Local Energy Oxfordshire

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Community of MPANS (D3.8)

Barbara Hammond & David Middleton

Local Energy Accelerating Net Zero

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Lead Authors:	Barbara Hammond, David Middleton
Organisations:	Low Carbon Hub and Origami

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Context

The UK Government has legislated to reduce its carbon emissions to net zero by 2050. Meeting this target will require significant decarbonisation and an increased demand upon the electricity network. Traditionally an increase in demand on the network would require network reinforcement. However, technology and the ability to balance demand on the system at different periods provides opportunities for new markets to be created, and new demand to be accommodated through a smarter, secure, and more flexible network.

The future energy market offers the opportunity to create a decentralised energy system, supporting local renewable energy sources, and new markets that everyone can benefit from through providing flexibility services. To accommodate this change, Distribution Network Operators (DNOs) are changing to become Distribution System Operators (DSOs).

Project Local Energy Oxfordshire (LEO) is an important step in understanding how new markets can work and improving customer engagement. Project LEO is part funded via the Industrial Strategy Challenge Fund (ISCF) who set up a fund in 2018 of £102.5m for UK industry and research to develop systems that can support the global move to renewable energy called: Prospering from the Energy Revolution (PFER).

Project LEO is one of the most ambitious, wide-ranging, innovative, and holistic smart grid trials ever conducted in the UK. LEO will improve our understanding of how opportunities can be maximised and unlocked from the transition to a smarter, flexible electricity system and how households, businesses and communities can realise the benefits. The increase in small-scale renewables and low-carbon technologies is creating opportunities for consumers to generate and sell electricity, store electricity using batteries, and even for electric vehicles (EVs) to alleviate demand on the electricity system. To ensure the benefits of this are realised, Distribution Network Operators (DNO) like Scottish and Southern Electricity Networks (SSEN) are becoming Distribution System Operators (DSO).

Project LEO seeks to create the conditions that replicate the electricity system of the future to better understand these relationships and grow an evidence base that can inform how we manage the transition to a smarter electricity system. It will inform how DSOs function in the future, show how markets can be unlocked and supported, create new investment models for community engagement, and support the development of a skilled community positioned to thrive and benefit from a smarter, responsive and flexible electricity network.

Project LEO brings together an exceptional group of stakeholders as Partners to deliver a common goal of creating a sustainable local energy system. This partnership represents the entire energy value chain in a compact and focused consortium and is further enhanced through global leading energy systems research brought by the University of Oxford and Oxford Brookes University consolidating multiple data sources and analysis tools to deliver a model for future local energy system mapping across all energy vectors.

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Executive Summary

The Grid Edge will become the epicentre of the energy system in the future as we transition to a zero-carbon energy system based mainly on electricity with highly distributed generation and a doubling of demand as millions of people make the change to electric vehicles and electric space heating. It will need to be managed very efficiently and smartly if we are to accommodate the numbers of assets required to work together in balancing the local network without immediate and massive investment in new infrastructure.

Making these enormous changes quickly is a challenge because, among other system-wide complexities, the low voltage network is currently very dumb, apart from a handful of innovation projects, and operated passively. It is not generally monitored in real-time and so there is little granular detail about actual use patterns and how they are changing over time. Our nearly 28 million householders and 6 million small business owners increasingly want to take action to help address the climate emergency but generally have little knowledge or capability of their own to apply to finding solutions.

The Project LEO Community of MPANs trials will attempt to add to knowledge about the benefits of collective working at the grid edge, by developing and testing implementation of the concept in exemplar households and exemplar places in Oxfordshire. The Smart and Fair Neighbourhood trials will test the technical feasibility, commercial viability and social desirability of the Community of MPANs concept and attempt to identify what is best managed at the household and community level as distinct from the local authority, regional or national level. We expect that repeatable business models will be hybrid in nature, ie will require public or community benefit in some form to provide free advice and expertise to communities at the feasibility and pre-development stages of new projects.

The trials will also help the Low Carbon Hub to understand what its own role might be in enabling communities of MPANs to be rolled out across Oxfordshire, whether as advisor or service provider, and what its own growth strategy might need to be in order to support this role.

This paper describes the Community of MPANs concept, what we expect the benefits of implementing it to be, the exemplar places where trials will run, what services and products will form part of the trials and what the learning outcomes are that we expect to get from the trials.

We will report on the outcomes of the trials in our deliverable D3.10 'Smart and Fair Neighbourhood Delivery' at the end of Project LEO in March 2023.

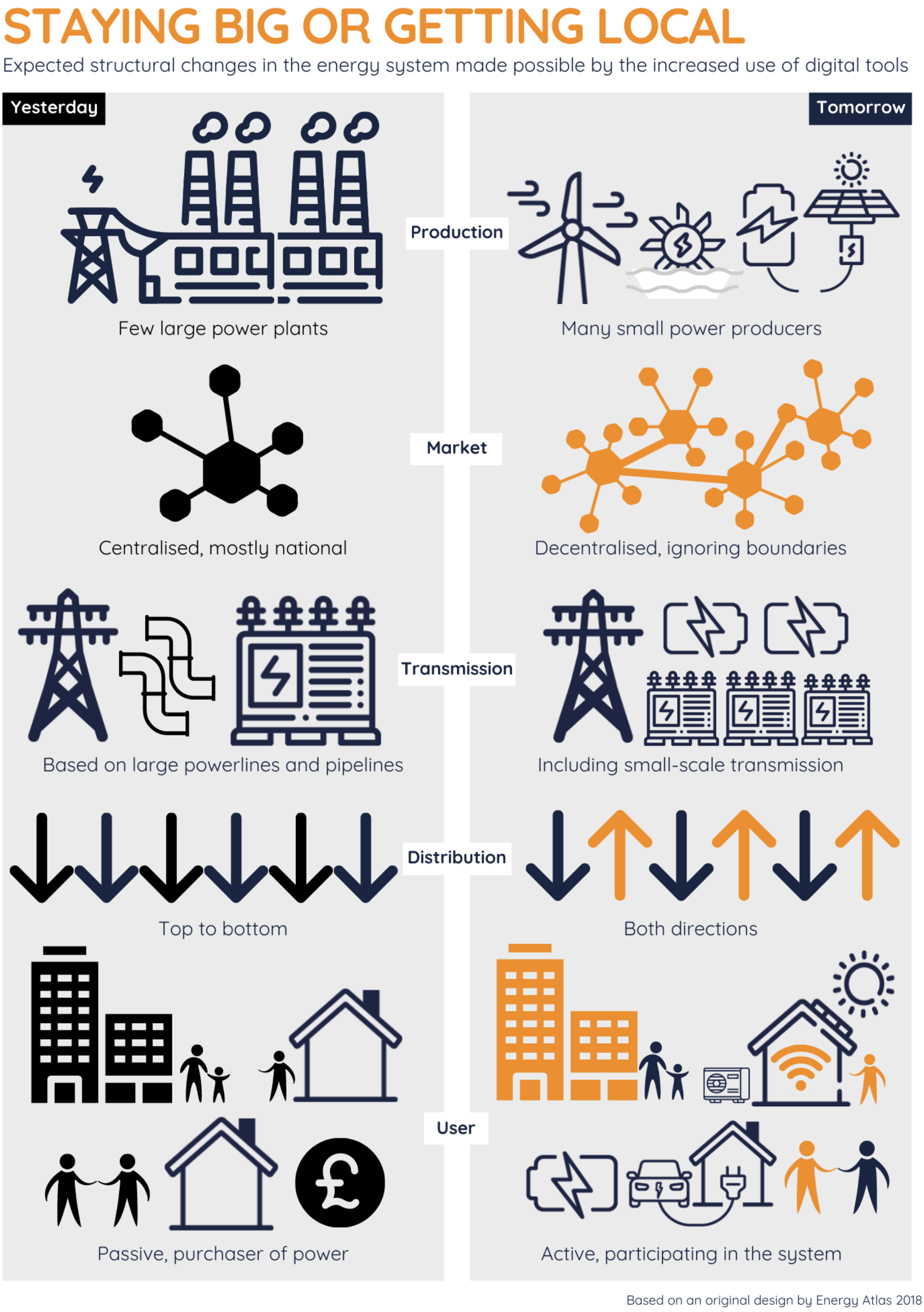


Figure 1: Staying Big or Getting Local (Source: based on an original design by Energy Atlas 2018)

Glossary of Terms Used in This Document

Allocated capacity: the amount of capacity a customer can use on the network to the import or export of electricity. This is set by the Connection Agreement the customer has with the Distribution Network Operator.

Anchor demand or generation: Anchor demand customers are dominant users such as schools, hospitals, and small manufacturing units that consume energy throughout the day and so provide predictable load around which a Community of MPANs project can be developed. Anchor generation customers are large, dominant energy producers such as solar PV, hydro, wind or anaerobic digestion plants that can provide a local, predictable source of energy production that can be balanced against local demand.

Aggregator (technical or commercial): aggregators bundle Distributed Energy Resources (DER) together to engage with energy and flexibility markets as a single entity. A technical aggregator bundles DERs together but does not operate in the markets itself. A commercial aggregator contracts with a number of DERs or technical aggregators to sell energy or flexibility services into the market. More detail is given in the definition in Figure 2 taken from the European Consumer Organisation, BEUC, report, 'Electricity Aggregators: starting off on the right foot with consumers.'

> **Aggregation** entails **grouping the energy consumption or generation** of several consumers.
>
> When it comes to **consumers**, an aggregator can set up an agreement with several consumers, based on which he can temporarily reduce their electricity consumption when there is high demand for electricity. He then sells this flexibility i.e. the 'avoided' electricity consumption in electricity markets. An aggregator could also be operating the reverse action and could increase the consumption of an electricity consumer when electricity prices are favourable. Aggregation can be carried out by traditional energy businesses such as **suppliers, or by new entrants such as independent aggregators**. **Independent aggregators** are, thus, electricity service providers. In practice, when consumers engage with them, they have one contract with the supplier and a separate one with the aggregator.
>
> An aggregator can also operate on behalf of a group of consumers engaging in self-generation by selling their excess electricity.

Figure 2: Aggregation definition (Source: https://www.beuc.eu/publications/beuc-x-2018-010_electricity_aggregators_starting_off_on_the_right_foot_with_consumers.pdf)

Community: in this paper we define 'community' as a self-identified group of people working within a self-defined place (community of geography) or area of interest (community of interest). Community energy schemes tend to be developed by communities of geography and can cover both energy generation and energy efficiency programmes. Schemes are generally started up and run by volunteers, but can grow to a scale where they professionalise into a sustainable enterprise with paid staff.

Community of MPANs: this paper proposes a new 'Community of MPANs' concept which we define as: *'A collaborative scheme between energy system users who co-ordinate the way they consume, generate, and store electricity, and manage their allocated capacity in the system to maximise the benefit to the community, other customers, the network and the system.'*

Customer: Ofgem defines a customer as someone who is supplied with, or requires to be supplied with, gas or electricity at their premises. A domestic customer is someone whose supply is taken wholly or mainly for domestic purposes. A customer takes their supply through one or a number of MPANs (see below). In this paper, we widen the definition to include energy generators who supply energy to the network through an export MPAN.

Distributed Energy Resource: small-scale units of local energy generation, use and storage connected to the grid at distribution level. DERs can include behind-the-meter renewable and non-renewable generation, energy storage, inverters (electronic devices that change DC, or direct current, to AC, or alternating current, electric vehicles and other controlled loads (separately metered appliances like hot water systems). DER also comprises new technology like smart meters and data services.

https://arena.gov.au/blog/what-are-distributed-energy-resources/

Common examples of DERs include rooftop solar PV units, natural gas turbines, microturbines, wind turbines, biomass generators, fuel cells, tri-generation units, battery storage, electric vehicles (EV) and EV chargers, and demand response applications. These separate elements work together to form distributed generation.

Grid Edge: This has been defined by Project LEO as '*the points in the electricity grid that are closest to the end users of energy (i.e. at homes and businesses). The term 'Grid Edge' is used to encompass the varying hardware, software and innovations being developed at the edge of the network, from behind the meter in premises to the secondary substation, to enable smart local energy systems and consumers to become prosumers.'* (see www.project-leo.co.uk/glossary).

Local: in this paper we define 'local' to be places that have an administrative boundary defined by Government and for which there is a local authority in place with elected representatives exercising statutory powers. This includes Parish and Town Council areas, districts and counties. Local energy schemes or plans, in these terms, are therefore distinct from community energy schemes in that they are led by the local authority rather than by the self-defined community. Local authorities and community energy organisations often work closely in partnership with each other.

Local Energy Services Company: a company that buys electricity from generation, batteries and wholesale electricity markets and sells it to demand customers and batteries in a single local area. It aggregates flexibility services to make a financial or other reward for its customers. It is responsible for balancing energy purchase and sales across its customers and for energy management and allocation between them. It is likely to operate behind a single primary or secondary substation but does not require all electricity users in its local area to be customers.

Microgrid: This is a physical entity that covers all the electricity users behind a single connection to the electricity network. It may have its own Local Energy Services Company to run it or be managed by one that owns a number of microgrids. Electricity management and allocation is done internally across all the users that form part of the microgrid.

MPAN (meter point administration number): this is the point of change between the energy network and the customer where import from and export to the network is measured. It is a number that identifies the energy supply or production.

