WESTERN POWER DISTRIBUTION

OPEN LV

OPENING UP THE SMART GRID

Community Learning Specialist: Deliverable 4

Mid-trial Report 1

ea technology

RIIO NIC NETWORK INNOVATION COMPETITION

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	Name	Date
Prepared by:	Poppy Maltby (Regen)	11.03.19
Reviewed by:	Johnny Gowdy (Regen)	
Recommended by:	David Russell (EA Technology)	13.03.19
Approved (WPD):		

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Contents

1. Executive summary

Background

The OpenLV project is trialling an open, flexible platform that could be deployed in every low voltage (LV) substation in Great Britain. The aim of the trial is to demonstrate the platform's ability to provide benefits to the network, customers, commercial entities and research organisations, and to understand the revenue or savings that they could access by using this data.

This report is part of Work Package 'Method 2 – Community Engagement', which is looking to demonstrate the value of providing LV network data and an 'open platform' to communities, housing associations and local authorities who want to be part of a smarter grid. Trials will take place in seven projects that want to use the OpenLV platforms to provide information and data to their community in order to better understand their electricity use (and generation) or exploit local supply options.

Regen's objective, as the Community Learning Specialist, is to:

1. Provide an assessment of the value and benefits of each community project and to assess the replicability of community projects using the OpenLV technology and data.
2. Review the learning generated by the community engagement and trial process in order to produce a guidebook so that other communities can start their own Community Project and develop/use an app to access data from the OpenLV platform.

Purpose of this report

This report is the first of three mid-trial reports for the OpenLV Method 2 community projects. The aim of this report is to monitor and report on Method 2 progress during the trial period.

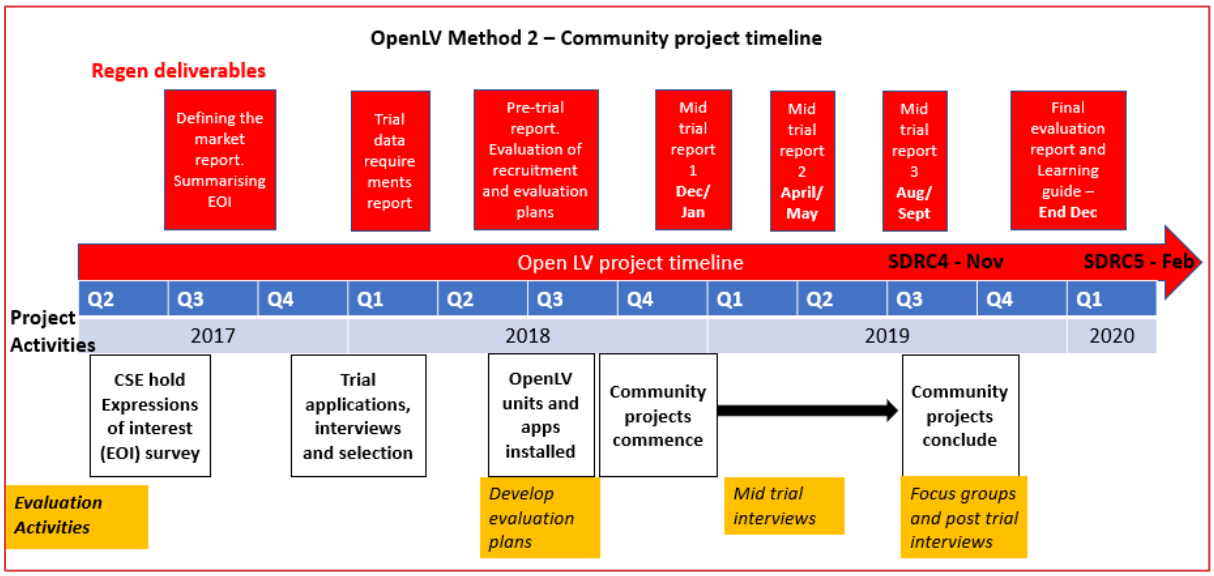
Through the three mid-trial reports Regen will be looking at key areas of the project relevant to learning for future innovation trials involving community groups or replicability for future community projects using OpenLV information.

- Mid-trial 1 focuses on initial project progress as well as community attributes and technology relevant to replication of trials with other communities.
- Mid-trial 2 will focus on a mid-point evaluation of learning and project outputs.
- Mid-trial 3 will focus on engagement in the communities and lessons from how best to communicate substation information.

Delivery timescales for these mid-trial reports are presented in

Figure 1-1 below.

Figure 1-1: Project timetable and Regen activities



Given the early stages of the trial it was agreed that this first mid-trial report would provide a short update about progress in the seven community projects as well as highlighting community and technology attributes in the trials that would be most relevant in understanding outcomes and replicability.

As the Method 2 Application (App) was launched in its final format in January 2019, this first mid-trial report also provides a short overview of the App development process and initial usage by the communities. A longer analysis of the App development including an assessment of community feedback about usage of the App will be included in the second mid-trial report which will be produced in April/May 2019.

Finally, the report also looks in more detail at the outcomes of the community projects and business cases in the context of national energy challenges of increasing the uptake of low-carbon technologies and managing network constraints.

Current progress with the community trials is summarised below:

- The Method 2 App developed by CSE was successfully launched in November 2018 with a workshop held for communities in December 2019 to explain the App and how to use it.

- New functionalities for the App were added in January 2019. These included an 'alert' feature so communities could send email alerts when the App detected certain parameters in the substation or externally (such as high carbon emissions). The App is also now able to process API[1] information from outside the OpenLV unit such as from local solar installations.

[1] Application Programming Interface

- The App has been working well, however some communities (Owen Square and Exeter) have experienced some issues with receiving data from the substations, which are now being investigated or have been resolved.

- All communities are using the App and logging in to see information regularly. CSE has reported that it has taken some communities a bit of time to understand and process the information they are receiving due to its detailed granularity.

- All of the Method 2 communities are still engaged with OpenLV and reporting progress on their projects. Both Bath and West and Tamar Energy Community started engagement activities prior to the launch of the App and have been particularly active.

- Progress in the projects is outlined in section 4 of this report, highlights include:
    - Bath and West have signed up 20 households who have expressed interest in the solar battery offer on the substation.
    - WHG have 14 residents of Little London House interested in the scheme to promote energy saving.
    - Exeter Community Energy have started developing the mobile phone application and are holding a workshop on 28 February 2019.
    - Tamar Energy Community have been working with the local school on the Tavistock substation and have started testing substation alerts on the Method 2 App.

2. Method 2 – Community App development

The seven OpenLV Method 2 projects were selected in Spring 2018 and all the OpenLV substation monitoring units were installed over the summer of 2018.

The Method 2 project scope originally anticipated that the communities involved in the trial would themselves develop Apps that processed the information being collected by the OpenLV units. However, it became evident in the early stages of the process that these volunteer and community organisations did not possess either the time or requisite technical skills to develop Apps.

It was subsequently agreed by EA Technology that CSE could develop a configurable App to be used by all the Method 2 participants to visualise and process information from the units. The community organisations then were able to focus their project activities on using this information for business cases or engagement events.

Learning: When working with communities it is important to have flexibility in the design of innovation trials. In this instance amending the process to include a third-party App developer allowed community groups to focus on their organisation's areas of interest and expertise including delivery of community engagement activities.

2.1 Development process

CSE's Method 2 App was developed after consultation with the communities. After their selection, the community groups were asked in a workshop what information and functionality they would value in an App, and how that information might be presented.

CSE then agreed the following key functionality that could be delivered within the Method 2 development budget:

- Being able to see graphical information about data trends at the substation – e.g. energy use over time.
- Integrate external data (such as from local or national generation) and present that, for instance, as the carbon intensity of electricity.
- An email alert function so community users can set parameters to alert when certain conditions are reached (e.g. low carbon or high voltage).
- A modelling function for tariffs that allows groups to develop models for local balancing between generation and supply.

Even though some communities did not originally wish to have an App, for example Marshfield (they had originally applied for a project only to see the downloaded OpenLV dataset), they have subsequently decided to use the App functionality and visualisation developed by CSE for the other communities.

Learning: Having communities working together, for example in the workshop for the App development, meant that they learnt from each other and potentially helped shape and improve project outcomes.

