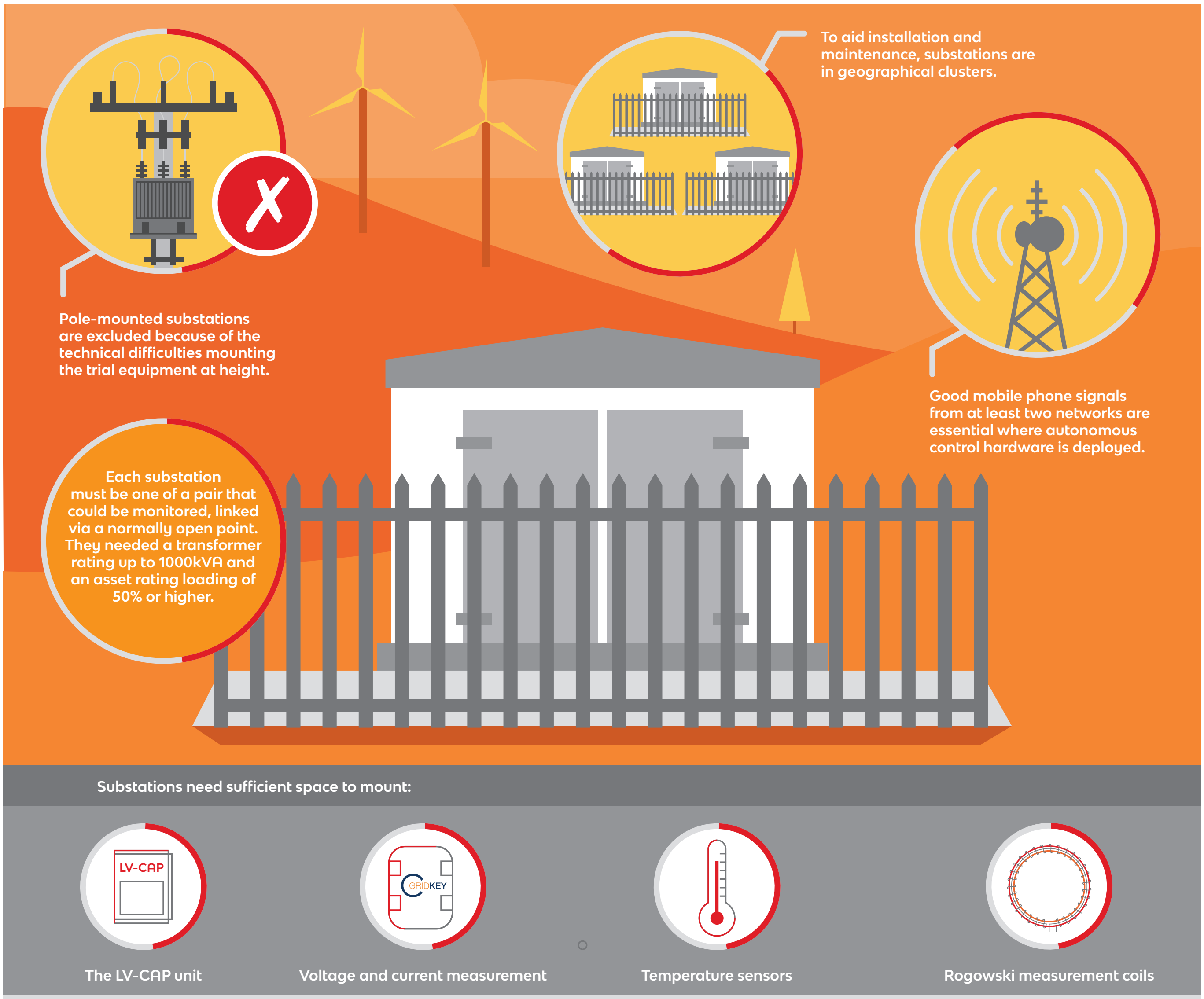


Installation

The OpenLV project installed LV-CAP® in 80 substations across the four WPD licence areas in the Midlands, South West and Wales. The installations were grouped according to their proposed purpose:

- 10 substations – selected based on which the participating community organisations was connected to,
- 10 substations – selected based on which the participating business or university was connected to, or because the network topography in the vicinity was of particular interest,
- 10 substations (five pairs) – selected for an automated load sharing trial using EA Technology's ALVIN® Reclose next-generation, smart supply restoration units as controllable meshing switches, and
- 50 substations (25 pairs) - selected to monitor and analyse the potential for automated load sharing.

The project team completed desk-top surveys of around 149,000 substations to narrow down potential candidates. The project team then visited and assessed approximately 400 LV substations for their suitability, assessing each one across a range of criteria, detailed below.