Network: the part of the electricity system that distributes electricity from the grid/bulk supply point through primary substations (33kV to 11kV) to secondary substations (11kV to 400V) and then to low voltage feeders that connect to individual meters that have an MPAN.

Peer to Peer (P2P) service: energy, flexibility and capacity service trading that is done directly between customers, demand or generation. These services are generally enabled but not procured by the distribution network operator and by the energy supplier.

People's Power Station (PPS 2.0): a software tool being developed by Low Carbon Hub as part of LEO that enables LCH to control assets and also to derive intelligence and value services; the People's Power Station 1 (www.lowcarbonhub.org/p/programmes/peoples-power-station/) showcases information on renewable energy generation and energy efficiency projects across the county

Self-consumption: managing energy consumption and generation behind the site meter (MPAN) to maximise use of energy generated at the site. They can sell any excess to the network or through P2P trading schemes.

Smart and Fair Neighbourhood: a geographic area identified by the incumbent community energy group as the location for a Project LEO trial. The smart community energy project is governed by the Project LEO Ethical Delivery Framework https://project-leo.co.uk/reports/developing-a-ethical-framework-for-local-energy-approaches/

System: the national electricity system where total production and consumption is balanced by the Electricity System Operator.

1 Introduction

As well as the development and demonstration of the new market for flexibility services at the level of the Distribution Network, Project LEO recognises that much of the transition to a zero-carbon energy system will happen at the level of the individual household or business or at the community level. Project LEO is therefore interested in creating new investment models for community engagement and supporting the development of a skilled community positioned to thrive and benefit from a smarter, responsive, and flexible electricity network.

This paper explains how Project LEO will work at the 'hyper-local' level with households, businesses, and communities to understand how individual and collective activity at the Grid Edge can provide benefits to the system, the system user, and the community. A recently completed Project LEO White Paper 'Inclusion of Small Assets at the Grid Edge'[1] identifies the potential size of their contribution to flexible management of the distribution network:

*'Delivering Net Zero will require a transformation in the scale of active participation at the local level. This will create opportunities to realise the (currently dormant) potential of millions of Small and Medium-sized Enterprises (SME) and domestic assets to support the flexibility needs of the marketplace as the penetration of low carbon technologies (LCTs) increases. For example, by 2050 the ESO Future Energy Scenarios envisage as many as 8 million homes will actively manage their heat demand via heat pumps and thermal storage with further 2.4 million homes with storage heating, whilst residential electric vehicle (EV) charging infrastructure is anticipated to offer up to 38GW of flexibility*Error! Bookmark not defined.*.'*

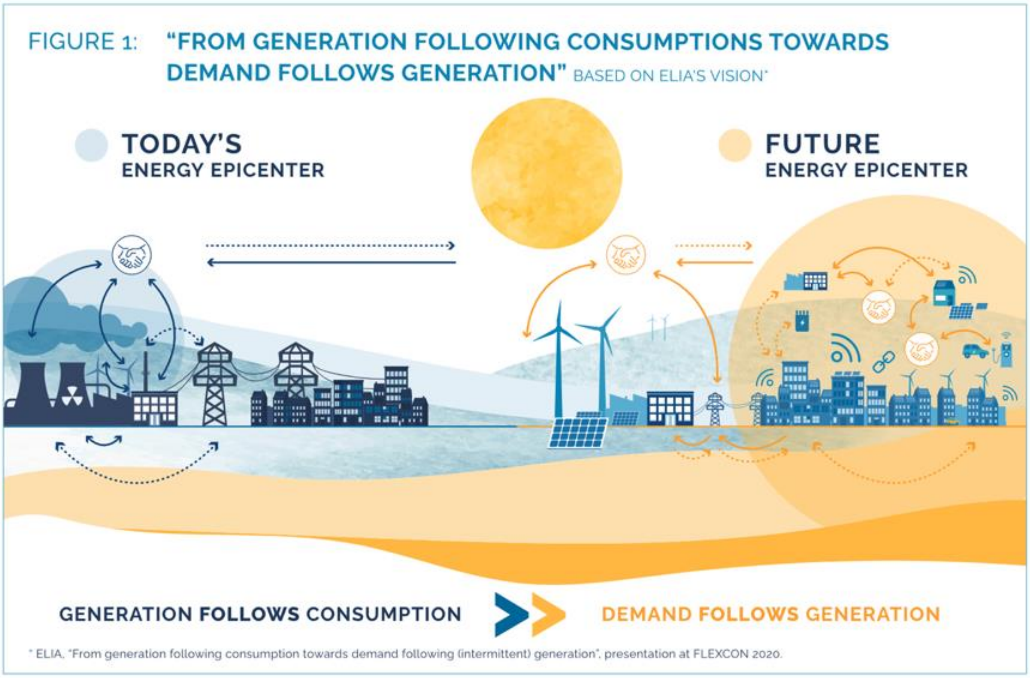


Figure 3: Diagram from FLEXcoop project: https://www.rescoop.eu/uploads/rescoop/downloads/Flexibility-services-for-energy-cooperatives.pdf

[1] Origami (2021) 'Inclusion of Small Assets at the Grid Edge'

The Low Carbon Hub position in developing the grid edge trials envisaged by the bid is that place-based, community action is *a priori* an important part of the net zero energy system. It has been interesting to see the new services and outlines of the new local energy market emerging through Project LEO implementation to date; this has suggested an interesting interplay between physical and virtual ways of managing the whole energy system that might bring our assumption strongly into question. It is possible to imagine some scenarios where no importance at all is given to place in managing the millions of small DERs virtually. This applies largely to national services procured by the ESO for system balancing. Other scenarios favour a system that strongly values location and may result in a system operating physically much more as a series of interconnected smart microgrids. This applies largely to regional services procured by the DSO for network balancing and may also include some P2P services enabled by the DSO to optimise use of grid infrastructure capacity.

We have set up the Smart and Fair Neighbourhood trials to help us understand some of the technical, commercial, and regulatory issues and benefits that might arise from taking a very place-based approach. Most importantly, we want to understand what the benefits of this way of working might offer to individuals and communities as well as to the distribution network. The SFNs will also help us to understand how flexibility services can be stacked to make an investable proposition alongside energy trading and other forms of place-based value.

We are strongly guided by what we know of the social issues. We know that individuals and communities are increasingly motivated to 'do their bit' in enabling the energy transition and want Project LEO to help answer the question, 'What can I do to help?' There is also a very strong desire for local people to be able to buy the energy generated from local renewable energy installations directly or through their local energy supplier; people are often very surprised that the system does not currently allow them to do that. Conversely, we know there is a large section of the population with no knowledge or motivation around these issues. In Project LEO, we are focusing on the most motivated given that polls show[2] that their number is high, and our experience tells us that we don't have simple, repeatable models to meet the increasingly urgent aspirations of the motivated population. We are working across a spectrum of very highly motivated and experienced community groups that includes a community and customers where most householders are tenants and there are high levels of multiple deprivation.

The purpose of the Project LEO Smart and Fair Neighbourhood trials is therefore to identify and trial ways of enabling households, businesses, and communities at the Grid Edge to accommodate this level of change to their daily lives in a way that might benefit them as individual householders or business owners and/or as members of a local energy community. We want to learn from the trials what the repeatable models are, ie that are technically feasible, commercially viable and socially desirable.

As part of the SFN trials, we also want to understand what the long-term business model is for the Low Carbon Hub, and other community energy organisations like it, in supporting the development of communities of MPANs. Our starting position is that the business model will likely be a 'hybrid' one, where free money (public funding or our own community benefit funding) pays for expert help and support to go in at the beginning to help a community-led project to get off the ground. We expect the value stacks underpinning these projects to be about values other than the purely financial, for example by building trust in new ways of running the energy system. In this scenario, Low Carbon Hub is acting as the advisor.

[2] Centre for Climate Change and Social Transformations IPSOS MORI poll for Earth Day (April 2021): 73% agree that 'if individuals like me do not act to combat climate change, we will be failing future generations; c. 90% say they are likely to or are already saving energy at home.

Low Carbon Hub may also, however, play the role of service provider, aggregating and trading energy and flexibility from community-owned DERs through our People's Power Station (PPS 2.0) cloud platform. A small set of LCH DERs has been integrated into this to enable automated control and participation in the first Project LEO trial period. This rest of our portfolio will follow before the second and third trial periods. We will integrate community-owned DERs associated with the community of MPAN trials as and when we can; but will also run 'thought experiments' throughout as we gather learning to understand how the PPS 2.0 could enable a scale-up of community activity in Oxfordshire. Our starting hypothesis is that the business model for developing the PPS 2.0 will also have a hybrid value stack, with a business case resting on optimising the core Low Carbon Hub-owned DER portfolio, and with community-led portfolios of very small assets being added at marginal cost.

Understanding these hybrid business models in more detail, will help us to understand what the growth strategy of the Low Carbon Hub needs to be to fulfil its aim to help as many communities in Oxfordshire as possible to set up communities of MPANs. There are around 300 geographic communities in Oxfordshire and 62 primary substation areas. We want to understand how the communities of MPANs concept can help us scope out our role as delivery agent for our local authorities in helping to realise the transition to a zero-carbon economy in these communities of geography. But we also want to know how big our community benefit fund will need to be to support us in performing this role over the next 30 years. Our current projects show a total net present value community benefit fund of just over £10m.

We expect to report on our learnings from implementing Communities of MPANs concepts through our Smart and Fair Neighbourhoods in our SFN Delivery Report (D3.10) at the end of Project LEO in March 2023.

2 Community of MPANs Concept

We have identified the concept of a Community of MPANs as a way of describing this community-level model of engagement. We have formulated a tentative definition of this concept as follows:

'A collaborative scheme between energy system users who co-ordinate the way they consume, generate, and store electricity, and manage their allocated capacity in the system to maximise the benefit to the community, other customers, the network and the system.'

We think this is a useful definition for trial work in Smart and Fair Neighbourhoods at the Grid Edge because:

- It captures the five resources that are available to everyone in the system: level of demand, generation, storage of energy, flexibility of demand, generation and storage, and the capacity of their individual and collective connection.
- It is open to many different mechanisms for the scheme to buy, sell or otherwise exchange energy or capacity and so a number of different revenue streams can be 'stacked' together. For example: peer-to-peer mechanisms that take out the "middle-man" as well as collectively providing a service to the network operator that perhaps isn't viable as an individual.
- By referring to the allocated capacity it inherently implies that the scheme is aligned to the performance of the system as understood by the network operator.
- It allows for a scheme coordinator role while maintaining a collaborative, opt-in principle.

- We assume that this works best in local, place-based schemes – or at least that this is the easiest approach for us to test the concept – but it doesn't exclude schemes that are not focused on a limited geography.

In proposing this model as the organising principle for trials at community/neighbourhood scale, we will attempt to demonstrate technical feasibility, commercial viability, and social desirability, i.e. demonstrating a sustainable business model that has value for the participants. We do not, however, assume that all, or any, of the trials will be successful in demonstrating a full value proposition in these terms. We also expect that the trials will give us some understanding about how to scale up from community level to aggregation of Communities of MPANs, for example by using our People's Power Station as the technical or commercial aggregator.

The Community of MPANs concept aligns well with a recent paper by the Council of European Energy Regulators that looks at the regulatory aspects of self-consumption and energy communities[3]. This paper identified three legal definitions of this type of activity: Self consumption; collective self-consumption; and energy communities. These are shown in the diagram in Figure 4; the Community of MPANs would span the first two of these and probably not the third.

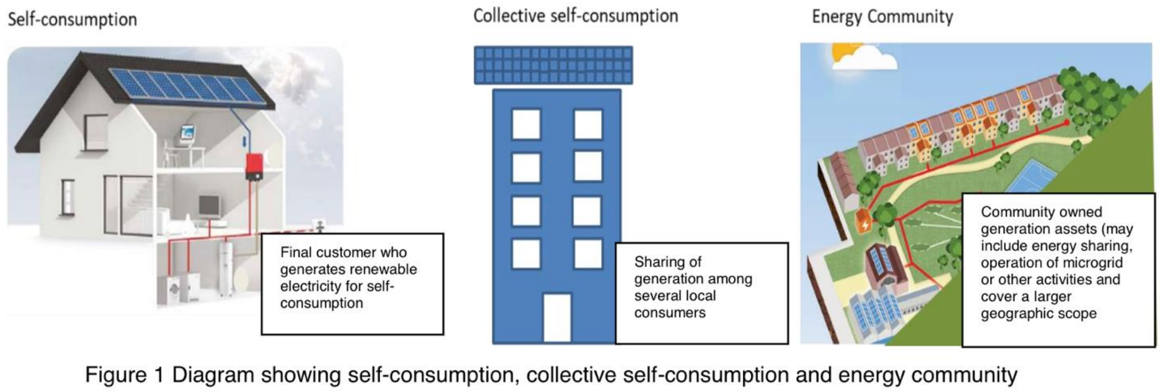
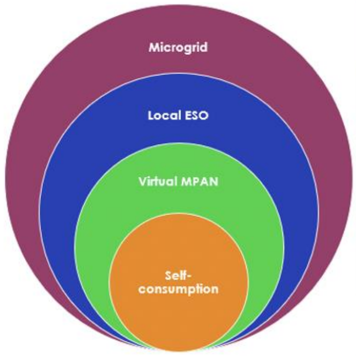


Figure 4: Typology of self-consumption and energy communities (Council of European Energy Regulators as footnote 3 below)

A major question associated with this tentative typology is how the Collective Self-Consumption model is managed and therefore what scale of activity is required to support the administration and transaction costs of such schemes. A particular reference project here is the UKPN /Re-Powering London project 'Urban Energy Club'. We will liaise with them on developments in that project to allow us to provide a wider understanding of the model, especially as that project is due to complete in September 2021 (unless extended due to COVID).