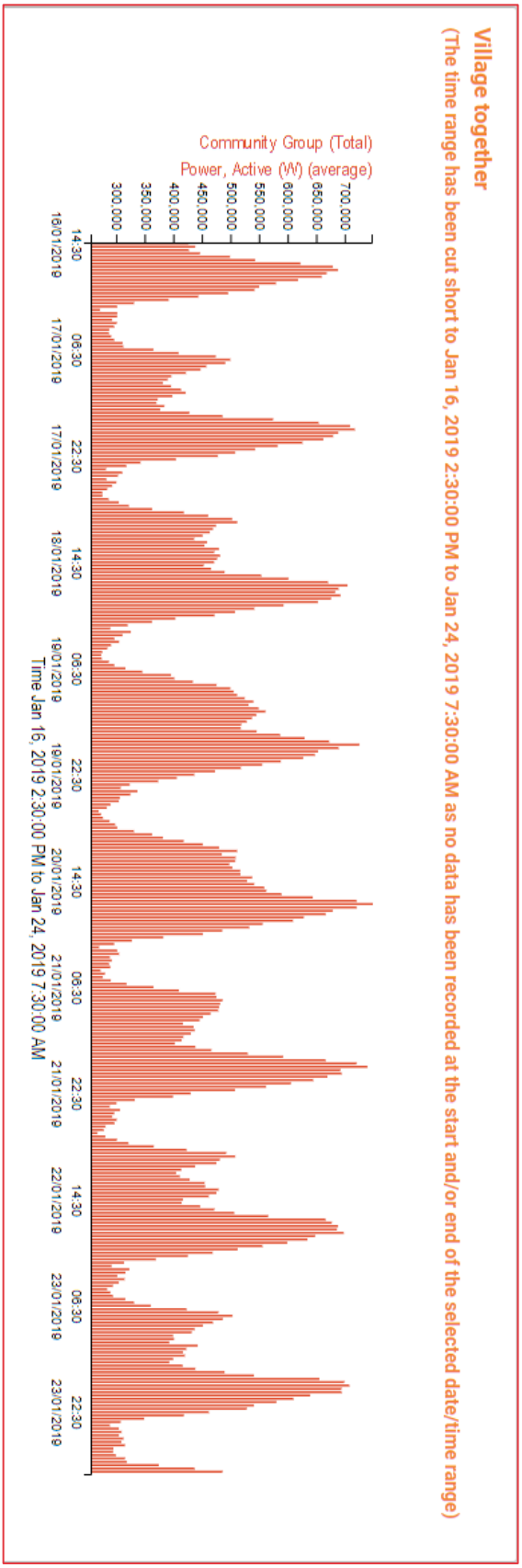


Figure 2-1: Marshfield 'total village' energy use downloaded from the App

The dataset provided by the OpenLV units was available from early September 2018[2] and the first iteration of the Method 2 App was available for communities to use from November 2018. A workshop hosted by CSE was held on 11 December 2018 to explain the App and help the communities understand its functions and usage to the trial communities.

In January 2019 a further iteration of the App was launched where projects were able to set up 'Alerts' about parameters at the substation, such as carbon emissions or voltage levels. An API function was also added that could display solar PV output from Solar Edge installations. The App also has the ability to estimate solar PV output for groups without Solar Edge installations.

2.2 Community use of the App[3]

As the App has been running for a short period of time, this section gives only an overview of initial usage of the App by the communities. A longer analysis of the App development including an assessment of community feedback about usage of the App will be included in the second mid-trial report.

All communities currently have the App configured to allow them to see the information from the OpenLV unit in a graphical form. **Error! Reference source not found.** shows an example of Marshfield village total energy use during a period in January 2019. The usage profile shows very clear peaks and troughs of electricity demand through working and non-working days.

January 2019 data suggests that the App portal itself has an average of 35 'visitors'[4] a day to the site. The use of the App itself currently varies across communities. In the dates between 20

[2] 10 or 11 September 2018 is the base data for most of the web Apps
[3] as at 28th January 2019
[4] Hits with the same IP address, date and agent per day are counted as a 'visitor'

December 2018 and 29 January 2019, the graph pages for each of the projects had the total 'visitor' numbers as outlined in Table 2-1.

Table 2-1: Summary of use of CSE App by Method 2 projects

Method 2 projects	App – number of graphs set up for analysis	Daily visitors to 'graphs' between 20.12.28 and 29.01.19	Number of alerts set up	Tariffs modelled
Bath and West	3	60	-	-
Exeter Community Energy	2	11	-	-
Marshfield	3	33	-	-
Owen Square	2	15	-	-
Rooftop Housing	1	9	-	-
Tamar Energy Community	3	46	2	-
Walsall Housing Group (WHG)	3	17	-	-

This data shows that the most active projects within that period were Bath and West, followed by Tamar and Marshfield. One community, Tamar, has started to configure an 'alert function' that sends alerts when certain parameters are met within the substation or externally. No communities have so far used the tariff modelling tool.

CSE's interactions with the communities suggest that since the launch of the App, community groups have been working to understand the format and information being provided to them. There is likely to be more usage of the App functionality such as alerts and tariffs, once they have been able to fully comprehend and manipulate the information for the purposes of their projects.

Learning: Community innovation projects need to build in extra time and support budget to help participants understand and process complex information such as the information being provided by the App.

3. National energy challenges

As well as intending to provide community benefits, the OpenLV community projects are expected to provide some important insights into how community engagement could help overcome some of the key national energy challenges.

Two key areas in particular are how community engagement with local energy information could increase the uptake of domestic level low-carbon technologies (LCTs) such as electric vehicles and heat pumps, which are important to help achieve the governments carbon emissions reduction targets. Secondly whether, in response to higher local demand from LCTs and increasing levels of distributed generation (mainly intermittent renewables), local and community engagement may help mitigate or delay the need for network upgrades by encouraging provision of local flexibility and demand and supply balancing.

3.1 Support the uptake of LCTs

The overall aim of many community energy organisations is to promote local solutions to climate change and other energy challenges such as fuel poverty.

In most cases this involves reducing the amount of energy being used and increasing the generation of electricity from low carbon sources. Most are also keen to develop opportunities for community and local ownership of renewables with the aim of allowing people to have a greater proportion of their energy consumption coming from low carbon, local sources.

The groups in the trial all represent a trusted local intermediary. Whether community energy or housing association representatives, the organisations are recognisable in the local area and able to use face to face engagement to increase awareness of issues or encourage behaviours. Furthermore, in engaged communities such as those hosting active community energy groups, the power of social normalisation will be important to encourage more take up of technologies such as electric vehicles or pro-environmental behaviours.[5]

Currently most community energy organisations see the energy challenge from a national perspective. Through the OpenLV project, communities will be able to see a further layer of complexity in the electricity system and understand the specific local network conditions. The projects will be operating both with an understanding of national carbon and energy challenges along with how their actions or technologies can impact on the operation of the local network.

For example, a number of the projects have a specific aim to increase the uptake of LCTs in their local area through technologies such as heat pumps (Owen Square), electric vehicles or new renewable generation (Marshfield) or solar with battery storage (Bath and West), amongst households served by their substation.

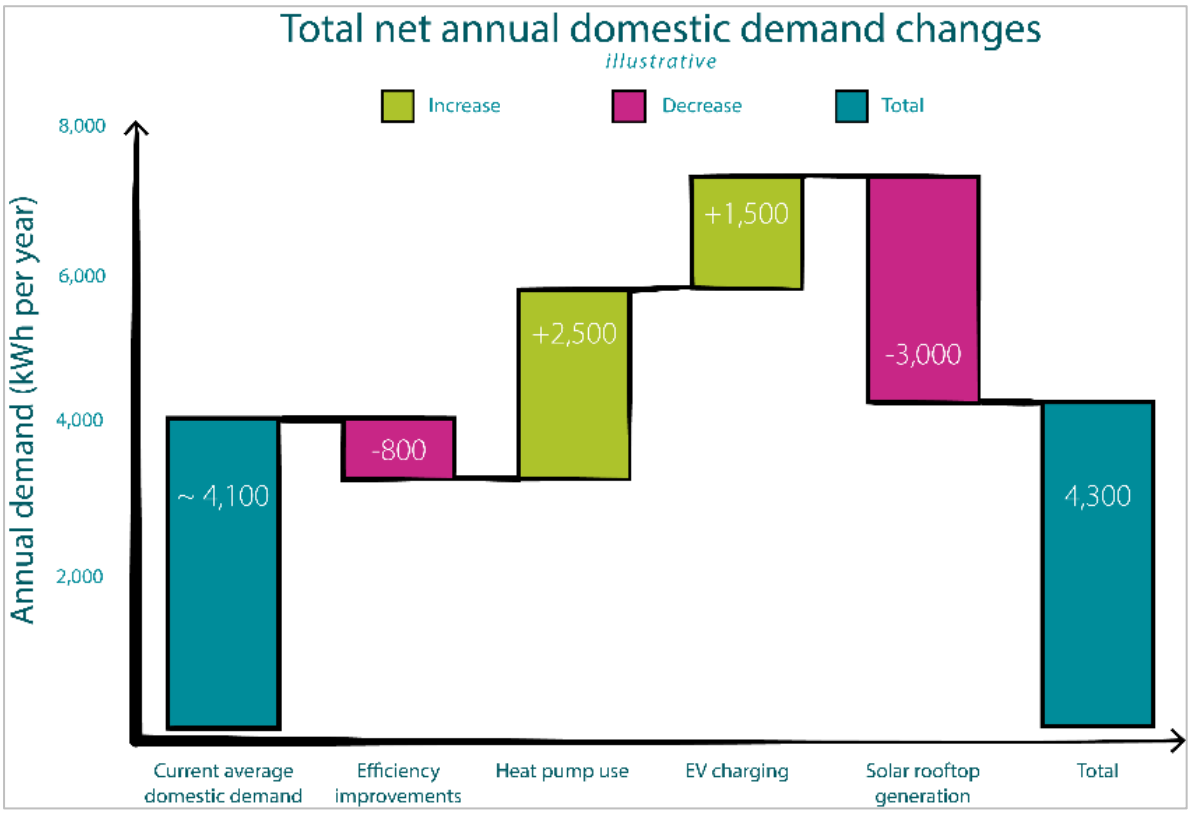
LCTs are important for achieving national targets, but it is anticipated that they may cause local network issues depending on how they are operated. The Bath and West project for example hopes to be able to test various impacts of the solar and battery configuration to understand the impact on the local network, potentially reducing the solar peaks.