Substations should represent a cross section of networks types, as identified by the Low Voltage Network Template project. Completed in 2013, this was a previous WPD Innovation project where we developed an understanding of how LV electricity networks can best cope with a future, low-carbon world using smart grids and other next-generation solutions.

Benefits of distributed intelligence

LV-CAP provides users with a 'distributed intelligence' solution. This is, essentially, where a large system is separated into multiple subsystems to improve its reliability, efficiency and flexibility.

In this section, we explain how the OpenLV project provided a distributed intelligence solution to the trial's participating community organisations, businesses and universities, using a range of situations to highlight the benefits these groups received thanks to LV-CAP.

"We would continue with the forecasting app that we've written but we would like to deploy more of our apps... onto OpenLV and scale up to monitor many more substations than we are currently doing."

Robert Brown, Orxa Grid

"Future services – it's almost limitless. It is a huge range of things that we can do in the future with this data."

Paul Beck, Lucy Electric GridKey

How LV-CAP® benefits networks

LV-CAP is a distributed intelligence solution and benefits local electricity networks by:

- Monitoring LV network assets
- Taking a hardware-agnostic approach to allow operators to use their choice of monitoring hardware
- Performing on-platform calculations to reduce data transmission requirements
- Calculating the state of network assets in near real-time, providing up-to-date information on the amount of additional load a local network can accommodate
- Predicting the future network state based on previous performance
- Enacting changes to the local network in response to current and predicted network states.

Network Capacity Uplift Trial

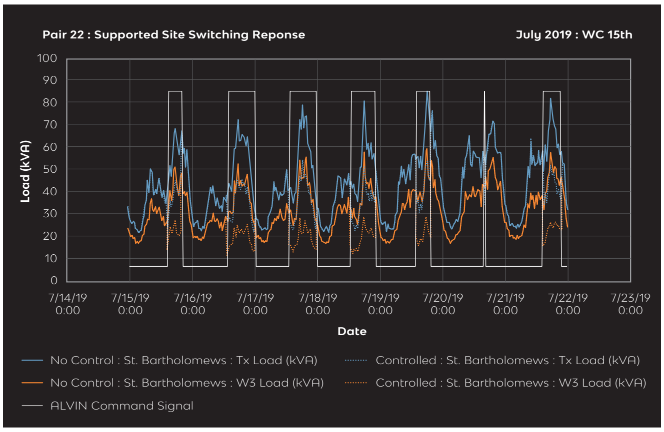
The Network Capacity Uplift Trial demonstrated the capability of LV-CAP to record, process, and respond to network conditions. A range of third-party apps were also developed outside the OpenLV project for use by network owners. These included:

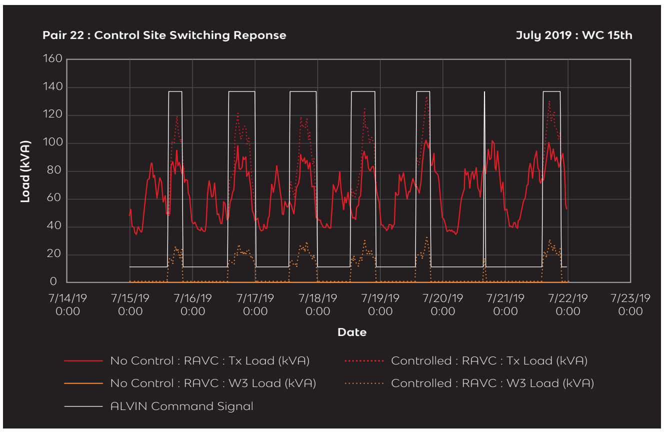
- **Load Profile Predictor App** (EA Technology) – utilises previous load data from the connected substation and monitored feeders to predict the future load profile.
- **WeatherSense** (core algorithms developed by the University of Manchester) - uses the measured load and ambient temperatures with a Real Time Thermal Rating (RTTR) algorithm to predict the transformer operating temperature. Then it uses the calculated transformer temperature and predicted load profile from the Load Profile Predictor App to forecast the transformer temperature.
- **LoadSense** (EA Technology) – based on the operating conditions at two interconnected substations, this app contains a set of rules that trigger the meshing or un-meshing of the local network.
- **Network Meshing App** (EA Technology) – if the LoadSense app determines that network meshing is required, this app sends a signal to the ALVIN® Reclose devices to close the breakers and mesh the adjacent networks.

The project team selected five pairs of substations that could be interconnected to demonstrate this capability. In each selected pair, one transformer experienced a greater proportional load in comparison to the transformer rating.

The system was designed to share the interconnected feeder's load between the two substations, when appropriate. Using historic data collected from each substation, an app predicted the future network conditions, forecasting when interconnection would be required.

The ALVIN® Reclose units, which were deployed as controlled meshing switches, were closed - allowing one substation to support another.