A slightly different typology has been developed by Origami as part of its support to LCH in developing the Smart and Fair Neighbourhood trials. It identifies three levels: a virtual MPAN analogous to the collective self-consumption model above; a Local Energy Services Company where more MPANs are involved, and more formal management is required; and a microgrid where all the MPANs in a local area or a whole secondary sub-station area form part of an energy community. The characteristics of each level are set out in Figure 5.

[3] CEER (June 2019) Regulatory Aspects of Self Consumption and Energy Communities. Ref: C18-CRM9_DS7-05-03



Type of Community	Properties involved in CMPAN	CMPAN connections with DNO	Description
Microgrid (physical)	All	One	• Single connection to the electricity network (MPAN or substation) with internal energy management and energy allocation
Local ESCO (fullest scope; physical)	Some or All	Some or All	• Buys electricity from generation, batteries and wholesale electricity markets • Sells electricity to demand customers and batteries • Aggregates flexibility to deliver flexibility services for reward • Responsible for energy imbalance between purchases and sales • Internal energy management and energy allocation
Virtual MPAN (virtual)	Some	All	• Commercial arrangement to buy, sell and trade electricity when not all customers in an area are part of the Community of MPANs
Self-Consumption	One	One	• Manging energy consumption and generation behind the site meter (MPAN) to maximise use of energy generated at the site.

Figure 5: Typology of Community of MPANs model developed by Origami

The tables included at Appendix A show the requirements, solutions, and barriers for each level of CoMPAN model. We are developing the specifications for each Smart and Fair Neighbourhood project focusing mainly on the requirements for the Virtual MPAN model but bearing in mind how these very small projects could scale up to the Local ESCO or microgrid model.

We are working at the simplest, 'starter' level of the Virtual MPAN for the Project LEO SFN trials on the basis that the model needs to work as the entry level on its own merit and that it has still to be demonstrated technically, as well as socially and commercially. Our assumption is that it will be hard to move to the Local ESCO or full microgrid models if we have not worked out how each household, business and local generator can get involved first in a safe, simple, and fair way. Of particular concern already to communities is how their data is used and managed, and the extent to which they own and have control over it. But in working at the starter level, we need to bear in mind as we work through the trials what the pathway may be to those more complete and larger scale models. For example: what role 'anchor' demand or generation assets might play; how risk can be allocated and managed at the household level, the community level, the town, city, and national levels; and what the benefits might be of working collectively to achieve a firm demand profile for the Community of MPANs.

We also have a question about whether there is a subdivision in the model typology given that there are two main motivations for wanting to develop a CoMPAN model:

1. **Virtual private wire:** in this example, the main motivation comes from the need of those connected or wishing to connect to achieve a cost-effective and timely connection. Generally speaking, a generator is constrained by the size of their connection, or cannot secure a cost-effective connection, and so cannot export some or all of their generation.
2. **Virtual MPAN:** in this example, the main motivation comes from the community wanting to make best use of the headroom that exists at the secondary substation in order to accommodate much more local generation and demand in the form of EVs, heat pumps, PV etc. that can then be balanced and shared across the community. Headroom can mean either: capacity relative to maximum demand/generation; or the infrastructure utilisation factor.

We have shown in Figure 6 the main differences between these two CoMPAN types.

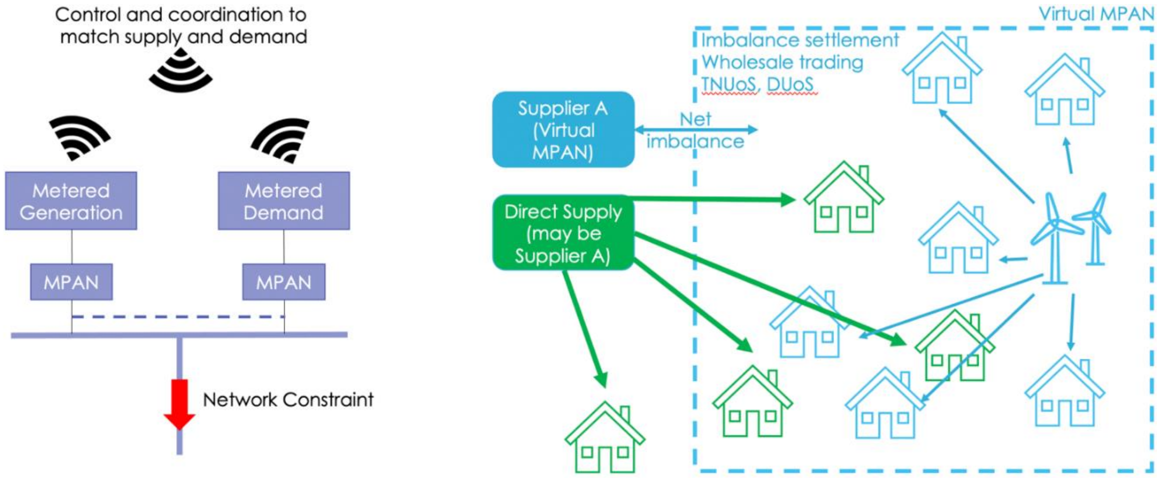


Figure 6: Virtual Private Wire and Virtual MPAN models compared

3 Community of MPANs Benefits

We have set out below the benefits we hope to get from applying the Community of MPANs concept through our Smart and Fair Neighbourhood projects. We have grouped them into three categories: benefits for the catalysing community; benefits for the customer; and benefits for the network.

Benefits for the customer

The participants in the community of MPANs

Participation

- Opportunity to participate in new local energy activities
- Opportunity to define what value means to them beyond the purely financial
- Opportunity to participate in existing local energy activities which they were previously unable to do because they were unaware/too small/lacked the know how/could not control their supply or demand
- Flexible opportunities to participate e.g. not just for owners of specific assets and not just for homeowners but also for tenants[4]

Simplicity

- Opportunities to get involved and reap benefits of local energy services without having to understand the intricacies of the mechanisms underpinning it all
- Opportunities to benefit even if they have no ability to flex their individual energy use if the community of MPANs in their area is advanced enough (flexibility poverty may be akin to fuel poverty)
- Low minimum requirements for participation

Value

- Creates financial value for previously unvalued resources they control (eg demand/capacity)5

[4] We will also be testing whether participation can be just in terms of behaviour change around demand rather than being solely asset-based

[5] Although we do need to be aware that there may be perverse incentives for customers to 'game' the community

- Opportunity to directly contribute to a net zero energy system to help tackle climate change
- Helps minimise/delay disruptive reinforcement works in their community eg roadworks
- Small part in reducing network upgrade costs (which they will ultimately pay for via their bills)
- Offers opportunity for increased participation should you wish eg by investing in new DERs
- Avoided costs of grid connection, both in terms of actual cost for connection and time delays caused by the reactive nature of the application process and reinforcement programme

Trust

- A CoMPAN is likely to be run by local, trusted catalysing community, but your electricity supply continues to be fully backed by the energy system - best of both worlds
- A single mechanism to allow you to benefit from multiple opportunities and learn about other tangential activities either from experts or from peers eg energy efficiency
- No added risk to security of supply
- Opportunity to collaborate with others in their community on a project that creates benefits for both the participants and the wider community
- A clear and consistent approach to use of personal data§; all Community of MPANs participants will necessarily fall under the General Data Protection Regulations because all will have an identifier, such as the postcode or the MPAN itself

Benefits for the catalysing community

The actor implementing a community of MPANs in their ‘place’

Collective action

- A way to harness local potential (in terms of generation/demand /storage/capacity/flexibility) for the collective good
- Can accommodate participants of varying sizes upwards from single household[6]
- Similarly, a mechanism that encourages people to help solve a local issue, for example: lack of space in the local network for more generation or demand; supporting local roll out of EVs; income generation for a local project or cause; working collectively to move from oil to electric heating; amongst many others

Value creation

- Creates social, environmental as well as financial value: can be shaped to create the most engaging model for a particular community, or specifically formulated to address concerns about energy equity
- Provides a means by which a catalysing community can achieve a number of different ends, e.g. a low carbon group may focus on reducing impact on climate change, a local authority on meeting carbon emission reduction targets or facilitating uptake of EV charging points
- Optimises local use of local generation (energy allocation) keeping energy spend local

Scalability

- A versatile and adaptable toolkit that can be configured to make the most of local opportunity
- Small ‘minimum viable system’ unit so easy to start and test

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[6] It is not yet clear what the operative scales are from the community of MPANs up to the Local Energy Services Company and then the Microgrid. We expect learning from these projects to give us some sense of that, starting from the individual Meter Point Administration Number (MPAN) and working upwards in numbers. We expect to start on this process by understanding how Communities of MPANs can be technically aggregated by our People’s Power Station.

- Lower administrative and transactional costs than alternatives e.g. Local Energy Services Company (LESCO), but can scale up
- Can operate both as an ‘add on’ to existing low carbon community activity or as a standalone service
- Provides a platform for further engagement

Benefits for the network

Primarily, the local energy network, from each individual feeder up to the secondary substation (the Grid Edge) but potentially also up to primary substation and transmission system. As well as the specific benefits listed below, there may also be a general benefit of system resilience if use of the Grid Edge network is optimised.

Flexibility

- Aggregates small amounts of flexibility/ generation/ capacity/ demand/ storage into material volumes
- Increases overall flexibility on offer to the system by unlocking currently unharnessed flexibility

Efficiency

- A more predictable, stable demand profile
- Concept harnesses the power of community-led action without the network needing to manage the complex community level relationships within a CoMPAN

Targeted action

- More efficient use of existing network capacity that reduces, defers or avoids the need for reinforcement works and so may reduce customer costs
- Optimises and increases use of the DNO infrastructure (wires and switches in the secondary substation itself) at lower voltages by changing the time of use of demand or aligning it with the pattern of generation
- Geographic nature of CoMPAN means its deployment can be encouraged to target specific needs of customers or specific points of constraint on the network

Coordination

- Multi-tool approach to the CoMPAN concept means that a particular configuration of tools can be used in any particular place, responding to local network needs
- Can also deliver balancing benefits that are less place-sensitive

There may be benefits for the wider local authority area, such as helping to meet net zero targets. This paper does not explicitly cover these, but we would expect to be gathering learning from those stakeholders for reporting in at the end of Project LEO.

4 Implementing the Concept: Exemplar Places

4.1 Defining the Place

We are proposing the CoMPAN concept as a way of working for the benefit of the network and the local community at the Grid Edge where the electricity network will need to accommodate the demand and generation of many millions of new small DERs. Defining both the physical place and the associated community for each SFN has been interestingly problematic in all cases, however. It is rare to find that administrative, social and energy network boundaries map neatly onto each other. Our general approach has been to work with established communities where we have a track record of working well together and where this has been consolidated by the communities becoming community shareholders of the LCH Community Interest Company. And so we do not discuss here the many and complex questions about definitions of community, nor about how they develop agency and legitimacy within their chosen geographic boundaries; we accept that these things already exist for these communities. We are then led by the community in terms of the choices made about the areas to work with and how they fit or not with administrative boundaries (particularly postcodes important for socio-economic mapping) and energy network boundaries.

The five Smart and Fair Neighbourhoods are:

Eynsham Smart and Fair Futures SFN is developing a 'Zero Carbon Energy Action Plan' for the Eynsham primary substation area plus a plan for its long-term governance
Deddington and Duns Tew SFN is looking at how the installation of heat pumps and smart monitoring can help decarbonise rural, off-gas communities and how energy efficiency measures can be installed in households under planning constraints
Osney Island SFN is a study in how small densely populated urban areas can cope with an increased demand for electric vehicles (EVs) and how people who don't have access to their own EV aren't left behind in this transition
Rose Hill SFN is looking at how a largely residential community with several relatively small DERs, including battery storage, can change energy use patterns, generation and storage to support balancing the network locally and benefiting the local community
Westmill SFN is looking at how the existing solar and onshore wind farms, along with potential battery storage, could participate in local flexibility markets.
Case studies and one-pagers for each community and their project can be seen on the Project LEO website: https://project-leo.co.uk/our-trials/place-based-trials/

Figure 7 shows an overview of how each SFN maps onto the Community of MPANs typology set out in Section 2 above. Figure 8 then shows a Line of Complexity comparing the SFNs with each other in terms of the range from simple boundaries and project concepts to more complex ones. Appendix B sets out in more detail how this line of complexity works out for each SFN.

We hope that this range of places and communities will allow us to draw insights that may be helpful to others in developing CoMPAN projects, or in projecting how they might aggregate to make a significant new geographic lens for forecasting energy system futures. We don't present them as definitive either in terms of their range or their methodologies.