[5] http://www.bbc.com/future/story/20170314-how-do-we-determine-when-a-behaviour-is-normal

3.2 Potential network benefits from projects

The UK are in midst of a major shift in how we generate, supply and use electricity. The energy system is moving away from a centralised generation where electricity flows from large plants connected to the transmission network to end consumers - towards a decentralised system where electricity flows both ways. Over the past decade, 20 GW of wind and solar generation has connected to the network, allowing more local matching of supply and demand and, in some cases, reversing the flows on the distribution network back onto the transmission grid. These changes have already caused Distribution Network Operators (DNOs) and the System Operator (National Grid) challenges in the way they operate their networks. These challenges are likely to increase as more distributed generation is connected, and as more households electrify heating and transport.

Figure 3-1: Illustration of LCT technologies and indication of changes in household annual demand



The distribution networks currently try to manage local issues with local commercially focused flexibility solutions, such as active network management, demand side response and alternative connections. However, there is potentially a large amount of flexibility that can be delivered by communities and households working together[6]. A number of the OpenLV projects are looking specifically at delivering network benefits and Regen has been exploring these opportunities for both communities and network companies through projects including

[6] https://communityenergyengland.org/files/document/169/1530262460_CEE_StateoftheSectorReportv.1.51.pdf

a guide produced for the Electricity Network Association[7] as well as through community energy events held for Western Power Distribution[8].

Traditionally, domestic consumers have had predictable demand profiles, however Figure 3-1 illustrates how much more electricity might be used over a year in a house with a number of LCTs installed. Both electric heating and transport will increase demand but houses with solar rooftop PV installed may be able to offset some of the increase. Solar rooftop however is unlikely to be generating electricity during times of peak electricity demand (usually winter evenings). As a result, flexibility solutions will be needed to manage fluctuations on the local network.

It is anticipated that some flexibility can be delivered over a 24-hour period by household level smart systems such as connected appliances, electric vehicle chargers or battery storage. This 'balancing' could also be done at a community level such as the community battery in Owen Square. Community organisations like those in the OpenLV trials are well placed to engage local residents in this relatively complex area.

In Marshfield, with the network already constrained for more generation they are looking at how potentially matching demand to supply locally (for example such as charging EVs and batteries during high solar load) might alleviate network constraints and allow the community to build more renewable energy.

Particular challenges for networks are however likely to arise with large increases in heating demand which, unlike electric vehicles is likely to be less flexible in terms of when heat can be delivered. High numbers of air source heat pumps may have this impact in some future scenarios.

[7] https://www.regen.co.uk/wp-content/uploads/Engaging_Community_in_Network_Innovation_WEB.pdf
[8] https://www.regen.co.uk/wp-content/uploads/WPD-DNO-DSO-community-consultation-report-designed.pdf

Figure 3-2 illustrates the significant demand peaks currently caused by electric storage heating being used to heat the flats in Little London House. The graph clearly shows the electric heating being switched on more regularly due to the colder weather towards the end of 2018 and early 2019.

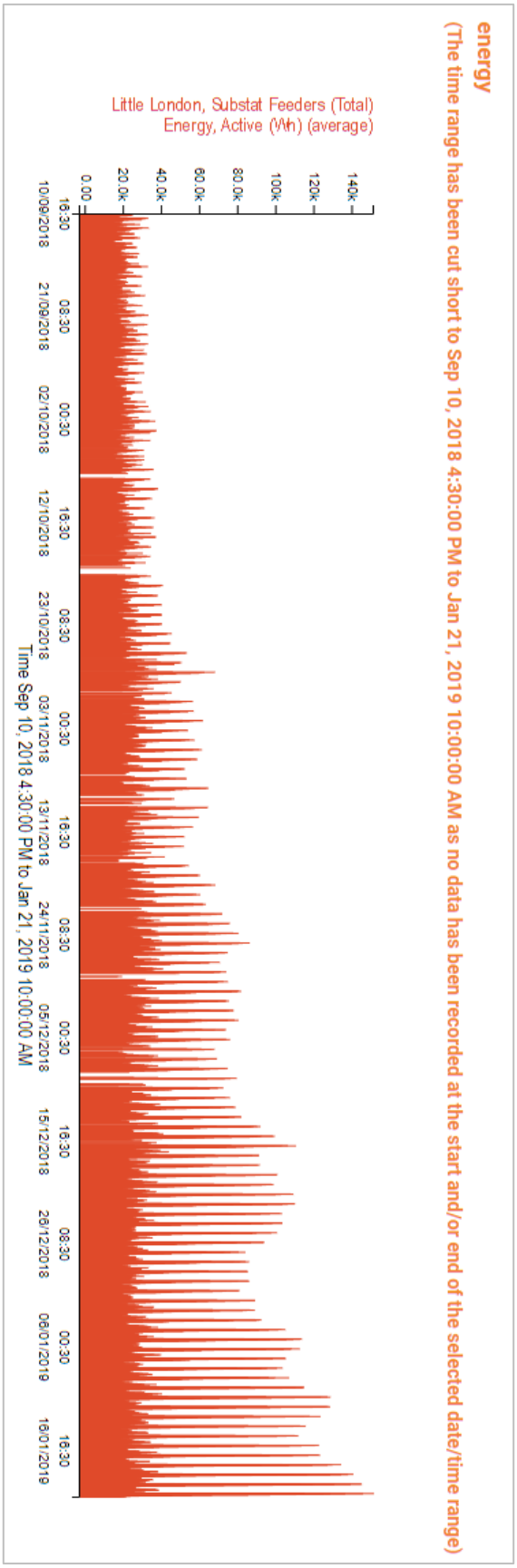


Figure 3-2: Little London House – total electricity usage profile Sept 18 to Jan 19

These electric heating demand peaks could become significantly more widespread in the future with electricity demand being concentrated at certain times or months of the year.

The Freedom project being run by WPD, with Wales and West Utilities, is looking at whether hybrid heat pumps installed domestically could be an important source of flexibility, as the electric heating demand is able to shift onto gas when there is a network need. Local substation data, such as that provided by OpenLV technology, is likely to be an important factor in the programming of these hybrid systems and their ability to provide important domestic flexibility services.

Communities are a largely untapped resource to help network operators deal with these challenges and use flexibility or smart systems to balance the network. Owen Square are also looking to offer more flexibility particularly with heating using thermal storage with heat pumps. Another OpenLV project (WHG) is looking at behaviour change and new electric storage heating to help residents manage their electricity use over the winter.

There is a clear message from communities within and outside the OpenLV trial that want to be involved in the changing energy system, but they need support and early engagement in decision making to better understand what network operators require and what network benefits they are able to provide[9]. Communities involved in the OpenLV trial have the opportunity to benefit from such engagement, using substation data to gain an understanding of the network services they could provide and whether there might be potential gains for households or communities that participate.

[9] Western Power Distribution communities consultation https://www.regen.co.uk/wp-content/uploads/WPD-DNO-DSO-community-consultation-report-designed.pdf

4. Method 2 project progress

4.1 Bath and West Project Summary

4.1.1 Introduction:

The Bath and West project centres on two urban low-voltage 6.6 kV substations and particular feeders within them, Bloomfield Avenue, which serves between 100 and 120 households, and Elm Place, which is concerned with a feeder serving around 60 households. As part of their Solar Streets initiative, Bath and West plans to install solar PV and battery storage systems on approximately 30 of these houses, at a reduced cost to residents. Using OpenLV data in conjunction with the scheme, they will monitor the impact these installations have on the local substation.

Many of the households on which the solar battery installations will be trialled are owned by BWCE members, and the project will be relying on these individuals to engage fellow residents and community members in their energy use.

Bath & West Community Energy
Generating local energy

Bath & West Community Energy (BWCE) is one of the leading community energy groups in the UK.

They have installed over 20 MW of solar PV projects since their formation in 2010. They currently own 12.35 MW of their own PV capacity.

Over the next 3-4 years, BWCE aim increase community renewables capacity, raise their local profile and develop innovative approaches to local energy markets, which has included launching a local energy supply tariff with Our Power.

The BWCE team consists of five non-executive directors, two executive directors, two co-opted directors, two employees, 16 volunteers and 650 members.

4.1.2 Community attributes[10]

The LSOA[11] area around the trial substations has 117.3 kW of domestic Feed-in Tariff PV capacity installed. There are PV installations on around 2-3% of houses. The substation area is relatively wealthy with low deprivation and high median house prices (£561,250 around the Elm Place substation)[12]. However, the older houses in the area mean that they also have the lowest EPC ratings of the seven trials and 28 properties around Elm Place substation are reported to be electrically heated. The areas have relatively high average electricity use, both above 4,000 kWh a year.

4.1.3 Project objectives

1. To develop a deeper understanding of how community energy organisations can be instrumental in encouraging people to install domestic solar PV or domestic storage, and their role in the energy system as whole.
2. To gain a better understanding of the business models open to BWCE.

[10] To note that all data and references in this attributes section are detailed in the section 5.

[11] The Lower Super Output Area (LSOA) is used for census processing and has around 800 houses

[12] https://www.ons.gov.uk/census/censustransformationprogramme/administrativedatacensusproject/administrativedatacensusresearchoutputs/populationcharacteristics/researchoutputsincomefrompayasyouearnpayeandbenefitsfortaxyearending2016

4.1.4 Progress so far

Engagement with the community has initially been carried out with two public meetings in November 2018 for interested residents to learn more about the solar PV and battery installation offer. Expression of Interest forms have been sent out asking residents whether they are interested in having solar PV and a battery, and how engaged they are in understanding their energy use and energy efficiency behaviour. These were followed up by surveys on energy use completed by solar PV installers Moixa.