Case Studies

Haysys is a specialist manufacturer of electronic devices and volunteered to participate in the OpenLV project. Its products include low voltage monitoring solutions, which are capable of measuring a wide range of substation electrical parameters. As a project participant, Haysys proved that its FeederNet substation monitoring technology was compatible with LV-CAP in a substation environment, demonstrating the interoperability of these disparate measuring technologies.

"To have a holistic system where everything talks to each other has got to be a good benefit."

Joseph Hayden, Haysys

Nortech is a specialist communications equipment company, focusing on electrical distribution networks. Nortech was a project supplier to OpenLV but also volunteered to develop two apps to demonstrate the capabilities of open substation platforms. The two apps (a smart Maximum Demand Indicator (MDI) app and a Supervisory Control and Data Acquisition (SCADA) transfer protocol app) can provide extra functionality to distribution network operators using LV-CAP.

How the technology benefits community groups

51 community organisations responded to initial survey

Community groups suggested 45 app ideas

7 community organisations recruited

- **Rooftop Housing Association**
  1 substation monitored
- **Sustainable Marshfield**
  4 substations monitored
- **Owen Square Community Energy**
  1 substation monitored
- **Tamar Energy Community**
  1 substation monitored
- **Bath and West Community Energy**
  2 substations monitored
- **Exeter Community Energy**
  2 substations monitored
- **Yealm Community Energy**
  1 substations monitored

Do community organisations want access to LV network data?

During the OpenLV project, we wanted to determine if that appetite existed and, if so, understand how this data could be used to benefit community organisations. To achieve this, our project team engaged with the participating community groups, gathered their thoughts, and created a downloadable Community Guidebook for other interested parties to understand and utilise the project's data resources.

In the summer of 2017, community organisations were surveyed by community engagement specialists from the Centre for Sustainable Energy (CSE). The survey was designed to determine the level of interest among community organisations in receiving LV network data, what they would do with that information, and gauge enthusiasm for designing LV-CAP apps.

CSE received 51 responses from the surveyed community energy groups. They included organisations that own renewable assets, those involved in electric vehicle projects, and companies that provide energy advice to UK households. What's more, these organisations also outlined 45 potential app ideas for LV-CAP®.

In December 2017, CSE ran an application process to recruit community organisations into the project. This included an initial screening process to assess the feasibility of each group's local substations. As a result, seven organisations were invited to participate. Unfortunately, one organisation was forced to withdraw due to an internal restructure, but they were promptly replaced by another candidate.

With the help of the CSE web app (see page 12), this work was a success. The benefits of a distributed intelligence platform to community organisations are demonstrated in the following case studies, where data is being used to help deliver national Net Zero targets as well as benefiting local communities.

In order to maximise project learning, we were able to use some OpenLV platforms for both community groups and commercial organisations. This allowed community organisations access to more than 10 substations worth of data.

SECTION 3

COMMUNITY BENEFITS

Case Studies

Tamar Energy Community

The **Tamar Energy Community** (TEC) is a Devon-based community energy group that owns 327kW of distributed renewable generation. The group is volunteer led and runs a range of fuel poverty and domestic energy advice services.

The TEC combined the OpenLV data with local generation data from its privately-owned assets and carbon intensity. This allowed the TEC to engage with its community, discuss energy issues and influence their behaviour. Using data and graphs displayed on the OpenLV app, for example, TEC set up 'Eco clubs' at a local junior school to teach pupils about energy efficiency and carbon emissions.

By engaging first with this primary school, TEC built a solid brand reputation in the local area, enabling them to engage with the wider community. They have now set up an online householder survey and are knocking on doors in the substation area, asking people about their time-of-use tariffs, distributed energy resources, and their impact on the wider energy system. TEC believes it could not have achieved these results without access to the OpenLV data. The group expects to continue using the data in their future work, and is also developing a smart phone app that will utilise project data.

"One of the key things that looking at the data has enabled us to do is to understand a lot more about how the energy network around us works. We've all learnt a huge amount from this... in fact our impression was that the children are far more aware of these things than adults."

Kate Royston
Tamar Energy Community

SECTION 3

COMMUNITY BENEFITS

Case Studies

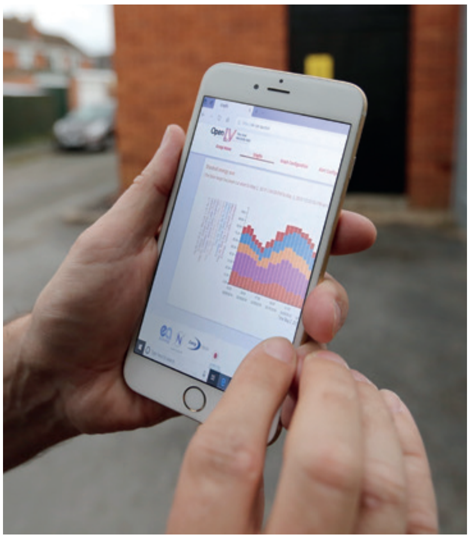
While many community organisations were eager to use the LV network data, it was quickly apparent that very few had the expertise or resources to develop an app, a situation that was exacerbated by the short timescales of the trial. So, given the considerable cross-over in the functionality required by each group, the **Centre for Sustainable Energy** (CSE) developed a web app for the participating community groups to use.