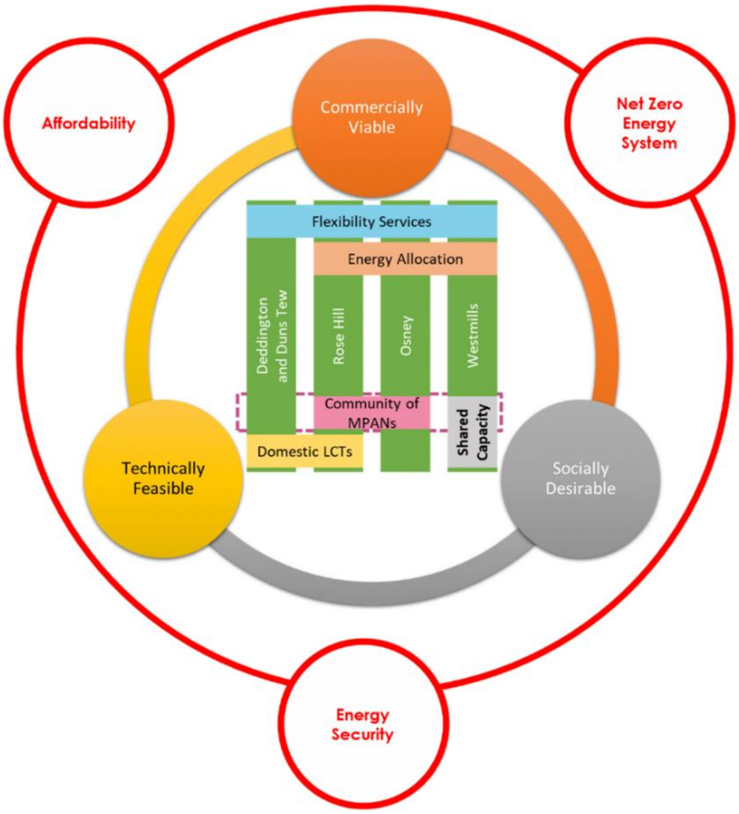


Figure 7: Overview diagram: mapping the SFNs onto the CoMPAN typology

SFN	Osney	Deddington and Duns Tew	Rose Hill	Westmills	Eynsham
Geography	Single LV substation	Multiple LV substations	Multiple LV substations	Shared Capacity at 33kV	Primary Substation Area
DERs	Single Generation anchor	Single DER Type	Multiple Small DERs	Three DERs, Three MPANs	
Timetable					
TP1	Prepare	Prepare	Prepare	Prepare	Thought experiments for new development
TP2	Develop	Prepare	Develop	Develop	
TP3	Implement	Develop and Implement	Implement	Implement	

Figure 8: Line of Complexity diagram

4.2 Defining the Trials

We have worked with each community to specify the SFNs using the model Project LEO has developed to describe a new energy product or service (technically feasible, commercially viable and socially desirable). This ensures that the project will work both within and outside Project LEO and so will remain sustainable in the trial place beyond Project LEO. Figure 9 shows how trial outcomes are identified with the community and developed into a full specification for each SFN.

SFN suite of documents					Specification							
	1-pager	Website	Scope	Mapping	Spec doc	Programme	Resources - people	Resources - budgets	Value proposition	Engagement	Monitoring, Evaluation and Learning	Memorandum of Understanding
definition	*PPT diagram*	*Outline of each SFN for new LEO website*	*Scoping document agreeing SFN scope with Local Steering Groups*	*Spatial and data*	*Word document defining SFN aims and objectives*	*Timeline of activities with including review points*	*Budget of time available to deliver the specification*	*Finance available to deliver the specification*	*Value proposition and customer journey for each service offering*	*Comms and engagement plan (inc. stakeholder analysis first)*	*Inc. data collection mapping (who will collect what when and why)*	*Formal agreement of specificaiton and resources*
Deddington												
Eynsham												
Osney												
Rose Hill												
Westmills												

Nb: the mapping exercise included in the table identifies the SFN boundary and the topography of the local network. The use of the Oxfordshire mapping tool and the Local Energy mapping approach (LEMAP) being developed in WP4 of Project LEO will be defined within the project specification for each SFN.

Key	
Complete	
On track	
Behind schedule	
At risk	
No longer applicable	

Figure 9: Suite of documents defining a SFN project

The place-based context is a vitally important aspect that ensures the socio-economic context is addressed in parallel with the range of technical opportunities. An energy transition based on developing new market-places or new commercial products and services is likely to benefit those who have assets to trade or resources to buy new services. It is important to address questions of equity in the transition, as we have set out in our paper ‘Developing an Ethical Framework for local energy approaches’: https://project-leo.co.uk/reports/developing-a-ethical-framework-for-local-energy-approaches/.

Table 1 summarises the main points under each heading: place-based context; technical trial; commercial viability; and social drivers.

Table 1: Summary of SFN characteristics: place-based context; technical trial; commercial viability’ social drivers

Place-based context	Technical trial	Commercial viability	Social drivers
Osney Island Community of c.300 densely developed Victorian terraces and modern flats; mainly affluent but with some social and private tenants	**How** the community can use energy generated at Osney Lock Hydro more effectively; **How** domestic and community flexibility can help Osney to accommodate EVs; **How** community power can enable community e-mobility	**Working** out how administration and transaction costs can be optimised to achieve a sustainable collective self-consumption model on Osney Island	**How** to share energy and flexibility for the benefit of everyone on the island and the island community **Helping** everyone to take part in the transition to e-mobility
Deddington and Duns Tew An affluent, rural, off-gas household and community.	**Flexible** operation of domestic heat pumps that have been integrated into a cloud-based control platform in order to optimise performance and use flexibility for the benefit of individual properties, the community and the network.	**Demonstrating** sufficient financial value creation for the system operator or other market players such that a financially viable business model exists. **Testing** the conditions, such as scale, required for that model and exploring the contractual arrangements.	**Testing** assumptions about the desirability of individual and collective benefits such as: decarbonisation, moving from oil to electric heating and affordability. **Testing** product design and messaging to maximise uptake and retention in order to maximise the benefits realised.
Rose Hill	**Optimising** and managing many small assets (PV,	**How** many small amounts of flexibility and energy generation	**How** to benefit tenants in a dense urban area of multiple deprivation

Estate of social housing; one of the most deprived areas in the UK	storage, appliances) to make a 'zero carbon estate'	can be optimised and managed collectively	
Westmills Two community energy co-operatives owning separate generation assets on the same site Over 3,000 co-operative members who can't yet share the benefits of trading directly Three surrounding villages for future consideration as Community of MPANs – Longcot, Shrivenham and Watchfield	**What** emerging flexibility markets mean for existing community-scale assets – particularly a new Shared Capacity Agreement trial; **Whether** new storage would provide more dispatchable flexibility to offer into the market; **Review** scope for creating a Community of MPANs in villages surrounding the site.	**Commercial** arrangements between three different organisations and market structures: how to ensure viability whilst assigning liability and risk correctly between the parties	**How** to share the benefits of the trade with co-operative members **How** to organise the leadership structure for the two existing co-ops and a potential new social enterprise
Eynsham Area A mixed area of 5 settlements where 3,200 new houses will double the size of the main settlement	**Zero** Carbon Energy Plan for primary substation area to include the 3,200 new houses and the existing settlements: how the whole area can transition to net zero by 2050 at the latest	**Business** models for zero carbon new development that deal with the split incentive between developer wanting to minimise capital costs and occupier wanting to minimise operational costs	**Acceptance** of new development that doubles the size of the village **Long-term** sustainable stewardship model to govern the zero carbon energy plan

4.3 Precedent Projects

We have identified a range of precedent projects (see Table 2) that can inform the development of each trial, and from which we hope we can build to develop new knowledge in each one. The range of precedent projects has been identified based on the features set out in Table 1.

Table 2: Precedent projects

SFN Trial	Precedent projects
HOPE group: household generic	Flex Community, Bath and West Community Energy: https://www.bwce.coop/flex-community/
	Home Response, Repowering: https://www.repowering.org.uk/local-energy-innovation-trials/
	FlexCOOP, demand response for energy cooperatives: http://www.flexcoop.eu/
Deddington and Duns Tew:	Unlocking the value from flexibility in housing, Flatline Project SERO: http://www.seroprojects.com/flatline-project/
	Heatpump section of Energy Superhub Oxford: https://energysuperhuboxford.org/technologies/ground-source-heating/
	Smart Islands project, PassivSystems: https://passivuk.com/press-releases/passivsystems-installs-smart-home-energy-management-to-support-isles-of-scillys-smart-energy-islands-project/
Eynsham	Communiheat project at Barcombe: https://communiheat.org/barcombe/
	Zero Carbon Rugeley: http://www.rugeleypower.com/zero-carbon-rugeley-project/
Osney Island	SSEN Orkneys project: https://www.ssen.co.uk/FlexibleConnectionOptions/
	My Electric Avenue, SSEN: https://www.ssen.co.uk/myelectricavenue/
	Electic Nation, WPD: https://electricnation.org.uk/
	Energy Local hydro case studies: https://energylocal.org.uk/clubs

Rose Hill	SWELL Shrivenham Energy Local with Longcot: https://www.weset.org/historic/swell/
	Project ERIC: https://www.moixa.com/case-study/project-eric-energy-resources-integrated-communities/
	CommUnity, Repowering: https://www.repowering.org.uk/local-energy-innovation-trials/
	Roupell Park, Energy Local/Repowering: https://energylocal.org.uk/elrp
Westmills	No relevant precedents have been identified to date.

4.4 The Scale of the Individual MPAN

As a precursor to working with households in each of the Smart and Fair Neighbourhoods, we are working with five households to understand the technical, commercial, and social opportunities and issues to address at the level of the individual MPAN.
In order to do this, we have set up a group called the Home-Owner Pioneers for Energy (HOPE) group of five households. We are starting with 5 householders, who are all part of the Project LEO consortium: Mairi Brookes; Adriano Figueiredo; Barbara Hammond; Saskya Huggins; and Malcolm McCulloch.

There are 4 stages to the process:

1. **Situational analysis:**
   a. Producing a Whole House Plan for each house using the Cosy Homes Oxfordshire methodology (www.cosyhomesoxfordshire.org). This ensures that householders are considering all aspects of a self-consumption model including the fabric;
   b. gathering data from smart meters where households have these installed;
   c. comparing this data and individual control of data with test meters that have an API interface with the People's Power Station 2.0. These are designed to provide a very fine grain of data, using open source software[7]; and where the level and amount of personal data shared is highly controllable by the home-owner. They interface with the People's Power Station to test the extent to which individual households could be technically aggregated to take part in flexibility and energy allocation markets;
   d. analysing the pattern of usage over a 6-week period;
   e. completing a capabilities analysis to assess household capabilities or attributes for taking part in potential smart energy trials in Project LEO (www.cse.org.uk/projects/view/1371)
2. **Options analysis to understand:**
   a. Demand reduction potential from improved building fabric or increased self-consumption;
   b. Flexibility or surplus generation available;
   c. Potential benefits from acting as a single household to maximise self-consumption;
   d. Potential benefits from trading energy allocation or flexibility services.
3. **Self-consumption business models:**

[7] Note that open-source software are tools available without the need to pay for licences to use. However, not all future functionality of the PPS2.0 will be available as ready-made open source tools given that what is being developed is highly innovative. The aspiration is to develop those tools and make them available under open-source licences. At the current stage of prototyping costs will be kept to a minimum but larger scale deployment will likely incur development costs - a good example being graphic user interfaces and more sophisticated apps.

   a. technical, commercial, and social aspects and how each household might approach their own personal value stack.
4. **Development and implementation of a pilot implementation/action plan for each household:**
   a. Features of the plan;
   b. Ethical delivery and ethical customer offer;
   c. Use experience of HOPE group to understand how to develop the customer journey for household self-consumption models;
   d. Use experience of HOPE group to inform the development of customer offers.

5 Implementing the Concept: Trial Products/Services

Table 3 shows how each of the SFN projects maps onto the Community of MPAN models identified in Section 4.1 above.

Table 3: Mapping the SFN projects onto the Community of MPAN models

SFN	Virtual Private Wire	Virtual MPAN	Local ESCO	Microgrid	PPS2.0 (technical aggregation)
Osney Island	N / A	**Yes** if low participation rate	**Yes** with critical mass of participation	**Yes** with full enrolment of residents	**Yes** (for hydro, storage and EVs)
Deddington and Duns Tew	N / A	**Yes** if energy allocation is required from local generation	N / A	N / A	**Yes**
Rose Hill	N / A	**Yes** with local tariffs (e.g. ToU)	**Yes** with Local tariffs (e.g. ToU) and critical mass of participation	N / A	**Yes** (for storage and PV)
Westmills	**Yes** using Shared Connection Arrangement	Possibly (if local community included)	**Yes,** as thought experiment	**Yes** as thought experiment	N / A
Eynsham	**Yes** as thought experiment for existing settlements	**Yes** as thought experiment for existing settlements	**Yes,** as thought experiment for Salt Cross new development	**Yes** as thought experiment for Salt Cross new development	N / A

As we have said above, the CoMPAN trials will focus on the defining services, business models and financial models for the simplest expressions of the concept: the virtual private wire and the virtual MPAN. The table does show, however, which trials could be approached from the point of view of potential scaling up to Local ESCO or Microgrid. The complexity of implementing a Microgrid during the timescale of Project LEO is probably prohibits us implementing an actual trial, but we will include 'thought experiments' and test them with the community groups to measure level of interest and potential engagement.