Currently 20 households have signed up to the installation and a formal offer will be made at the end of January, or early February 2019.

4.1.5 Outcomes and evaluation

The aim of this engagement, as well as kicking off the solar battery installation scheme, is to gauge community attitudes to energy use and establish a base for measuring behaviour change, which will allow Bath and West's staff to log behaviours during ongoing engagement throughout the project.

The project has three key areas where they are focusing efforts:

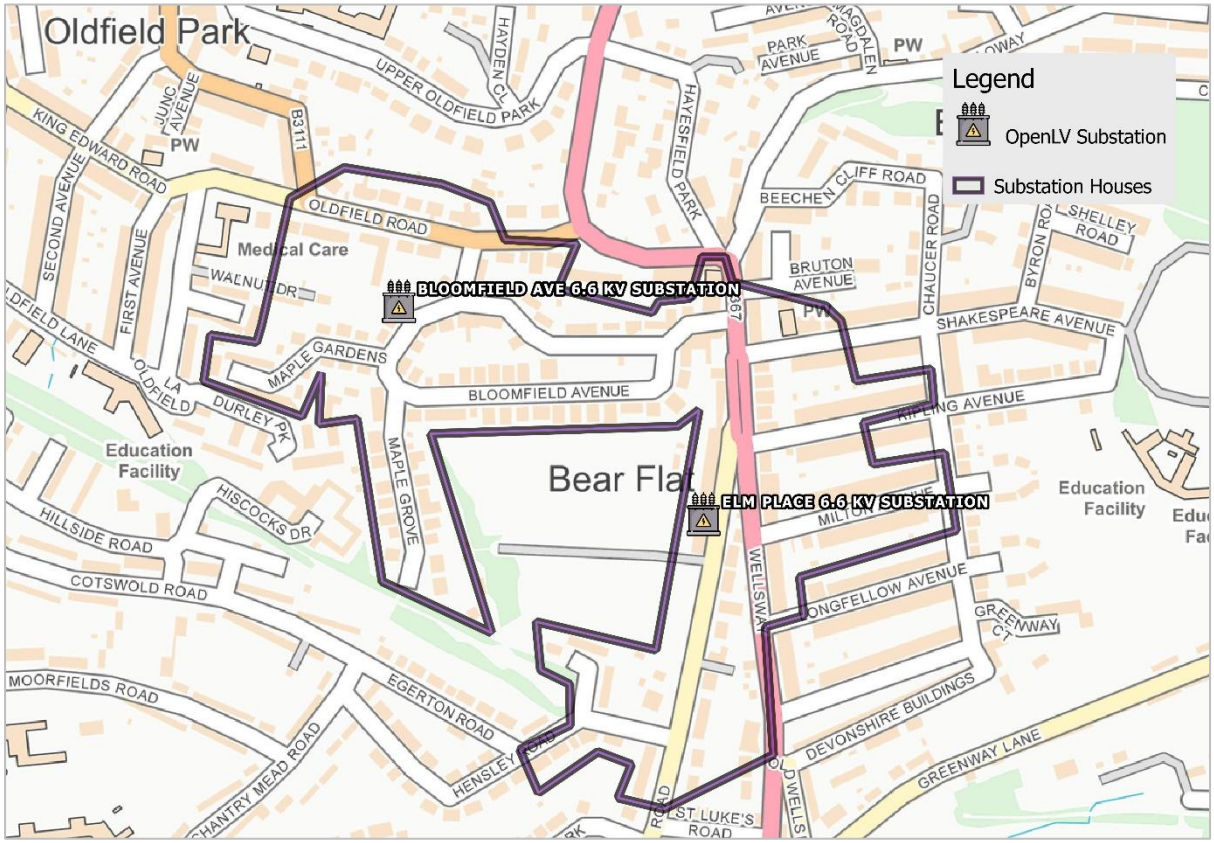
1. Changing how much energy residents use.
2. Changing the times residents use energy.
3. How residents work with neighbours and their local community around energy issues, liaising with an external organisation.

The outcomes of these behaviour change objectives are two-fold. Firstly, to measure the impact of energy use and behaviour change on the substation data, and secondly to build a business case for further solar battery installations on households.

Aside from behaviour change outcomes, data from the substations will also prove the impact of domestic solar batteries on these substations, helping Bath and West understand how they could provide future network services and earn additional revenue.

These outcomes will then be evaluated by Regen at the end of the trial through both qualitative and quantitative methods. An online survey will be designed, aimed at local residents to establish their changes in energy behaviour, and compared with the findings from the pre-trial survey. The quantitative evaluation will come from substation data, before and after the domestic solar battery installations, to measure their impact. Together, this evaluation will be able to measure the extent to which the Bath and West project has achieved its overall project objectives, and key behaviour change objectives which make up part of this.

Figure 4-1: The OpenLV trial area looking at two substations in Bath



4.2 Tamar Project Summary

4.2.1 Introduction

Tamar Energy Community (TEC) have named their project 'The Power in Your Hands'; they want to use the OpenLV data from their local substation, Meavy Way, to raise awareness in their local community in Tavistock and try to influence the energy behaviour of their residents. This raise of awareness forms a key part of their mission to localise energy, as they can use the data to inform people about local energy issues such as the higher emissions associated with their electricity use at peak times and the value of smoothing energy demand curves.

Tamar Energy Community (TEC) is a community energy group based in Tavistock, Devon, formed in 2014. As a community-run social enterprise, they provide free and impartial energy advice and support to people in West Devon and South East Cornwall.

Their mission is to localise energy, keep the money spent on energy in their local economy and help vulnerable people in fuel poverty. As part of this mission, TEC installed 265 kW of solar PV on rooftops in their community in 2016, with their team of 13 active volunteers.

4.2.2 Community attributes[13]

The LSOA area around Meavy Way has 44 kW of rooftop PV, on around 2% of houses. The substation area is however rated as fairly deprived (4/10) with over 4% unemployed. The houses have a relatively high median Energy Performance Certificate with 86% rated D and above[14]. With a relatively low average electricity consumption compared to the other trials (3,200 kWh a year), nearly all properties have gas central heating.

4.2.3 Project objectives

1. To raise awareness of local energy issues and engage the community in their energy behaviour.

2. To determine the potential for a time-of-use-tariffs (TOUT) for residents.

This project is fundamentally about raising awareness, and TEC want to see what difference the availability of data makes to households and their energy behaviour. To do this, they have been door knocking in the community around the Meavy Way substation and sent out a survey to gauge attitudes.

This secondary objective for TEC's project fits in well with their regular fuel poverty work in Tavistock and the surrounding area, as potentially developing a local TOUT could help residents save money on their energy bills, and better balance demand with generation from domestic PV installed on homes connected to the Meavy Way Greenlands substation.

People in this community can easily log on to the OpenLV App that has been developed to see local substation data and the impact their energy use has on its performance, identifying the best time of day to switch on high electricity consumption appliances in their homes. This could then enable TEC to move the conversation on in their community and get people

[13] Data and references are outlined in section 5.
[14] http://opendatacommunities.org/home

thinking, for example, about time shifting their energy use patterns, opening the door to the development of TOUTS for local residents.

4.2.4 Progress so far

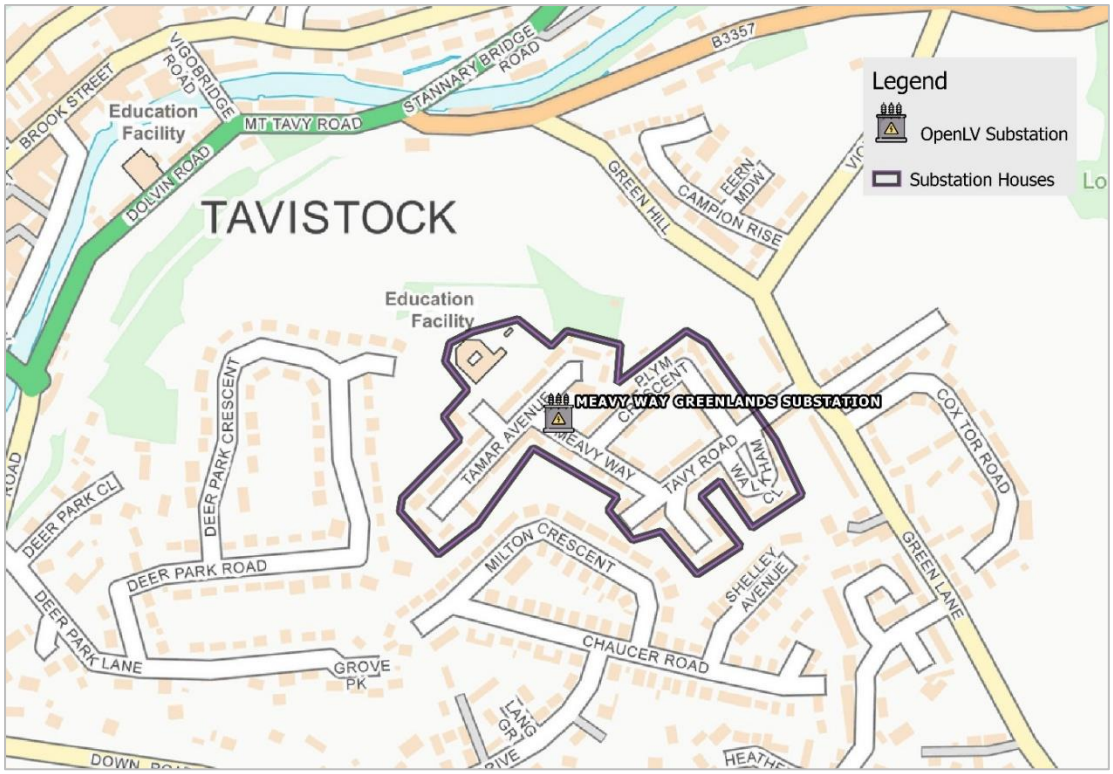
TEC have already been working closely with Tavistock College and St Peters Junior School in the Greenlands area of Tavistock as part of The Power in Your Hands project, with information from the OpenLV web app to be displayed on a screen in the local school. Both the school and the college have rooftop solar, allowing TEC to monitor the impacts of their solar PV on the local substation at Meavy Way. As part of their community engagement, they also run an eco-club in St Peters school and workshop sessions at Tavistock College, where their renewable energy education programme is supplemented by information from OpenLV which has now been uploaded on the project website: http://tamarenergycommunity.com/test/

As of 28 January 2019 the group had also set up two App alerts 'reduce energy use' and 'transformer too hot' to be sent to alert email addresses when parameters are met.