CSE consulted with the community organisations to understand their functional requirements and developed a configurable web app. The app can display different substation parameters in a variety of ways, receive and display third-party data (including data from renewable resources and national carbon intensity), and send out alerts. At the end of the OpenLV project, the web app will still be available to community organisations.

Exeter Community Energy (ECOE) is an established and volunteer-led community energy group, which provides 209kW of distributed solar PV in the local area. ECOE also wanted to develop a prototype smart phone app that provided local users with energy usage information at their local substation, as well as data on local generation and national carbon intensity.

App developer Q bots gave ECOE £10,000 of in-kind funding to help develop a prototype smartphone app. The group held a focus group with the local community to test this app and receive feedback from them

Graphs from the OpenLV app were presented at an ECOE annual general meeting, generating a high level of interest in the data from the group's members. ECOE commented that, if they could access data from several substations across Exeter, this would help them identify areas that are less constrained at the substation level and aid future planning of future rooftop solar generation projects.



COMMUNITY BENEFITS

Case Studies

Owen Square Community Energy

"The platform has empowered communities by helping them understand their energy consumption."

Sam Rossi Ashton,
Innovation Engineer, WPD

Owen Square

Owen Square Community Initiative (OSCE) is a member-based local energy company. OSCE wants to develop a replicable business case for intensive low-carbon domestic retrofits, where OpenLV substation data has provided an evidence base for funding applications for these schemes. It has also helped raise awareness of energy use in the community, promoting the take up of low carbon technologies by local households.

OSCE used the OpenLV data to examine the operation and function of its local substation, to understand how much low-carbon generation the substation could support. OSCE also developed models to investigate the viability of a microgrid[2] to increase the network capacity and assess whether the network could support the installation of low carbon technologies in properties connected to the local substation. They also recruited university students to financially model the OpenLV data, which helped the OSCE build a business case for decarbonised heat projects. This work can also be used to support future funding applications.

[2]A microgrid is a small network of electricity users with a local source of supply that is usually attached to the central network but is able to function independently.

How the technology benefits businesses

79 businesses and Universities expressed an interest

6 third party apps developed

1 hardware system

What about corporate enterprises? The project team examined whether there was a commercial need to provide businesses with access to the LV network data or a route to market for different organisations' apps.

We adopted a similar approach to CSE's work with the community organisations here. A project team was initially set up, working with businesses and universities to gauge their level of interest in developing and trialling an app, and receiving data from LV substations. The interest was definitely there, with more than 50 different use cases identified by the respondents over a three month period.

In the spring of 2018, an application process was opened to respondents who also wanted to participate in the trial. A range of businesses volunteered, with a variety of use cases and data requirements, including those who wanted access to historic and API-based data, and businesses that wanted to develop an app.

A series of workshops were held over the course of the project to familiarise participants with the technology, allowing them to meet the project team, WPD representatives, and each other.

The project team would like to thank all the businesses who took part in the OpenLV project and shared their learning with us. Participant organisations received no financial reward for taking part in OpenLV and had to self-fund their participation. This is a major undertaking for a commercial organisation and was identified as a major barrier, preventing other organisations from participating. Other barriers included a lack of sufficient skill sets, full workloads for staff with the relevant skill sets, and a lack of clear direction on steps to commercialisation for the technology.

SECTION 4

BUSINESS BENEFITS

Case Studies

OrxaGrid specialises in hardware, software and analytics, providing insights into electricity networks and asset condition. The company developed an OpenLV platform app that forecasts future voltage profiles and generates voltage alerts based on those predictions. These predictions and alerts could provide DNOs with increased low voltage network performance visibility, without manually analysing low-level data from individual sensors. To achieve this, the OrxaGrid app used historic data to train its voltage forecasting algorithm. After deployment on LV-CAP, the algorithm continued to learn from the real-time streaming data, fine-tuning its forecasts. The OrxaGrid app could be deployed without data, training itself once deployed to the device.

However, this method would mean the prediction model would take months to reach the required level of accuracy. As such, OrxaGrid's trial demonstrates the requirement for an open platform, such as OpenLV, to train next-generation prediction algorithms. Using this information and its existing analytics packages, OrxaGrid could develop its app, expand its business, and identify new routes to market.