The process for developing the products and services to be trialled is as follows.

1. **A review** of local opportunities is carried out using local knowledge, Google Earth/Maps, and other mapping data.
2. **Data** is collected from Low Voltage monitoring at the local secondary substation(s), from the metering of generation assets and from individual MPANs to give a picture of the capacity

available for new generation, storage, and demand assets to be connected to the local network.
3. **Technically** feasible proposals for Community of MPANs projects are proposed.
4. **Social** desirability of the resulting defined products or services will be checked by developing and testing value propositions with communities and their members.
5. **Commercial** viability will be tested by developing business model canvasses and financial models for each proposal.

The slides attached at Appendix C shows steps 1-3 resulting in two technically feasible proposals identified for the Osney Island SFN. These technical assessments form the basis of the project specifications agreed with the local community which are then evolved into full business models through consultation within the community on value propositions and business models canvasses. A financial model for the desired product or service is then produced in the normal way.

6 Learning Outcomes

The tables at Appendix D shows the set of learning outcomes we have identified for the trials. Table D1 focuses on the direct and extrapolated learning the Low Carbon Hub, as a community energy organisation, hopes to gain from the trials.

The direct learning is about:
- **The project itself:** how to set up and run a Community of MPANs model
- **The process:** what the key steps are in setting up a Community of MPANs
- **Barriers to participation:** what they are and ways of overcoming them
- **Capabilities needed for projects to thrive:** of individuals, assets, communities, and the system
- **Scaleability potential:** how to assess whether and how to grow a project and how to assess whether it is worth repeating or replicating

The extrapolated learning is about:
- **Replication potential:** what would help or hinder replication and what an enabling environment for replication might look like
- **Actors:** who needs to be involved for a project to be a success, what they need to make it a success, and how to ensure the project is resilient when they move on
- **Ethical delivery:** whether the Community of MPANs concept is deliverable within our ethical framework and where it addresses or exacerbates issues with ethical delivery
- **Energy equity within smart local energy systems:** what support or action can ensure better outcomes in terms of energy equity

Table D2 focuses on how we gain direct experience and learning relating to the challenge of implementing Community of MPANs trials. We address 5 key dimensions:

- **Technical feasibility:** whether the concept actually works in reality
- **Commercial viability:** the financial and legal requirements for a sustainable project
- **Social desirability:** the audience for the product; whether anyone actually wants it
- **Governance/regulatory:** how the governance and regulation of the energy industry helps or hinders implementation of a Community of MPANs
- **Value creation:** what environment, social and financial co-benefits are created, for whom and how those people value the benefits

7 Conclusion

This paper sets out how Project LEO will identify and test the Community of MPANs concept as a way of organising place-based community-led action at the grid edge.

We will start from the level of the single household or business MPAN to understand what technical and commercial issues need to be addressed for the 'self-consumption' model to work. We will find out what capabilities are required for a household to implement the model and what benefits the householder and the system itself might gain from mass individual action based on this model.

We will work in a range of exemplar Smart and Fair Neighbourhoods to understand how a number of individual households or businesses might form a Community of MPANs to realise benefits for the community and the system, as well as the system user. We will find out what capabilities are required for the community to collaborate in this way and hope to gain understanding of the scale required to manage and allocate risk effectively through commercially viable business models.

We will be learning by doing and hope to add to understanding about what benefits might be gained from working at the household level or the community/neighbourhood level as distinct from the town, city or national level.

We will use learning from the trials as they develop to inform understanding about the LCH role and growth strategy as an enabler, advisor or service provider to roll out repeatable models across Oxfordshire. This will include 'thought experiments' to work out how successful models could scale up into local energy service companies (LESCOs) or into complete microgrids. It will also include experiments to work out how large numbers of small assets operating through communities of MPANs might be technically and commercially aggregated through the PPS 2.0.

We expect to work in a way that is community-led and attempts to include all members of the community in an equitable way. We will do this by applying our Ethical Framework to each project and reviewing delivery of the trials against it.

We will maintain contact with other relevant organisations and community projects to share challenges, solutions and progress as an enabler for earlier rollout.

Appendices

A: Community of MPAN models and implementation requirements

Table A1: Virtual MPAN: critical mass of customers sign up but small size requires simple commercial solution

Area	Implementation Requirements	Solutions Available	Barriers
Technical	1. Metering of generation 2. Metering of demand 3. Generation capacity 4. Flexibility capacity 5. Optimisation and control	1. Exists and appropriate 2. Exists for premises 3. Exists 4. Osney Hydro exists; battery, DSR and additional EV chargers which do not yet exist 5. No implemented solution	1. Nil 2. Need real-time central metering 3. Insufficient for balancing 4. Sizing the battery and DSR is unknown 5. Require solution
Commercial	1. Organisation to buy, sell, trade and supply electricity and aggregate flexibility 2. Supply contracts with ToUTs, PPAs and other smart products 3. Capacity Sharing Agreement (Westmills)	1. Commercial solutions available in market 2. Commercial solutions available in market 3. Has been done before by SSEN but in limited numbers and there is a possibility of an ENA sponsored trial	1. Need to establish and may need credit for trading 2. Require more knowledge, experience and expertise 3. Cost and DNO appetite
Regulatory	1. Clarify regulatory requirements, understand issues around the protection of domestic customers and negotiate Capacity Sharing Agreement	1. Engage with ENA trials and Ofgem and use regulatory sandbox	1. Access to Ofgem; ENA appetite
Social	1. Need a critical mass of properties to sign up to contracts 2. Means of allocating, using or distributing the net benefit	1. Understanding and educating customers and stakeholder engagement 2. To be developed	1. Obtaining a critical mass 2. Require more knowledge and experience

Table A2: Local ESCO: critical mass of customers sign up and size can support specific new corporate structure

Area	Implementation Requirements	Solutions Available	Barriers
Technical	1. Metering of generation 2. Metering of demand 3. Generation capacity 4. Flexibility capacity 5. Optimisation and control	1. Exists and appropriate 2. Exists for premises 3. Exists 4. Battery, DSR and additional EV chargers which do not yet exist 5. No implemented solution	1. Nil 2. Nil 3. Insufficient for balancing 4. Sizing of the battery and DSR are unknown as is number of EV chargers 5. Require solution
Commercial	1. Organisation to buy, sell, trade and supply electricity, be responsible for imbalances and aggregate flexibility 2. Supply contracts with ToUTs and PPAs 3. Need ESCO agreement	1. Solutions available in market 2. Solutions available in market 3. Solutions available in market	1. Need to establish and may need credit for trading 2. Require more knowledge, experience and expertise 3. Cost to implement
Regulatory	1. Regulatory requirements applicable to commercial structure	1. Use regulatory sandbox	1. Require more knowledge, experience and expertise
Social	1. Need a critical mass of properties to sign up to contracts 2. Means of allocating, using or distributing the net benefit	1. Understanding and educating customers and stakeholder engagement 2. To be developed	1. Obtaining a critical mass 2. Require more knowledge and experience

Table A3: Microgrid: all customers behind a secondary substation sign up

Area	Implementation Requirements	Solutions Available	Barriers
Technical	1. Single point of connection 2. Metering of generation 3. Metering of demand 4. Generation capacity 5. Flexibility capacity 6. Optimisation and control	1. Existing 2. Exists and appropriate 3. Exists for premises 4. Osney Hydro exists; battery, DSR and additional EV chargers which do not yet exist 5. Exists 6. No implemented solution	1. Needs to be repurposed 2. Nil 3. Need real-time central metering 4. Insufficient for balancing 5. Most unknown 6. Require solution
Commercial	1. Organisation to buy, sell, trade and supply electricity and aggregate flexibility 2. Supply contracts with ToUTs and PPAs 3. Locational charges for community 4. Location of single point of connection and whether this includes buying DNO assets, e.g. LV side of substation	1. Solutions available in market 2. Solutions available in market 3. Exists for large single connection 4. Has been done before	1. Need to establish and may need credit for trading 2. Expert knowledge 3. Creation of single large connection 4. Finance and DNO appetite
Regulatory	1. Regulatory requirements applicable to commercial structure	1. Use regulatory sandbox	1. Require more knowledge, experience and expertise
Social	1. All properties to sign up to microgrid 2. Means of allocating, using or distributing the net benefit	1. Understanding and educating customer and stakeholder engagement 2. To be developed	1. High chance of resistant customers or low level of interest 2. Require more knowledge and experience

B: Defining place for each Smart and Fair Neighbourhood

Osney Island is at the simple end in terms of defining the place and its context because:

- It is an island of just under 300 households
- With one secondary substation serving the whole island
- And there is a community group, Osney Island Residents' Association, using the same boundary to define its area of operation

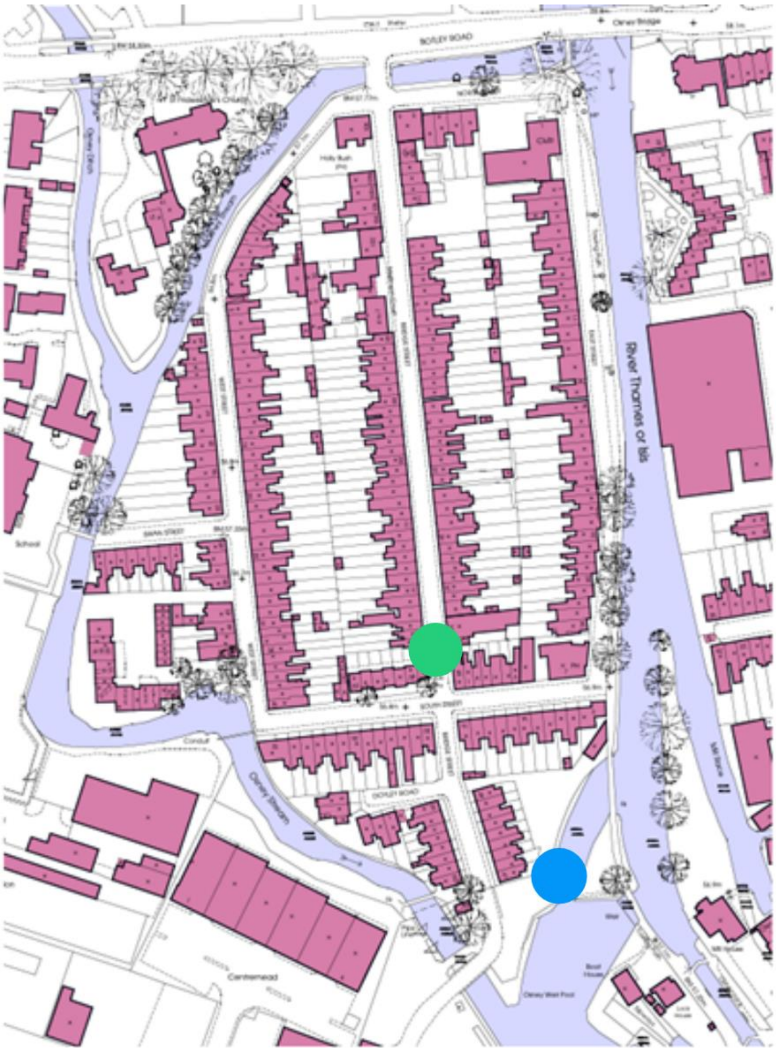


Figure 10: Osney Island SFN area: secondary substation shown as green circle; Osney Lock Hydro as blue circle

Eynsham is probably the most complex because:

- The community itself identifies a whole ‘area’ of operation (Eynsham Green Transition Area) that encompasses 5 parishes and their associated settlements;
- The motivation for taking part in LEO is to understand how to accommodate a doubling of the house numbers in the area as well as the new generation and demand we are foreseeing for distribution networks in general;
- And so there is no obvious alignment of administrative, social or energy system boundaries that give a neat spatial definition for the project;
- So we have agreed with the community to use the primary substation area as an experimental boundary for the project, though with the clear understanding that there is a risk there because energy network boundaries are all subject to change as the network evolves