4.2.5 Outcomes and evaluation

The project objectives will be evaluated by Regen at the end of the project. This will include an online survey to gauge attitudes to understand the behaviour of residents towards energy use, in comparison to the start of the trial. Another key evaluation metric will be the number of people signed up to receive alerts from the OpenLV App, helping to understand how many people became engaged in energy issues and modified their behaviour. Regen and CSE will also hold a focus group with community participants in the trial to understand or confirm the level of attitudinal or behaviour change.

Figure 4-2: Tamar's substation and connected buildings in Tavistock, Devon



4.3 Exeter Project Summary

4.3.1 Introduction

The Exeter Community Energy OpenLV project aims to develop a smart phone app for users in the local area (Topsham) to inform them of energy use at the substation level, local energy generation and National Grid carbon intensity. The app will then provide alerts to users' phones to encourage users to change their energy behaviour.

The aim is that the availability of data will encourage local consumers to alter their energy use patterns in order to use more local electricity and at times of day associated with lower carbon intensity and potentially cheaper electricity, such as off-peak. One of the goals of the app would be to see how much consumers could save on their energy bills by changing their energy behaviour in accordance with local substation data.

Exeter Community Energy (ECOE) is a community energy group started in 2014 by a group of eight local people, springing from Transition Exeter.

Their main projects have included community solar, Solar PV 1 and 2, with 300 kW installed on rooftops across Exeter, and Healthy Homes for Wellbeing, helping local people to lower their energy bills and alleviate fuel poverty. ECOE are also currently exploring developing a hydro project at Trews Weir on the River Exe, and Solar PV 3, the next stage of their solar project.

4.3.2 Community attributes[15]

The trial area in Topsham has an elderly population, with 36% of residents over 65[16], and very low levels of registered unemployment. The housing stock is mainly terraced housing with a median EPC rating of 64[17]. A third of the properties are registered as having electric heating and the average electricity use is around 3,600 kWh per year.

The area is the only one in the trial with no registered solar rooftop PV in the surrounding LSOA area.

4.3.3 Project objectives

1. To develop a mobile phone application for residents to use.
2. To encourage behaviour change as a result of mobile app information or alerts.

The mobile phone application is intended to be available for smart phone users right across the community in Topsham, not just those in homes connected to the Topsham Local substation. This means that the availability of OpenLV data is not expected to have an impact on the substation.

4.3.4 Progress so far

The group has had problems accessing data from the CSE web App and as a result the engagement activities have been delayed.

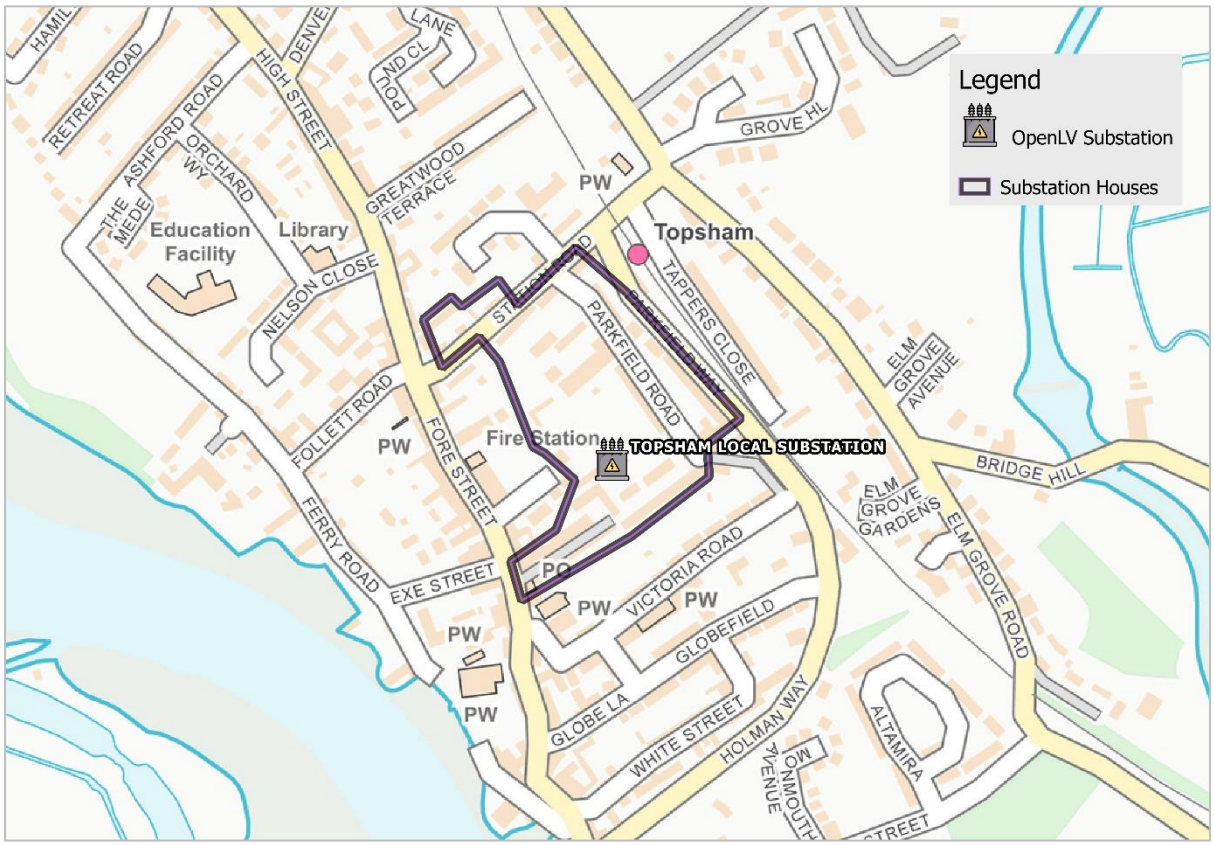
[15] Data and references are outlined in section 5.
[16] https://www.ons.gov.uk/census/2011census/2011censusdata/2011censusdatacatalogue
[17] http://opendatacommunities.org/home

However, project partner Q-Bots have been working to develop a prototype mobile App and a focus group has now been arranged for 28 February 2019 in Exeter. This event will gauge interest amongst the community in downloading and using a mobile phone application to monitor their energy use, in order for them to go ahead with the next phase of the mobile phone application development.

4.3.5 Outcome and evaluation

A key metric for the evaluation of this project will be the development of the mobile phone application, and the number of registered users, along with behaviour change amongst residents in the community. The first objective will be straightforward to measure quantitatively, while running a focus group at the end of the trial in the community will be done to establish behaviour changes and gauge any changes in attitudes to energy use.

Figure 4-3: The Exeter Community Energy project is focused in Topsham, south of Exeter



4.4 Owen Square Project Summary

4.4.1 Introduction

The Owen Square OpenLV project differs from some of the other community projects in that, rather than focusing on community engagement in energy use, they want to gain a technical understanding of how heat pumps for thermal storage in a local area can work economically. Owen Square want to use OpenLV substation data (from Kilburn Street substation) to help build a business case for installing heat pumps which has so far been problematic financially, with the data supporting their model and backing up funding bids.

Owen Square Community Energy (OSCE) is a co-operative local energy supply company ran by Easton Community Centre, Easton Energy Group, an urban community energy group in Bristol, and microgrid developer Clean Energy Prospector.

Their mission is to supply low-carbon heat and electricity to homes and businesses in the Easton area of Bristol, promote the uptake of low-carbon energy and support energy efficiency amongst their customers.

They are based around Owen Square Park in Easton, a densely populated but relatively deprived urban area, and a young population, with 26% of residents under 16 years old.

In 2019 they plan to offer three energy tariffs to local residents as part of a virtual microgrid and new physical electricity networks, which will all come with solar panels and some with air source heat pumps for each household that signs up.

4.4.2 Community attributes[18]

The surrounding LSOA area already has 49.76 kW of domestic solar PV capacity installed and Owen Square report 43 kW of which is connected to the substation along with 140 kWth heat pump and thermal store [19].

The area has a high deprivation score of 2/10 and high unemployment rate of 7.8%.

67% of homes in the trial area are terraced housing[20] rated either D or E. The majority are gas heated and electricity use in the area is the lowest in the trials at under 3,000 kWh a year.