For this project, computing giant **IBM** developed an application on LV-CAP that can interact with a Jaguar I-PACE electric car and control the vehicles charging. IBM's involvement was not a commercial move but was, instead, a strategic gesture to help demonstrate the benefit of an open platform within the energy industry. According to IBM there is a lot of interest in controlling low carbon technologies; managing and maintaining a diverse ecosystem of solutions will however present significant challenges. The use of a container based platform, such as OpenLV, opens up the possibility to use cloud derived edge computing technologies that can address these challenges and make the solution highly scalable. This work also demonstrates the capability of the OpenLV platform to control electric vehicles via an API and using an app developed by a car manufacturer or other third party.

SECTION 4

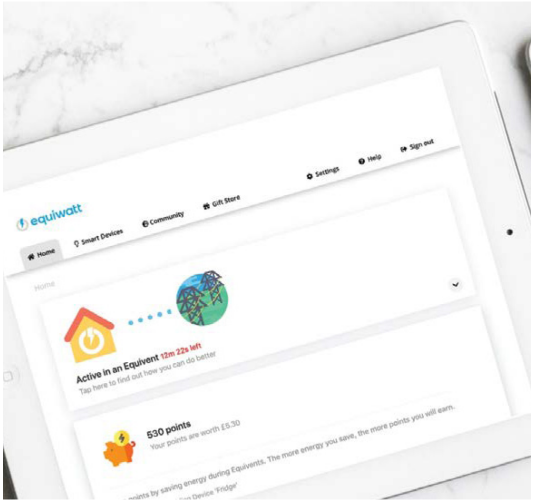
BUSINESS BENEFITS

Case Studies

Energeo creates built environment analysis tools and recently developed a platform capable of assessing 1,000 homes for solar PV suitability. The platform is also used by local authorities to analyse and plan their decarbonisation strategies. The resulting insights are generated using diverse input data including satellite imagery, transport data, pollution data and energy efficiency metrics.

Energeo wanted to demonstrate that their platform could incorporate LV network data and, in particular, overlay that data against other built environment metrics, providing a significant enhancement to its existing product. Both these factors were demonstrated and Energeo won support from the EU-funded Datapitch scheme innovation programme. Datapitch brings together corporate and public sector organisations to use shared data to help build sustainable businesses. As a result, Energeo could expand its business offering and the capabilities of its existing platform. This is a clear demonstration of how OpenLV can help organisations identify and develop new business opportunities.

Equiwatt are a clean technology company pioneering change in the way households use energy. Their platform uses AI to identify smart grid requirements and rewards consumers through a mobile app for automatically turning off high energy usage appliances when energy is most expensive and polluting. This is demand side response on a residential scale (rDSR) that puts money in the pockets of consumers, saves cost for system operators, DNOs and energy providers as well as helping everyone to reduce their carbon footprint. Equiwatt used data from the OpenLV trial to simulate the network-level rDSR events. This data was translated into signals, which could trigger actionable responses to connected domestic loads, including EV charging and smart household appliances. Equiwatt is also looking at opportunities to develop an app to sit on the substation platform, which will eventually report network data measurements into LV-CAP.



How the technology benefits academia

> "The OpenLV project should be seen as business as usual for the other network operators."
>
> **Julio Perez Olvera,**
> Imperial College

> "It gives the most granular data that is possible of the distribution network."
>
> **Phani Chitti,**
> Bristol University

Universities participated in the OpenLV project to a varying extent, with some institutions leveraging the project data for their research and others providing support to the participating businesses and community organisations. The OpenLV project data provided the following, favourable attributes for these research institutions:

- All LV project data was made available,
- High granularity data,
- Information on a range of network types, including residential and commercial networks,
- A broad geographical spread of monitored substations, and
- Information on the renewables connected to certain substations.

The project team invited its academic participants to attend a series of workshops, providing them with the opportunity to present their research to other academics, discuss their work, and investigate the networks under analysis from a business and community perspective. The workshops also provided these institutions with additional insights into the activities carried out by businesses, community organisations and WPD in this area.

The researchers remarked that because the data was "open", this allowed them to pursue their research, removing data barriers and providing autonomy of academic thought, removing their reliance on a specific sponsor.

Data from the OpenLV project has informed the following academic papers and presentations:

Institution	Title of Research Paper
Cardiff University	Use of prediction based meter reputation factors in power systems
Imperial College	Self-learning Control for Active Network Management
University of Bristol	Digital and physical perspectives of the effect of renewables on the LV distribution system
University of Girona	Detection, Isolation, and Diagnosis of Abnormal Grid Operation with Multilayer Multiway PCA
University of Strathclyde	End-to-end analysis to help improve understanding of how the LV network can be balanced

SECTION 6

How the technology benefits the Net Zero transition

Whether you're heating your home or travelling to the supermarket, we now use more electricity to power our everyday lives. Increased electricity consumption can also help us meet national Net Zero targets where distributed renewable sources provide an environmentally sound solution - but also increase the strain across distributed networks. This is where we need to think smarter. DNOs need the right information to allow them to change their network configuration, or directly control local EV loads, for example, and make the best decisions for the power network.