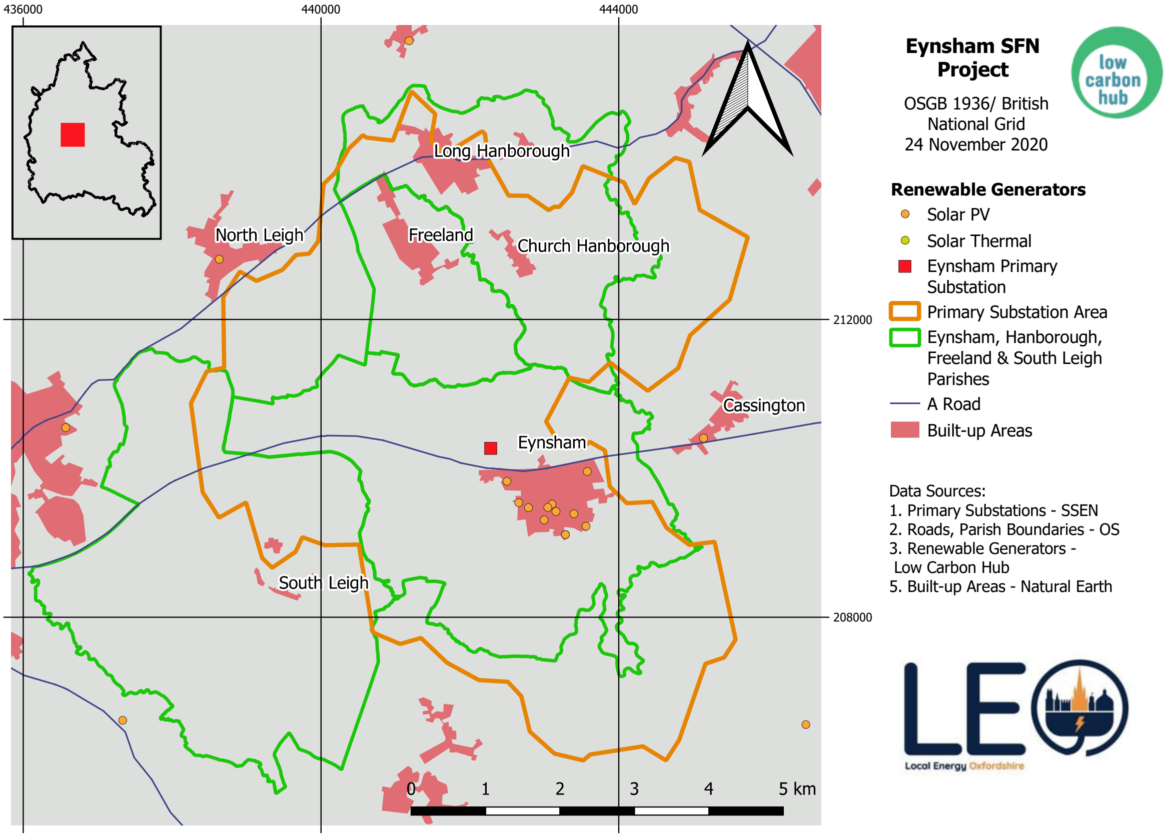


Figure 11: Eynsham SFN area: decision to use the primary substation area

Rose Hill and **Deddington and Duns Tew** are of medium complexity in these terms because:

- The community boundary covers many secondary substations;
- But the communities involved have both decided to focus on particular secondary substations that map well onto social and physical distinctions already present;
- This process has not been entirely simple and uncontested, however, and it has been problematic to allocate SSEN monitoring resources effectively across all the SFNs

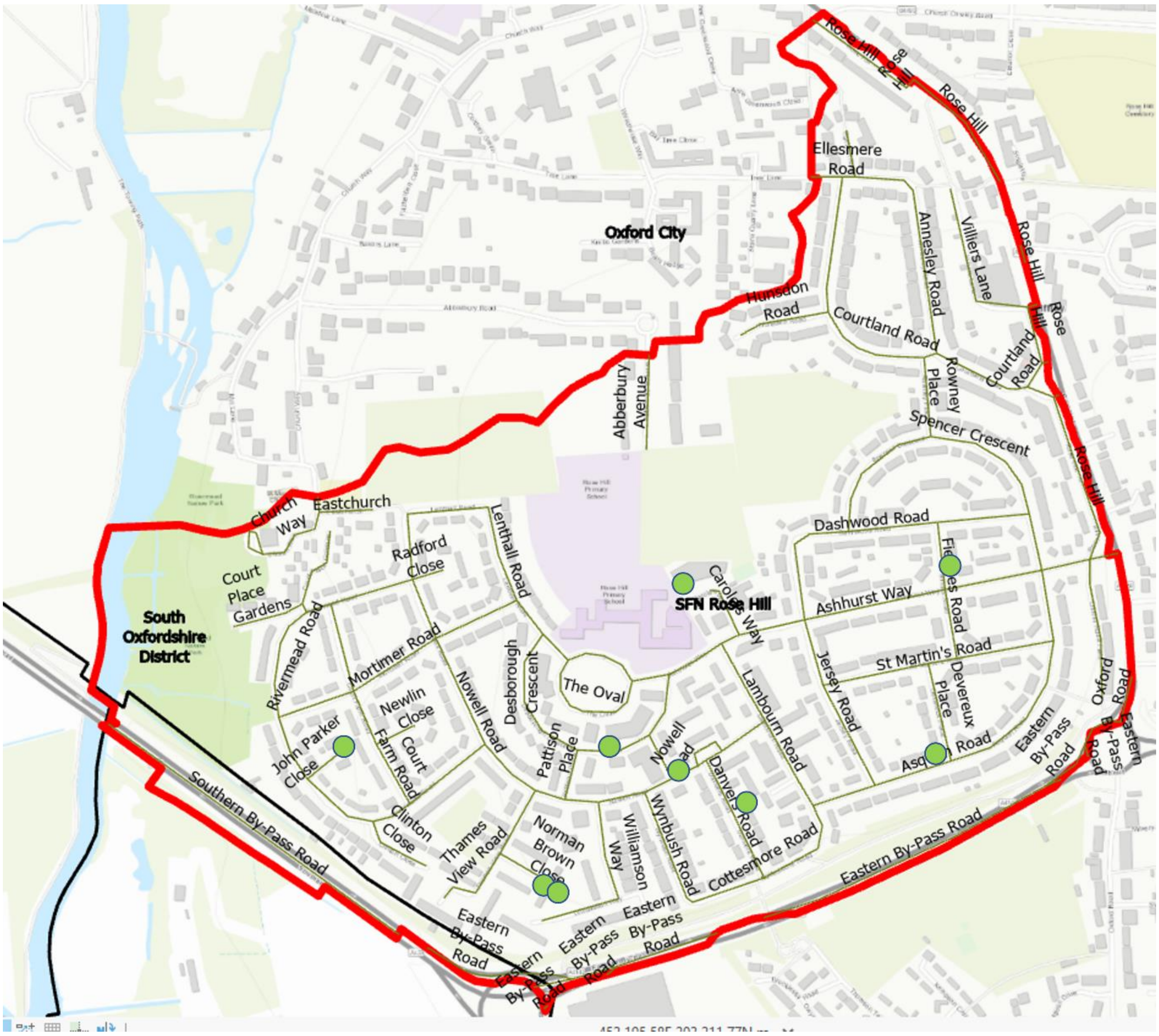


Figure 12: Rose Hill SFN boundary with nine substations marked in green.
Area focuses on the social housing estate, mostly owned by the City Council

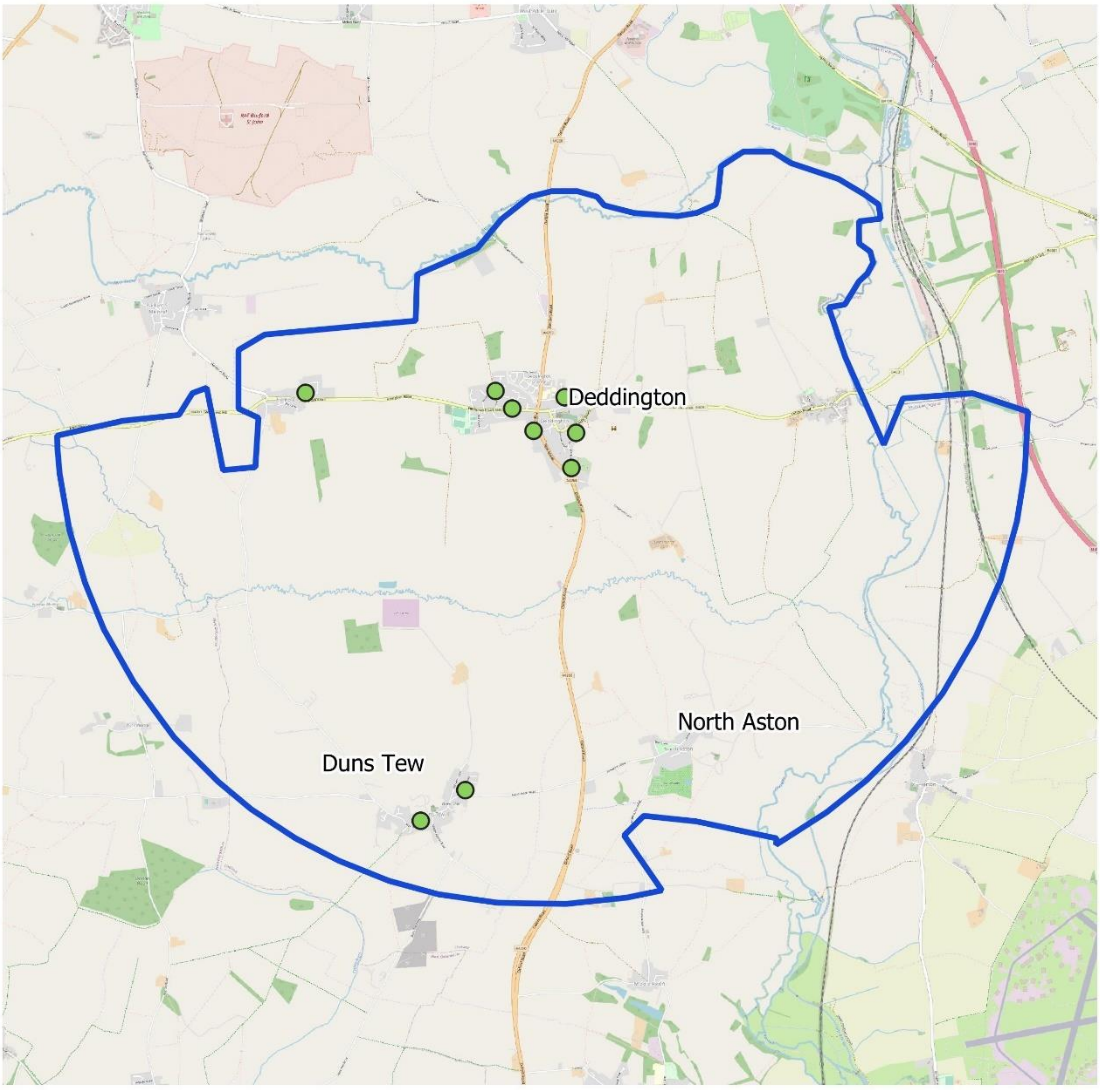


Figure 13: Deddington and Duns Tew boundary with nine substations marked in green. SFN boundary is the blue line focusing on the off-gas area of Deddington and Duns Tew

Westmills is a different case again in that the place is very clearly defined as the total area leased to Westmill Windfarm and Westmill Solar Park cooperatives by the farmer landlord. The primary substation area crosses the County boundary however and there is a bulk supply point very close by, so a single site very quickly links into the network well beyond the grid edge. In this case, also, the community benefitting is one of interest, i.e. the 3,000+ investor members of the two co-operatives.

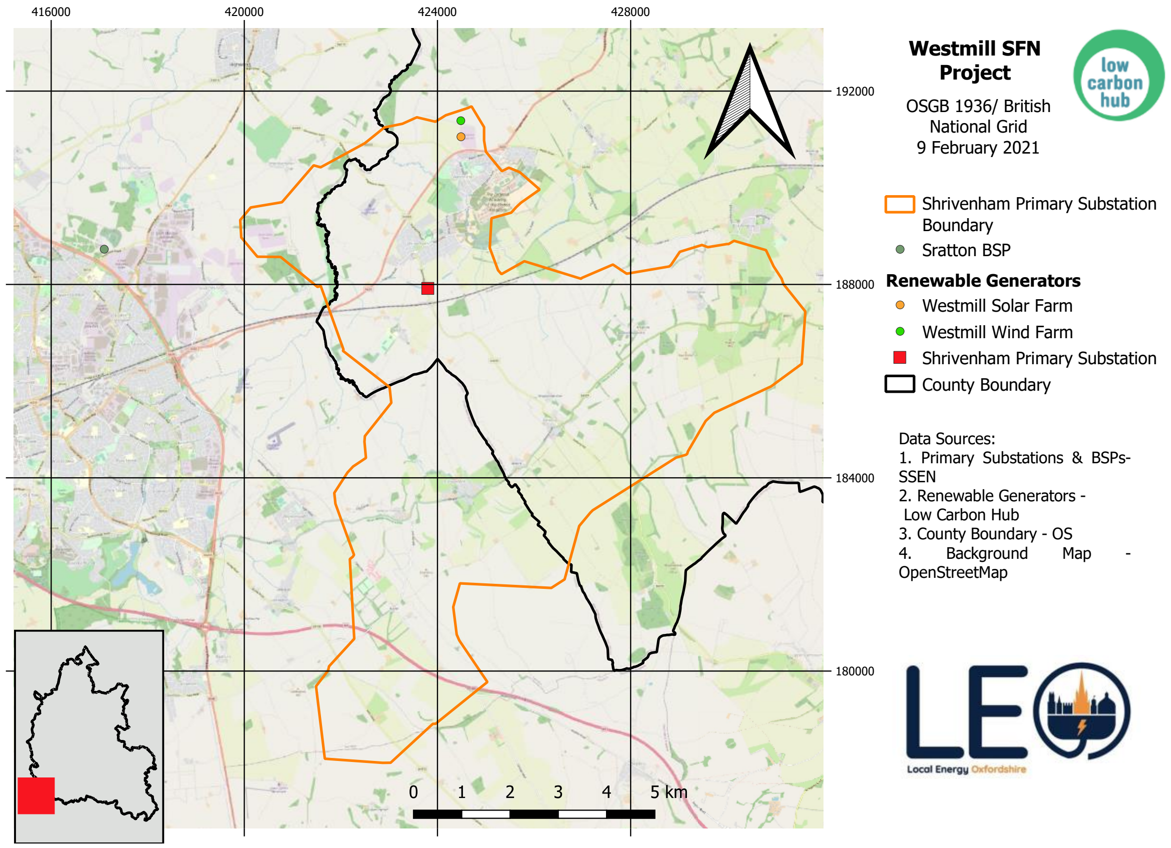


Figure 14: Relationship between primary substation and county boundary

Figure 15: Relationship between the Westmill site, the primary substation, and the Bulk Supply Point