4.4.3 Project objectives

There are two main activities that the project will perform from OpenLV data:

1. Substation data analysis and modelling.
2. Developing a business model to demonstrate to grant funding providers.

4.4.4 Progress so far

The Owen Square project had experienced issues with poor mobile signal stopping data being received by the App. An external mobile signal aerial was fitted in January 2019 and is understood to have resolved the signal issues.

The project has been analysing data from the unit and using the information to understand their local energy network to develop a business case for further projects.

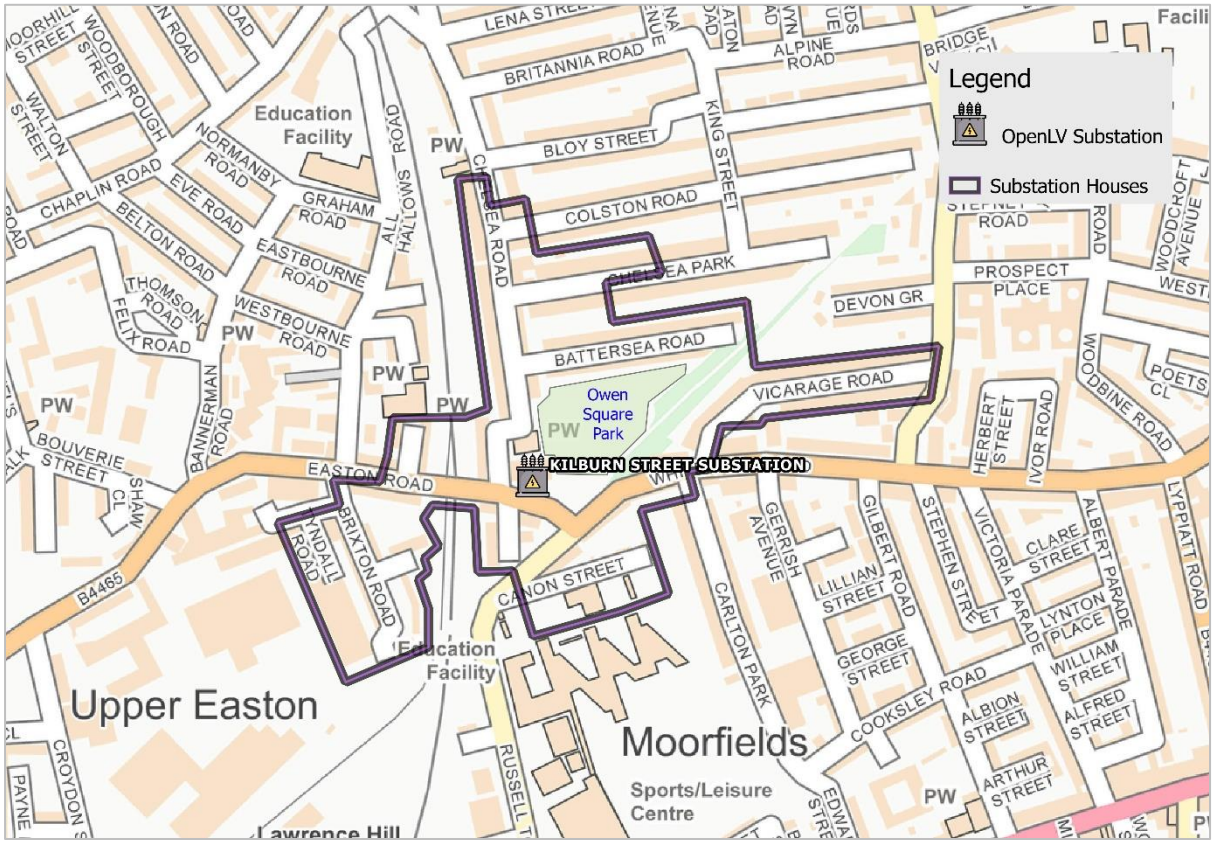
[18] Data and references are outlined in section 5.
[19] https://www.ofgem.gov.uk/publications-and-updates/feed-tariff-installation-report-30-june-2018
[20] https://www.ons.gov.uk/census/2011census/2011censusdata/2011censusdatacatalogue

4.4.5 Outcomes and evaluation

One of their concepts which was proposed to the Department for Business, Energy and Industrial Strategy (BEIS) in July 2018 was using OpenLV data to do demand response using virtual thermal batteries, which during winter could respond to demand constraints at all levels of the network. OSCE received Phase 1 funding from BEIS for this concept but not for Phase 2, and as such are using OpenLV data as a useful part of their bids to alternative funders, such as Power to Change's Next Generation fund. Being able to see the electricity demand in the local area from the 358 homes connected to the Kilburn Street substation is a crucial part of these bids, as it gives more certainty to funders and makes the business case more compelling. Once the data is analysed and modelled to see how much low-carbon generation the substation could support, it can then tell Owen Square whether heat pump retrofit and additional solar panels would be feasible.

Regen's evaluation of the Owen Square project will consist mainly of interviews with the project team at OSCE on how OpenLV data has helped the community to develop their business case for heat pump thermal storage and additional solar panels. This will focus on how the data made clear local energy needs, supported funding bids and aided planning for future investment in local low-carbon generation.

Figure 4-4: The Owen Square project is in the Easton area of Bristol



4.5 Marshfield Project Summary

4.5.1 Introduction

Marshfield is a village of around 800 households in Gloucestershire, close to the Chippenham and the Wiltshire border. The project is unique in the OpenLV trial in that it is monitoring four substations across the entire community of Marshfield. The village already has an active energy group that has developed renewables in the village. As a community they are keen to develop more renewable energy projects, however the village is currently constrained from adding new generation by the local network.

MARSHFIELD ENERGY GROUP

Marshfield Energy Group is volunteer-led, with support from the Community Land Trust.

The local community has been active in installing renewable generation with the local primary school installing a 12 kW wind turbine and there are 30 domestic PV installations in the village ranging between 3-4 kW each.

The community group has undertaken research in the past looking at installing further renewable generation in the village. Exploring the potential for a solar farm, wind, and anaerobic digester.

4.5.2 Community attributes[21]

The Marshfield area is relatively affluent and has both low deprivation (rated 10/10) and low unemployment (2.1%). Feed-in-tariff data estimates that the community has solar PV on 5.1% of the houses, the highest in the Method 2 projects.

Energy efficiency is mixed across the four substations, both St Martins and Hay Street have fewer high rated houses with 33% rated E or below. The average energy use across the village is relatively high, nearly 4,300 kWh per year.

4.5.3 Project objectives

- To develop a deeper understanding of distribution network in the village and which substations are under stress, and under what conditions.
- To develop a village wide energy strategy and further renewable energy projects if the network allows.

4.5.4 Progress so far

The Marshfield project has been actively analysing the OpenLV datasets for each of the four substations. They are also measuring or estimating the renewable energy generation in the village and how to visualise that with the substation data.

The group have also developed posters for engagement events showing an OS map of the village along with a feeder map of the substation areas in order to help residents understand the local network infrastructure.

4.5.5 Outcomes and evaluation

The key objective for the Marshfield project will be to use the data to understand the level of outages currently experienced in the village. The data produced by the OpenLV unit will be correlated to the level of low-carbon technologies installed and any outages experienced in

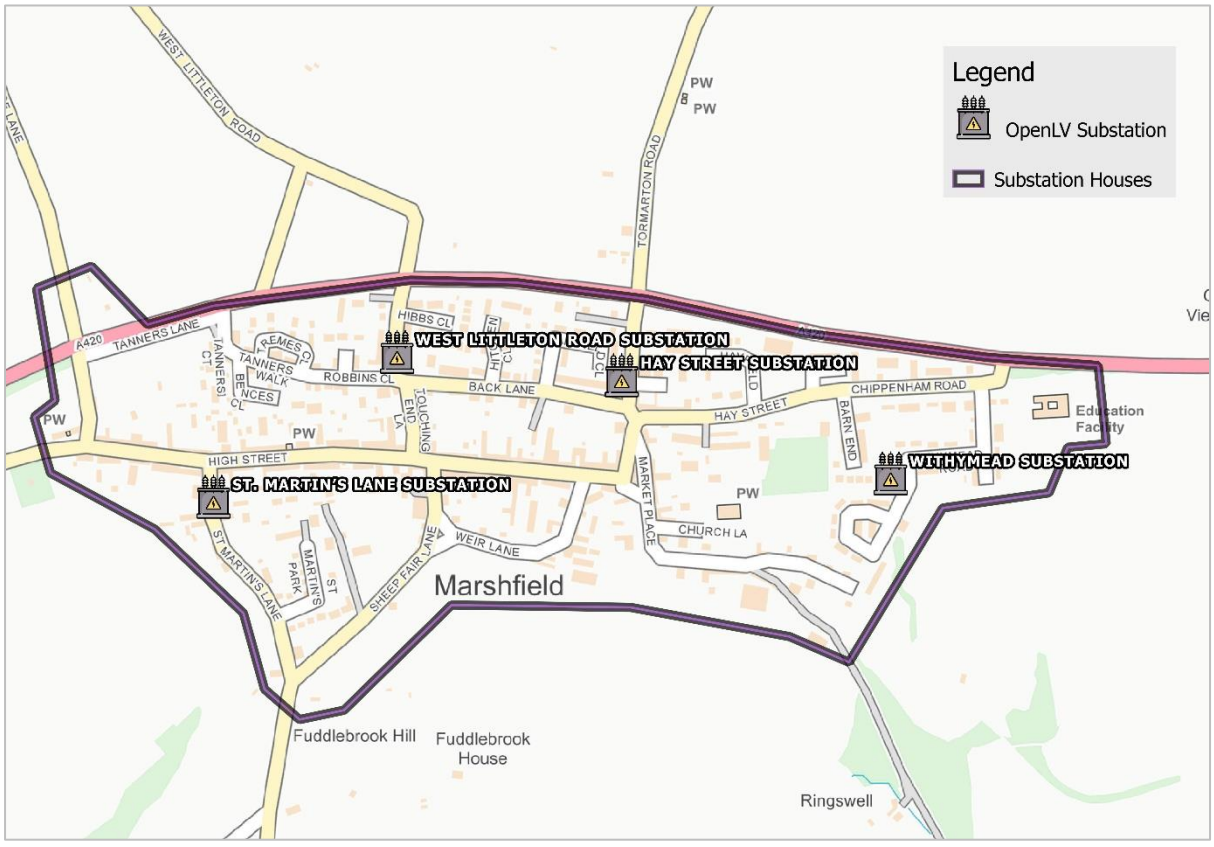
[21] Data and references are outlined in section 5.

the village. By the end of the trial period the project group hope to reach a good understanding of the drivers of any outages and have discussed this outcome with WPD.