The OpenLV project has provided a distributed intelligence solution, democratising LV network data to help organisations meet these power demands and Net Zero targets by:

- Increasing understanding of the environmental issues, the electricity network and how to reduce your impact on the network
- Using data to locate renewable generation or EV chargers for the network
- Controlling EV charging
- Balancing local networks.

Many OpenLV participant projects wanted to enable the uptake of low carbon technologies.
The following case studies highlight some of these projects.

SECTION 6

NET ZERO TRANSITION

Case Studies

Bath and West Community Energy (BWCE) is an early pioneer of community-owned energy generation and has recently installed domestic PV and battery systems in local homes. The OpenLV data has informed a series of demand reduction campaigns, facilitating local engagement and measuring the impact of this new technology on local energy demand.

BWCE commissioned smart energy company Moixa for the rollout of its domestic solar PV and battery installations. It completed 16 battery and solar installs during the project, with data from the Moixa installations available in the app, making it possible to assess the impact of these installations across the community. BWCE also used substation data to analyse both the carbon intensity of local electricity demand (using regional estimated intensity for given times) and community-wide electricity use. BWCE said the OpenLV data was useful as an initial engagement tool and in raising people's awareness. They plan to use the data going forward to encourage community flexibility, where individuals are encouraged to change their usage habits thanks to this new-found awareness.

Project partner **Lucy Electric** developed an EV smart charging app in tandem with the Kaluza intelligent EV platform. The app was designed to automatically control car charging based on the transformer temperature and network capacity. An app was deployed in the GridKey Data Centre to generate and relay a signal to the Kaluza back office system based on data from the OpenLV collected data. Upon receipt of this car charging signal, the Kaluza back office system instructed the trial cars rate of charging accordingly which included discharging the vehicle battery (V2G) to reduce the load on the network.

SECTION 6

NET ZERO TRANSITION

Case Studies

Yealm Community Energy

Yealm Community Energy (YCE) is a member-owned community group serving the Yealm area of South Devon. The group owns an existing solar farm at nearby Newton Downs and works with another one of the trial's participants, utilities company Engie.

The group combined data from the solar farm with local substation data to engage the community in issues such as local energy consumption, local energy generation and carbon intensity. The group also used the data to help the local community understand the link between domestic energy consumption, substation activity and local renewable generation, enabling Yealm to deploy more low carbon technologies without impacting DNOs.

"We are able to show people how much energy is being produced by the solar farms by the app that's being developed... it actually shows that the area is going to be carbon neutral in electricity use"

Ray Holland
Yealm Community Energy

SustainableMarshfield

Marshfield is a village in South Gloucestershire with approximately 850 households. The Marshfield Energy Group is a volunteer-led organisation in this area, with support from the Community Land Trust. The OpenLV Project monitored all four substations in the village of Marshfield, providing valuable insights into the community's electricity usage patterns.

The Marshfield Energy Group applied to the trials to access this data, which it wanted to use to identify a feasible and effective village-wide sustainability strategy.

The group was primarily interested in the 'raw' data, rather than the app's data visualisations. It investigated the impact of the expected increase in electric vehicle use, potential energy storage solutions, and additional community-scale renewable energy installations on the village's electricity demands.