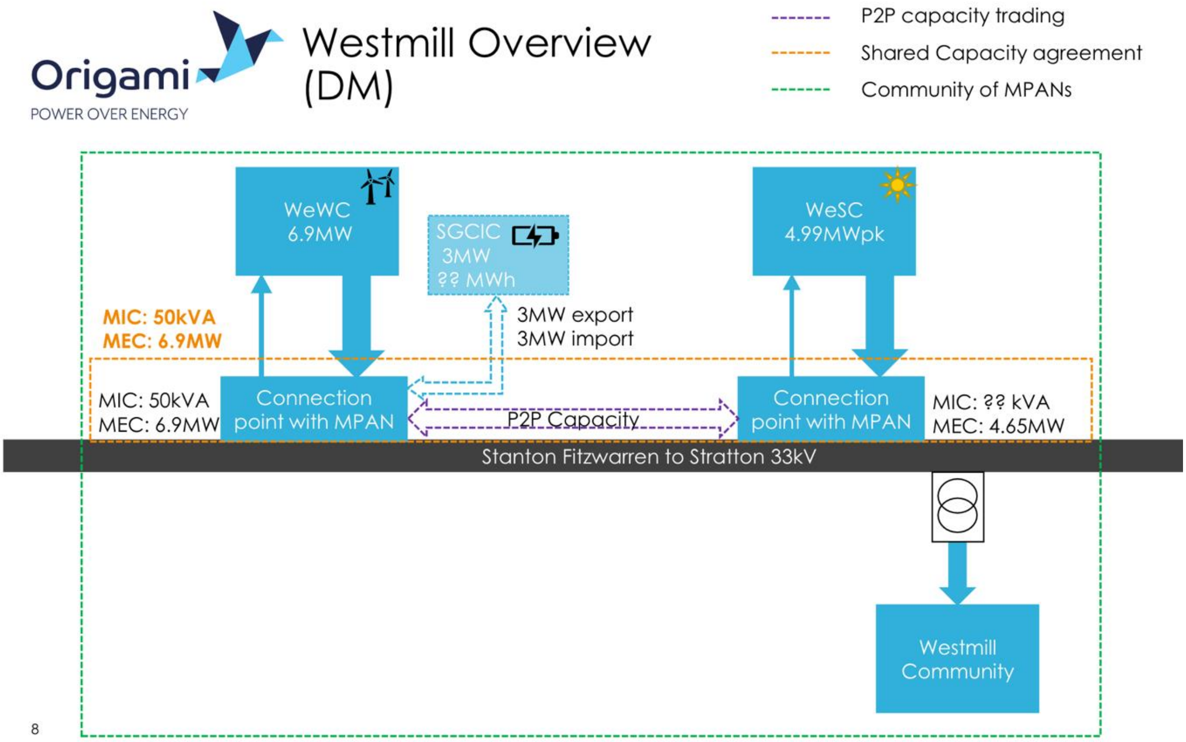


Figure 16: diagram of relationships on site between windfarm, solar farm and 33kV line

C: Osney slides of Origami technical assessment

The slides below show how the technical assessment for each SFN is done using Osney as the example.

Origami
POWER OVER ENERGY

Osney Overview - Analysis

Analysis

- Reviewed data from the Eneida portal (Oct-20 to Apr-21) to determine the demand profile of the island
- Reviewed the export data from the EA site (Jan-17 to Jun-20) to determine how much of the Hydro's generation was being exported and when
- Reviewed the historic data for the West St charging point at Osney (Dec-18 to May-20)
- Considered options to balance the generation from OLH locally

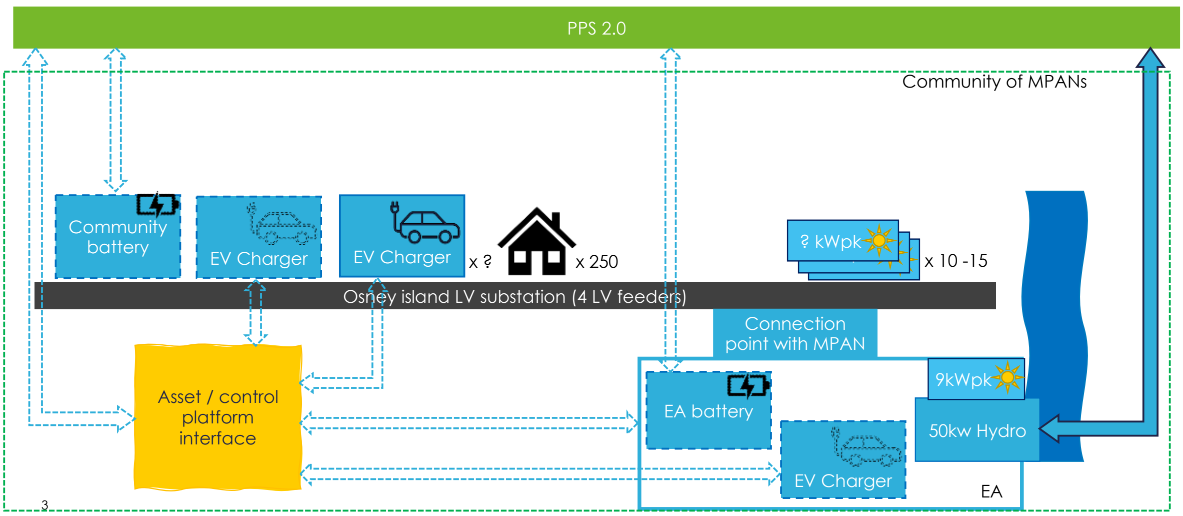
Outcome

- All the generation from OLH is consumed on the island
- Maximum total energy exported per day from the EA site is 982kWh
- Four users currently using the EV charging point at Osney
  - Larger charging sessions at night
- Could use a singular large battery at the ENA site with multiple EV chargers
- Could use two smaller batteries, EV chargers and demand at the South Street Feeder

2

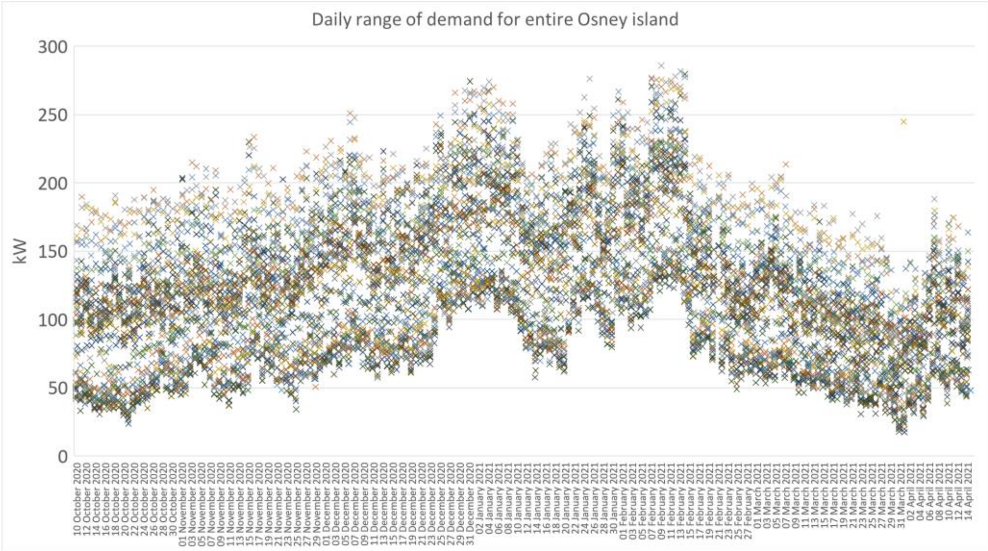
Origami
POWER OVER ENERGY

Osney Island - Overview



Origami
POWER OVER ENERGY

Osney Island – demand range



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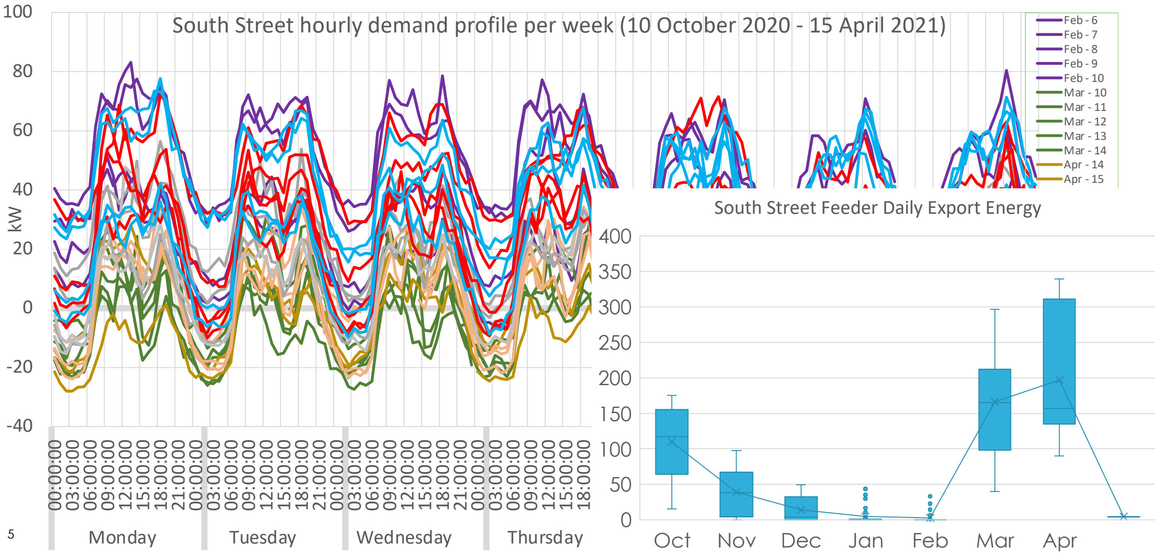
Origami
POWER OVER ENERGY

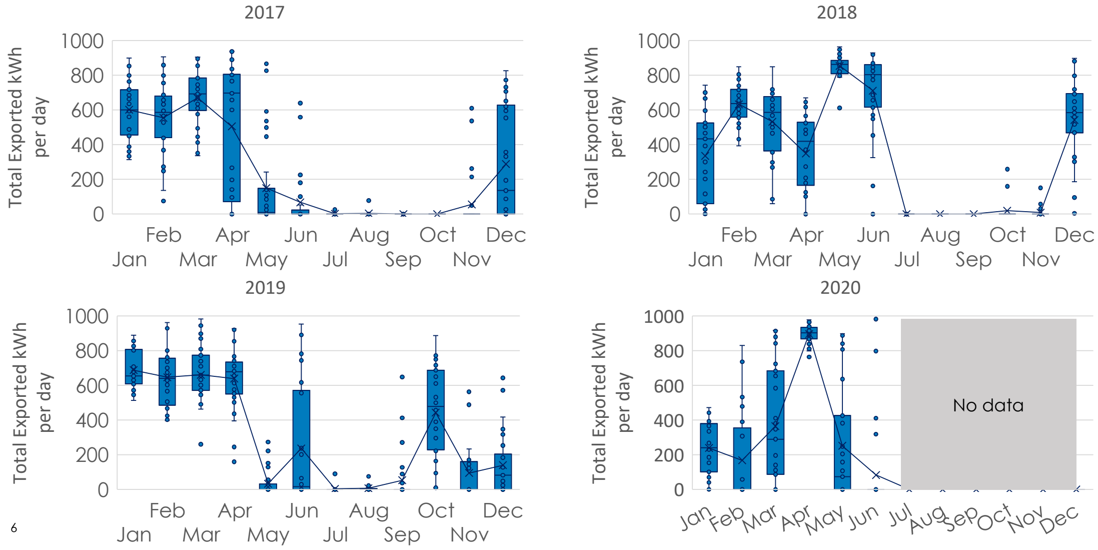
Osney Island – feeder level (with EA site)



5

Origami
POWER OVER ENERGY

Osney Island – Daily energy export from EA site



6

Origami
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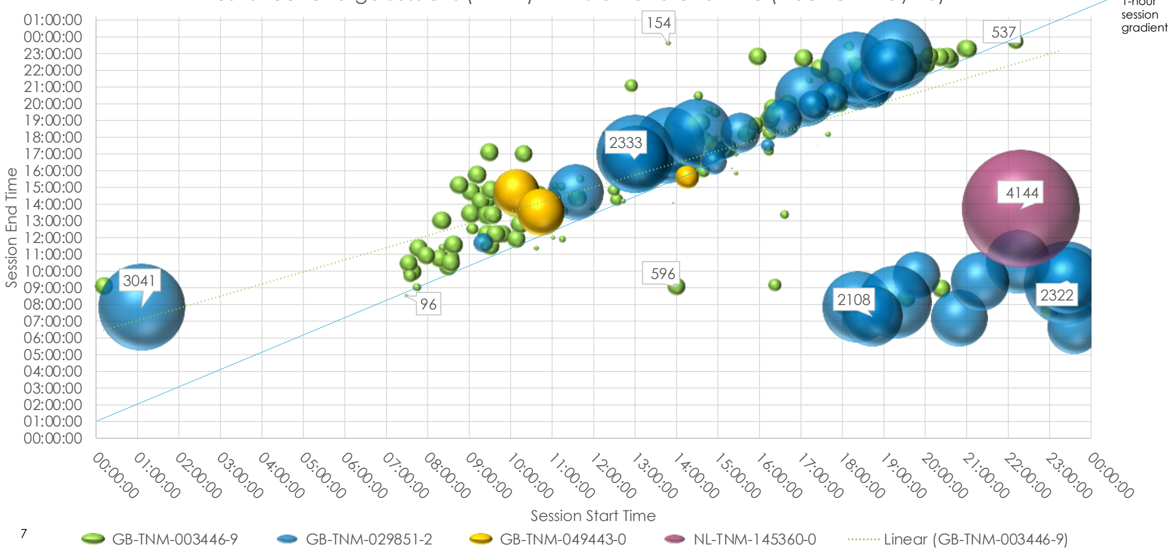
Osney Island – West St EV Charger

West Street charge sessions (in Wh) with start and end time (Dec 18 – May 20)



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Osney Island - options

- To absorb export from the EA site:

- To absorb export the South Street LV feeder:

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D: Table of learning outcomes

Table D1 below sets out the direct and extrapolated learning outcomes the Low Carbon Hub expects to achieve in implementing the SFN Community of MPAN trials. Table D2 sets out the learning outcomes we expect to achieve relating to the real-world challenges of implementing the trials across 5 key dimensions: technical, social, commercial, governance and regulatory.