A further objective for Marshfield is to use the data to provide an evidence base for the development of a village-wide energy strategy. With the area currently network constrained, they are unable to connect further significant generation within the village. Their strategy would look to potentially explore local flexibility to increase network capacity for additional renewable energy installations, this might include TOUTs, EV rollout and potential storage solutions.

The two key objectives for Marshfield will be evaluated through an evaluation interview at the close of the project. This will be held between Regen and the project team in Marshfield. This interview will focus on whether they and WPD were able to better understand outages and how the community was able to use the data to better understand their local energy needs and challenges.

Figure 4-5: The four Marshfield substation locations



4.6 WHG

4.6.1 Introduction

WHG is a housing association that own and manage Little London House in Walsall. Little London House is a tower block with around sixty flats which are occupied by low-income residents. The heating for the block is provided by electric storage heaters.

The OpenLV unit is monitoring three feeders in the local substation (Little London substation) that supply the block. The three feeders cover the flats in the top, middle and lower sections of the block.

Walsall Housing Group (WHG) are a West Midlands Housing Association who own and manage 21,000 homes.

They are committed to providing affordable, good quality homes and community-based services to the local community.

As part of their local community offerings, WHG have an Energy Champions initiative who offer residents free, personal support for customers struggling to keep their homes warm or to pay their energy bills.

4.6.2 Community attributes[22]

Little London House substation is in a relatively deprived area of Walsall (rated 2/10) and the unemployment rate in the immediate area is a very high 16.5%.

The block itself has mainly working age residents with only 3.4% registered as under 16 and 17% over 65. There are only two homes with rooftop solar in the immediate area and none currently installed in Little London House. Most notably the properties in the trial are all electrically storage heated and therefore the substation has the highest average electricity use of all the trials of 7,123 kWh per year.

4.6.3 Project objectives

- Through the project WHG are hoping that residents will be engaged to better understand TOUTs such as Economy 10 to reduce bills from running night storage heaters and general electricity use.
- WHG are also hoping to receive data on electricity usage in the block to support rollout of heating upgrades or energy investments planned there and in similar properties.

4.6.4 Progress so far

- WHG have already recruited 14 Little London House residents interested in energy and prepared to take actions as part of the project.
- They have also now developed a programme for customer engagement and decided how best to use the OpenLV data while working with this group to reduce energy use for heating.
- The heating upgrade of the night storage heaters had been on hold towards the end of 2018 but it had been confirmed that the new Dimplex Night Storage Heaters were expected to be installed before Christmas.

[22] Data and references are outlined in section 5.

4.6.5 Outcomes and evaluation

The project will explore how communication with residents, including via mobile phone texts, influences behaviour, particularly with regard to shifting electricity use away from peak times. The overall aim is to raise awareness about energy use and help residents control their expenditure on electricity.

The focus of the evaluation plan will likely be both a focus group with the participating residents as well as an analysis of the OpenLV data which may illustrate the impact of the installation of new night storage heaters as well as whether the engagement with residents changes the profile of usage on the substation during off-peak periods.

Figure 4-6: The substation and location of Little London House, Walsall

4.7 Rooftop Housing

4.7.1 Introduction

Rooftop Housing are a charitable housing association who are using the OpenLV unit data to support an 18 month modernisation programme of a housing estate in Bishops Cleeve, Cheltenham. Of the 183 properties on the housing estate 80 to 90 of these are owned by Rooftop. The project particularly hopes to engage residents with information about use of electricity and carbon intensity to encourage behaviour change and energy efficiency.

Rooftop will be using active residents to deliver the project along with a dedicated estate manager.

Rooftop Housing Group are a charitable housing association which focuses on provision of affordable housing for all household types and needs. Rooftop manage 6,000 properties and their main area of operation is in Worcestershire and Gloucestershire.

As a not-for-profit organisation, Rooftop reinvest surpluses back into the local community by building new homes, improving existing homes and supporting community initiatives.

4.7.2 Community attributes[23]

The majority of the properties in the trial are semi-detached houses or flats. The properties have the best reported energy efficiencies in the trial with nearly 90% rated D or above, and all are believed to have gas central heating.

Although the housing association residents themselves are low-income, the rooftop housing trial area sits in an area of relatively low deprivation (rated 8/10) with 3.4% of houses in the area registered as having rooftop solar PV.

4.7.3 Project objectives

- Rooftop are looking to engage residents and local community on energy use and behaviour change.
- The housing association are also interested to investigate the impact of the modernisation they are undertaking in the estate and build a business case for investment in energy efficiency of housing.

4.7.4 Progress so far

- The project has held some early engagement events in 2018 but further events were delayed until they were able to start to use and understand the outcomes of the substation data and App.
- The original estate manager went on maternity leave in early December but a replacement has now been hired and is getting up to speed with the project.

[23] Data and references are outlined in section 5.

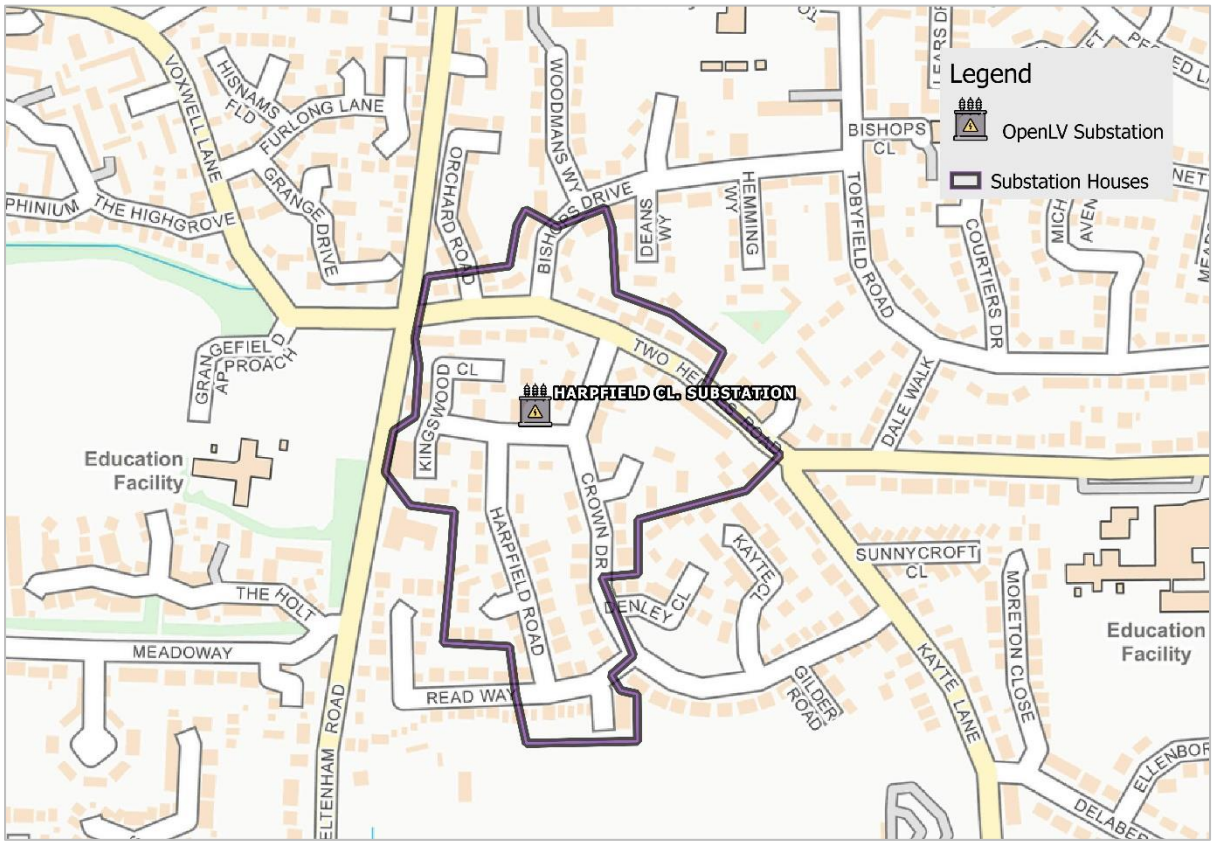
4.7.5 Outcomes and evaluation

Within the Rooftop housing project, the aim is to develop an engaging format to share the substation information with the residents with the aim of raising awareness of energy use and change behaviour of the residents.