SECTION 7

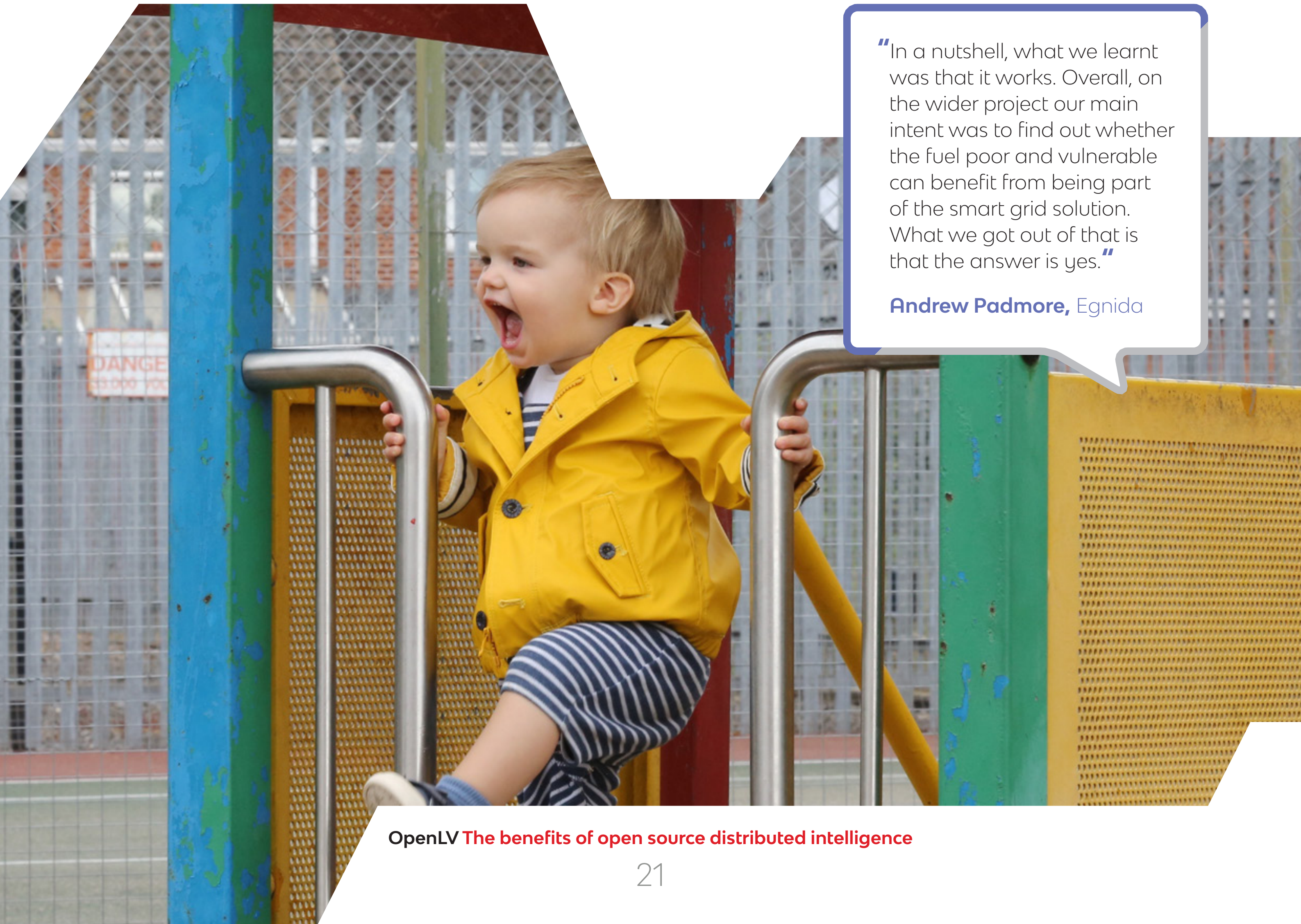
How the technology benefits social responsibility

Community buy-in is an important ingredient in the success of any proposed change. The electricity sector is no exception, where all community members must benefit from any proposed changes.

The OpenLV project demonstrated how distributed intelligence platforms like LV-CAP can achieve this by making data freely available to all.

The OpenLV trials revealed several ways in which the democratisation of energy data can aid society, including:

- Using local data to start conversations about electricity use and energy efficiency. This helped residents understand the cost of using different appliances, how to use them in a cost-effective manner, the implications of time-of-use tariffs and how households could benefit from them
- Helping housing associations invest in and best site renewables for their network
- Enabling housing association residents to benefit from market flexibility, allowing them to pick when they use their energy in the future for financial benefit.



"In a nutshell, what we learnt was that it works. Overall, on the wider project our main intent was to find out whether the fuel poor and vulnerable can benefit from being part of the smart grid solution. What we got out of that is that the answer is yes."

Andrew Padmore, Egnida

SECTION 7

SOCIAL RESPONSIBILITY

Case Studies

Rooftop
Housing Group

Rooftop Housing Association is a charitable housing association. OpenLV equipment was installed in a substation in the Bishop's Cleeve area of Cheltenham, which serves some of the association's properties. Rooftop used OpenLV data to encourage residents to think about their energy usage and make changes, forming the foundation of a wider drive to tackle fuel poverty across all Rooftop communities. Rooftop saw the value of this data to inform business decisions and investigate the potential impact of investments in energy efficiency, smart appliances and renewable technologies.

Rooftop wanted to communicate clearly to residents their strong stance on environmental issues and desire to help residents reduce their carbon footprints. They believe that data is a valuable tool to create a robust future community engagement strategy and are now working with residents to achieve widespread sustainability across the housing association.

"This project has a lot of potential to really change the way that we look at energy consumption on a local level."

Rob Seeley
Rooftop Housing Group

egnida
group

Egnida is a specialist energy consultancy, focusing on smart systems and mobility. The company develops and physically implements these innovative solutions. As part of a separate initiative, Egnida recently installed low carbon devices for a social housing project. They reviewed how access to near real-time LV network data could change the value proposition for low carbon technologies connected in social housing. Egnida designed and installed a smart energy control solution in six properties in the vicinity of a WPD LV substation, where OpenLV monitoring equipment was also installed. The smart energy solution included solar PV, battery storage, and smart energy and heating system monitoring and controls.