Table D1: Community of MPAN Learning Outcomes v2 16.8.2021 SH

	Low Carbon Hub desired learning outcomes	As a result, we will...	
Direct Learning		**know**	**be able to**
Project output	**To develop** a viable and replicable CMPAN model with clearly defined features and benefits for key stakeholders.	**The** key features of a Community of MPANs. The smallest unit of participation - is it an MPAN, asset or system user level?	**Identify** and describe the key building blocks of a Community of MPANs.
Process **How we did it**	**To use** our practical experience of participating in flexibility markets and P2P trials to develop the CMPAN model	**How** to link two or more system users together to create a Community of MPANs.	**Describe** the key steps in the process needed to set up and manage a Community of MPANs from the bottom up.
Barriers to participation: What barriers to participation did we encounter and how we did overcome them?	**Identify** the role of LCH and the potential for PPS2.0 to support open access to flexibility markets/P2P and provide a means for collective decision making. **To learn** how we can help overcome barriers that prevent: a) Participants realising potential benefits. b) Uptake amongst an identified target market c) full accessibility to the service by other system users	**Identify** the barriers to participation by system users in a CMPAN trial and how to mitigate them. **Identify** who is disbenefitted by an offering and recommend how this might be mitigated. **Identify** likely show-stoppers for a CMPANs.	**Propose** and test potential solutions to overcome these barriers. **Gain** insights as to whether there are any particular barriers that may prevent the concept from becoming viable within the current energy system.
Capabilities: What have we learned how the capabilities of individuals, assets, communities or the system level to enable specific	**What** are the minimum capabilities are required to participate in flexibility and P2P markets? **Does** LCH have these capabilities, and if not, how do/can we get them? **What** role can PPS2.0 pay in providing these capabilities?	**What** capacities are needed at the level a) an individual b) an asset to participate or c) a community to 'host' a CMPAN. **What** makes the difference between having the potential, and creating, a thriving CMPAN?	**Use** a community lens approach to help identify or support selection strategies for a particular place based approach. **Identify** which market segments are excluded from participation.

energy offerings or SLES to thrive?			
Scalability potential: What would be the potential to scale up this activity in this place?	**Know** how to assess the potential size of the local market for a service offering and the potential flex it could deliver within a defined area? **Develop** a baseline understanding of how to achieve full coverage and resourcing for local energy plans across Oxon, and explore LCH's role in delivering that. **Create** a compelling case for the role local energy, community energy and flexibility services, can play in accelerating the transition to net zero energy system	**The key** characteristics and capabilities that make someone a potential participant in a CMPAN. **How** to calculate the potential flexibility and energy allocation services that could be delivered from within our test communities.	**Identify** the pool of potential participants in a Community of MPANs in a given community **Assess** if it the exercise is worth repeating. **Assess** if it worth replicating elsewhere.
Extrapolated Learning	**Low Carbon Hub desired learning outcomes**	**As a result, we will…**	
		know	**be able to**
Replication potential: What would be the potential to replicate this activity elsewhere and what would help or hinder replication?	**Champion** the concepts of 'grid edge', 'community of MPANs' and 'shared capacity' in making a compelling case for the importance of the very local in the future in balancing the grid from the edge up to the centre. **Create** tools to support replication for working with communities on mapping, modelling and planning their local area energy plans. **Help** communities identify which are the most appropriate local energy activities for their particular area. **Make** LCH the go-to partner for post-LEO partnership projects on local energy.	**Is there** is a minimum, maximum and optimum size for a CMPAN to operate successfully. **What** are the drivers that might make other community groups want to trial a CMPAN?	**Assess** if the CMPAN can be expanded to include other LCH assets. **Better** understand what is needed for there to be an enabling environment in which a local energy approach can flourish. **Create** relatable case studies that inspire others to replicate our activities. **Create** a compelling case for the role local for the role local energy, community energy and flexibility services, can play in accelerating the transition to net zero energy system

Actors: Who are the essential actors, and do they have the back-up they need? How resilient is the SFN to losing any of them?	**What** roles can individuals and community groups play as users of services, delivering services, championing local energy and as stewards of a local energy plan. What help do communities need to work together to support the potential for local energy solutions to meet the needs of their communities in a way that is smart and fair? Use these findings to create a more enabling environment in which local energy and community energy can flourish and strengthen the Oxfordshire low carbon community network	**Who** are the essential actors in the set up and running of a CMPAN?	**Explain** the benefits and opportunities of participation can bring and the roles of different actors in delivering this. **Contribute** to a revised Oxfordshire Energy Strategy and a revised Pathways to Zero Carbon report (new name for Oxfordshire Low Carbon Economy report) and champion the role of communities, local energy, and community energy in its delivery
Ethical delivery of trials: Did we meet our ethical trial principles?	**To test** our proposed ethical principles, and the tools and techniques to guide the delivery of ethical trials and equitable service offerings.	**Know** if the principles, tools and techniques developed to guide ethical trials and equitable service offerings are fit for purpose. **Learn** if the CMPAN concept addresses or exacerbate the issues set out in our ethical principles for a service offering.	**Confirm** whether trials met our ethical principles for the delivery of trials.
Smart and fair energy systems: What insights did we gain about energy equity?	**Identify** which market segments are excluded from participation. Identify groups at risk of being left behind or disadvantaged and the capabilities they lack that causes this.	**Learn** if the CMPAN concept addresses or exacerbate the issues set out in our ethical principles for a service offering.	**Propose** support or action that might reduce barriers and widen participation.

Table D2: As a result of the trials, we will gain direct experience and learning relating to the challenges of implementation in a real world setting across five key dimensions (technical, social, commercial, governance, regulatory) and the value they can create.

Dimension	Low Carbon Hub Outcome	Through the trial we will learn	As a result, we will be able to…	And gain wider insights regarding:
Technical feasibility: What did we learn about the technical	**Support** the technical development of PPS2.0 **Assess** and enhance the technical capability of LCH	**How** to capture near-real time data from DERs. **How** to establish bi-directional comms with multiple types of DERs.	**Set** out the practical steps to connect DERs to the PPS2.0. **Remotely** monitor and control a range of assets. **Measure** the generation,	**What** are the 'crucial' sets of data when it comes to making decisions about local energy and flexibility.

delivery of the activity?	assets to participate in flexibility and P2P services **Assess** whether the role of PPS2 is as a technical or commercial aggregator.	**How** to control DERs remotely. **How** to create real time visibility over some of the local electricity network. **How** local energy assets can deliver DSO-enabled and DSO-procured services and energy. **How** to connect DERs to the PPS2.0.	consumption, storage and capacity of a number of different system users and their assets. **Estimate** potential flexibility a system user is able to contribute to a Community of MPANs. **Model** and manage intra and inter-MPAN energy profiles	**Understand** how granularity and immediacy of available data impacts on the ability to participate in a CMPAN. **The degree** to which an asset needs to be remotely controlled to participate. **The importance** of speed of dispatchability, and degree of automation, within the system. **Understand** the relative importance of the resource mix [generation/ demand/ storage/ capacity]
Commercial viability: What did we learn about the financial and legal aspects of the activity?	**Develop** the commercial framework between: a)DER owners and PPS2.0. b) PPS2.0 and wider markets. **Identify** a potential business model for PPS2.0 and key barriers that would prevent the full potential of the PPS service offering, inc accessibility. **Consider** the opportunities for PPS & flexibility services as both a marginal or strategic new post subsidy business activity for LCH and community energy. **Have** tangible egs of how community energy assets can deliver value to the operation of the local electricity network to make the case for routes to market to be enabled.	**Understand** what is needed to set up and co-ordinate a CMPAN with regard to: a) commercial arrangements b) OPEX/ CAPEX requirements c) breakeven and payback points d) Opportunity cost of participation e) regulatory **Propose** the minimum viable operating size for a CMPAN.	**Draft** the contracts needed between participants and what other contractual arrangements need to be place in order to manage the CMPANs **Estimate** the costs and benefits of integrating other assets into a CMPAN.	**Minimising** transaction costs for integration and participation of assets. What else would improve commercial viability? **Which** business models can be replicated a) from day one or b) if the trial market conditions are replicated. In particular: 'Self-consumption' models which combine trading energy, flexibility and energy efficiency with self-storage and generation to maximum benefit. **If flexibility** and P2P can make holistic approaches to energy efficiency and generation in retrofit and new build a more attractive an investment proposition to owner-occupiers and landlords **The viability** of investment models for emerging service offerings. What opportunities might exist in 2030 – and what needs to happen in order for there to be benefits for us in the future

				What is the role for energy efficiency and behaviour change
Dimension	**Low Carbon Hub Outcome**	**Through the trial we will learn**	**As a result, we will be able to…**	**And gain wider insights regarding:**
Governance: What do we learn about how the governance of the energy system helps or hinders the activity?	**Learn** how long-term stewardship of local energy plans can be resourced, both the people who can form the governance arrangements, and the funds to support their work **Promote** the concept of 'stewardship' of Local Energy Plans, and giving communities a formal role in that process	**Some** of the concerns individuals may have about sharing their energy data with a third party.	**Design** a transparent participant sign up process that fully explains how we collect and use their data. **Use** our real-world experience to highlight how local and national strategies can support or hinder the ability of local energy, community energy and flexibility services to contribute to the transition to net zero energy system	**Explore** how to build trust sufficient so people will allow a third manage their consumption and access their data, and what this might mean as to who would be trusted as the organiser of a CMPAN. **The value** of mapping tools such as LEMAP to enhance the role and clout of local communities in the development of LAEPs.
Social desirability: What did we learn about the desirability of our activity from the perspective of different stakeholders?	**Understand** the needs and drivers of domestic + SME service users. **Understand** how marketing techniques and messaging can enhance participation in local energy offerings **Understand** the value of mapping tools such as LEMAP for engagement at the grid edge	**Set out** the potential cost and benefits of participation in a CMPAN for a system user and for the catalysing community. **Describe** the customer journey for participation.	**Communicate** the features & benefits of a CMPAN such that a potential participant understands the opportunity. **Support** a system user through the process of signing up and the participating in a CMPAN **Propose** the minimum viable operating size for a CMPAN.	**Are there** particular audiences for whom participation in a CMPAN is more likely to be an attractive proposition? **The value** of collaboration as a community for initiating and maintaining participation. **Which** sorts of communities might be likely candidates as early adopters of CMPANs.
Value creation: What environmental, financial and social co-benefits were generated, for	**Develop** CMPAN value propositions for a) 3rd party energy assets b) catalysing communities **Test** if the 'off market' benefits created through CMPANs are sufficiently motivating to drive	**Identify** the environmental, financial and social benefits created by our test Communities of MPANs. **Test** the assumption that working off-market reduces	**Help** communities build their own value proposition for a CMPAN.	**Can place** based value stacking accelerate the transition to net zero. **The value** of LEMAP as an engagement tool **Explore** if there are particular audiences that participation in a CMPAN is more

whom and were they valued?	participation **Learn** how groups can identify which are the most appropriate opportunities for their community and assess the potential value the PPS 2.0 could generate for them **Understand** the role of consolidation of local area data and info to create value.	administrative costs and obligations. **Identify** additional costs and benefits that accrue if you then hook your Community of MPANs into the markets. **The potential** benefits of participation in and co-ordination of a CMPAN to individuals and communities.		likely to be an attractive proposition. **What** do we learn about the value of collaboration as a community for initiating and maintaining participation? Propose which sorts of community groups might be likely candidates as early adopters of CMPANs.