The key deliverables for this project will be engagement events for the local community. The focus of the evaluation plan will be to understand whether and how much the engagement activities using OpenLV data have been successful in changing understanding or behaviours of participants. This will be done in two ways, first encouraging the use of attitude and behaviour tracker questions that have been developed for the trials during community engagement activities – and comparing results achieved at the beginning and at end of the trials.

The second approach will be to hold a focus group with community participants in the trial hosted by Regen and CSE. The focus group will be used to understand or confirm the level of attitudinal change. Findings from the trial will be feeding into an approach to tackle fuel poverty across Rooftops 6,000 properties.

Figure 4-7: Substation location in Bishops Cleeve



5. Commentary on community attributes

Detailed geographical, social and energy attributes of the trial communities are important in order to understand the potential for replicability of community projects in other similar communities following the trials. Some notable attributes are highlighted below.

Heating technology

Data from Energy Performance Certificates in the localities of the substations suggest that the majority of the sites have domestic properties with mainly gas central heating. The highest number of electric storage heaters is recorded in Little London House but there were also significant numbers in Topsham (over a third of EPCs identify these) and in Elm Place, where around 20% of heating is from electricity. Only two air source heat pumps were found, one in Bath and one in Tavistock.

Electricity usage

The highest electricity usage was found in Little London House with over 7,000 kWh, nearly double of the other trial areas. This is due to the properties having electric storage heating. The second highest was recorded in Elm Place which also had a number of electric storage heaters. Topsham, with a third of the properties electrically heated, did not have significantly higher electricity usage than gas heated substations.

Rooftop solar PV

The highest recorded levels of rooftop solar PV were in Marshfield where Feed-in-tariff data was used to find around 5.1% of properties had installed solar PV. Both Elm Place and Bishops Cleeve had the next highest, both recording 3.4% of houses having solar rooftop PV. The substation in Little London House and in Topsham recorded no rooftop solar PV.

Energy performance certificates

Harpfield Close and Meavy Way had the most efficient housing stock with the highest ratings for Energy Performance Certificates completed in the area. 89% and 86 % respectively were rated D or above. The least energy efficient houses in the trials were those in Bath, Bloomfield Avenue and Elm Place which have over 40% being rated E or lower. Little London House has the majority of the properties rated D (66%) but also had the lowest number of properties rated C or above (6%).

Demographics

The Exeter community in Topsham has a high older population with 35% over 65 along with the lowest level of economically active unemployment at 0.7%. Kilburn Street in Bristol has the highest proportion of under 16 at over 25%. In contrast Little London House has less than 5% under 16 and the highest unemployment rate at 16.5%.

Affluence and deprivation

Deprivation has been measured using the Index of Multiple Deprivation by LSOA and has bandings where 1 is the most deprived (the lowest 10 per cent of LSOA areas) and 10 is the least deprived areas in the UK. Four of the seven community projects are in the higher bandings, with two projects, Marshfield and one Bath and West substation being rated as 10. Notably these areas also had the highest levels of solar rooftop PV. Three of the projects are in the lower half of the deprivation scale, Meavy Way in Tavistock was rated 4 and WHG area in Walsall and Kilburn Street in Bristol were the lowest rated as 2. There were no middle-income communities between 5-7 IMD.

Table 5-1: Energy rating of homes in substation areas receiving Energy Performance Certificates[24].

Project names	Substation	B	C	D	E	F	G	Rated C or above	Rated D or above
Bath and West Community Energy	Bloomfield Ave 6.6 KV		17%	36%	32%	12%	3%	17%	53%
	Elm Place 6.6 KV	1%	9%	50%	33%	6%	2%	9%	59%
Rooftop Housing	Harpfield Cl.	5%	37%	47%	8%	1%	1%	42%	89%
Exeter Community Energy	Topsham Local	7%	36%	40%	14%	3%	1%	43%	82%
Owen Square	Kilburn Street	2%	13%	52%	26%	5%	1%	15%	67%
WHG	Little London		6%	66%	19%	8%		6%	72%
Tamar Energy Community	Meavy Way Greenlands		34%	52%	11%	3%		34%	86%
Marshfield	St Martins		16%	51%	28%	5%		16%	67%
	West Little	3%	32%	43%	19%	3%		35%	78%
	Withymead	1%	31%	50%	14%	4%		32%	82%
	Hay Street	2%	20%	45%	27%	7%		22%	67%

[24] Source: http://opendatacommunities.org/home

Table 5-2: Community attributes in substation areas					Bath and West Community Energy		Owen Square	WHG	Rooftop Housing	Exeter Community Energy	Tamar Energy Community	Marshfield (average)
Town / Village					**Bath**		**Bristol**	**Walsall**	**Bishop's Cleeve**	**Topsham, Exeter**	**Tavistock**	**Marshfield Village**
Substation					**Bloomfield Ave 6.6 KV**	**Elm Place 6.6 KV**	**Kilburn Street**	**Little London**	**Harpfield Cl.**	**Topsham Local**	**Meavy Way, Greenlands**	**Hay Street, St Martins, West Little, Withymead**
	Scale / unit	**Data source**	**Granularity**	**Source**								
Deprivation	IMD decile (1 is most deprived, 10 is least)	English Indices of Deprivation 2015 - Ministry of Housing, Communities & Local Government	By LSOA (c. 800 properties)	Link	9	10	2	2	8	9	4	10
Unemployed, economically active	%	ONS - 2011 census	By OA (c. 125 properties)	Link	1.5%	2.3%	7.8%	16.5%	3.1%	0.7%	4.4%	2.1%
Median household income	£	ONS – Research Outputs	By LSOA (c. 800 properties)	Link	£15,000.01 to £20,000.00	£20,000.01 to £30,000.00	£10,000.01 to £15,000.00	£10,000.01 to £15,000.00	£15,000 to £20,000; £20,000 to £30,000	£15,000.01 to £20,000.00	£10,000.01 to £15,000.00	£20,000.01 to £30,000.00
Over 65	%	ONS - 2011 census	By OA (c. 125 properties)	Link	24.0%	17.1%	7.2%	17.6%	21.4%	35.5%	23.0%	19.6%
Under 16	%	ONS - 2011 census	By OA (c. 125 properties)	Link	14.6%	17.6%	25.8%	3.4%	19.6%	12.4%	17.4%	21.3%
Detached house	%	ONS - 2011 census	By OA (c. 125 properties)	Link	12.0%	10.2%	5.7%	1.0%	16.7%	7.0%	21.0%	29.7%
Semi-detached house	%	ONS - 2011 census	By OA (c. 125 properties)	Link	40.8%	30.0%	7.2%	1.0%	59.0%	17.0%	29.5%	29.5%
Terraced house	%	ONS - 2011 census	By OA (c. 125 properties)	Link	19.3%	41.8%	66.5%	0.0%	5.3%	55.0%	32.5%	33.5%
Flat/apartment	%	ONS - 2011 census	By OA (c. 125 properties)	Link	28.3%	17.8%	20.3%	98.0%	18.3%	22.0%	17.0%	4.0%
Domestic PV installations	kW	Ofgem – Feed-In Tariff Installation Report	By LSOA (c. 800 properties)	Link	16	26.5	9	2	27	0	13	38

					Bath and West Community Energy		Owen Square	WHG	Rooftop Housing	Exeter Community Energy	Tamar Energy Community	Marshfield (average)
Town / Village					**Bath**		**Bristol**	**Walsall**	**Bishop's Cleeve**	**Topsham, Exeter**	**Tavistock**	**Marshfield Village**
Substation					**Bloomfield Ave 6.6 KV**	**Elm Place 6.6 KV**	**Kilburn Street**	**Little London**	**Harpfield Cl.**	**Topsham Local**	**Meavy Way, Greenlands**	**Hay Street, St Martins, West Little, Withymead**
	Scale / unit	**Data source**	**Granularity**	**Source**								
Domestic FIT PV capacity	Number	Ofgem – Feed-In Tariff Installation Report	By LSOA (c. 800 properties)	Link	49.7	67.6	49.8	7.5	80.7	0.0	44.3	124.7
Homes with rooftop PV	%	Ofgem – Feed-In Tariff Installation Report	By LSOA (c. 800 properties)	Link	2.2%	3.4%	1.2%	0.3%	3.4%	0.0%	2.2%	5.1%
Numbers of gas boilers	Numbers registered in properties with EPCs (c. 50-70%)	Energy Performance of Buildings Data - Ministry of Housing, Communities & Local Government	By postcode (c. 15 properties)	Link	120	153	394		85	60	87	287
Air source heat pump	Numbers registered in properties with EPCs (c. 50-70%)	Energy Performance of Buildings Data - Ministry of Housing, Communities & Local Government	By postcode (c. 15 properties)	Link	1						1	
Electric storage/heaters	Numbers registered in properties with EPCs (c. 50-70%)	Energy Performance of Buildings Data - Ministry of Housing, Communities & Local Government	By postcode (c. 15 properties)	Link	8	28	19	73	7	37	3	14
Average electricity use	kWh	Postcode level electricity estimates: 2015 - BEIS	By postcode (c. 15 properties)	Link	4,082	4,407	2,990	7,123	3,123	3,665	3,254	4,288