Egnida believes the presence of this monitoring technology in social housing will provide fuel-poor residents with the opportunity to save money and extract additional value from the energy supply chain in the future, thanks to the flexibility it offers to residents.

Data security

10,000
data points
per minute

15 million
data points
per day

5.5 billion
data points
per year

LV-CAP must adhere to stringent cyber security protocols to ensure the safety and security of the distribution network. We asked independent cyber security specialist NCC Group to perform a review of the technology. This review included:

1. A design review of the architecture before deployment
2. A security test and review before deployment of any control connected hardware, including penetrations tests and access tests for unauthorised users
3. A post deployment code review, taking into account the recommendations from the security test
4. Business-as-usual cyber security recommendations for the future deployment of distributed intelligence platforms by the industry.

At the end of the project, the cyber security recommendations developed as part of this project will still be available.

When deploying distributed intelligence devices and automated network control, these recommendations will provide the industry with clear guidelines to ensure the security of key system assets.

SECTION 7

Project Legacy

Decarbonisation and electrification are here to stay, transforming traditional power flows and the role of the electricity network. Advancing electrification is placing more demands on our low voltage networks to heat our homes, power our vehicles, and enable a variety of value-added use cases. National decarbonisation ambitions are also piling on the pressure. They are now enshrined in law, and the Green Recovery is a significant feature of Government policy to 'build back better' in a post Covid-19 world.

Data-driven solutions can help us realise both our electric and Net Zero ambitions, allowing stakeholders to identify new business opportunities, optimise their existing processes, and empower communities to make the right energy-based decisions. But this data must be managed and made available in the right way to expedite innovation and protect our planet.

The OpenLV project has contributed to our learning and understanding of both our networks and the people they serve. The recent trials have revealed how customers, communities and collaborators can use data-facilitated by platforms like LV-CAP to build a Net Zero future.

When we embarked upon this journey in the summer of 2016, we did not anticipate the consumer appetite for data and the opportunities this data would unlock across such a broad range of scenarios. Our work has shown what is and isn't possible with a decentralised architecture and has revealed the intrinsic need for data-driven approaches to optimise and enhance our low voltage network.

Beyond its operational successes, the project has engaged with real citizens and communities, helping us gain an insight into their drivers and needs, and strike the right balance when converting complex network data into a digestible format. I'm pleased to see these communities are continuing to demand more data beyond the scope of this project, and I applaud Western Power Distribution for supporting these groups as they embrace such change. The project team's Community Guidebook will, I believe, be a great source of material and an aid for other communities and distribution companies up and down the country.

We've proven that a demand exists from industrial and academic partners to deploy software apps onto third party platforms. We've also shown that this is technically feasible. In parallel with the project, EA Technology has embedded LV-CAP into our VisNet monitoring platform and we are now exploring commercial models with organisations to provide an enduring solution - breathing life into the concept of data democratisation well beyond a project

OpenLV has informed work on the DNO to DSO transition and advised the Energy Data Taskforce, providing real life examples of how open data and platforms like LV-CAP can work and add real value across the electricity sector.

Over the course of the project, we have seen many distribution companies come out to tender for monitoring solutions, and we expect these activities to ramp up significantly over the next five years. I believe the work carried out by the OpenLV project on cyber security will help many of those companies determine the most appropriate security levels for their different data functions - noting for example, that monitoring is different to control signalling.

Monitoring is now a far from niche innovation. It is a fundamental necessity for the evolving electricity sector, enabling and optimising a range of use cases. The only question left now, is how quickly it can all be deployed.

David A Roberts
Technical Director
EA Technology

SECTION 8

Conclusion

OpenLV has been a fantastic opportunity for WPD and its customers. It has provided us with a glimpse of a future where greater data availability will allow us to manage our network more proactively and enable our customers to participate in this revolution.

We have been excited to see the enthusiasm among community groups to access and use network data. Previous projects have indicated that there was an interest in this among these organisations but it was inspiring to see the passion of the participating groups and the range of ideas that they put forward to utilise local network data. This project has shown us a new way to engage with communities and emphasised the importance of considering locality and community.

The solutions that this project developed provided communities with a tool that allowed them to engage with local residents. It has helped them to communicate previously abstract concepts like energy consumption and decarbonisation in ways that become meaningful when applied at a local level. This will become more important as we strive toward our Net Zero future.

We will be continuing to work with the community organisations who took part in the project, carrying on providing them with access to data to enable their ambitions. We are also exploring ways that we can make network data more widely available to other interested community organisations.

Alison Sleightholm.
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Find Out More

For more information visit: **www.OpenLV.net**

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Serving the Midlands, South West and Wales