LEO Local Energy Oxfordshire




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Learning from the Smart and Fair Neighbourhood Trials

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Local Energy Accelerating Net Zero

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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 for 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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1 Foreword

In the original bid for Project Local Energy Oxfordshire (LEO),[1] the Low Carbon Hub committed to enabling communities and households to determine their energy future by taking part in 'hyperlocal' projects that could deliver flexibility services and also trade energy. This would be done by developing communities of skilled people who could evolve and deliver novel investment models. At that point, our understanding of why this new approach was needed and what benefits it would deliver was largely instinctive, building on the work we, and our community members, had been doing on behaviour change, energy efficiency retrofitting and community-owned renewable energy installations since the early 2000s.

Over the four years of Project LEO, we have experienced an almost vertical learning curve in gaining a better, more evidenced and more nuanced understanding about the need for mass action at the grid edge. This is where the voltage steps down from primary to secondary substations and then down to the 240 volts that comes into each house and each business (Figure 1).

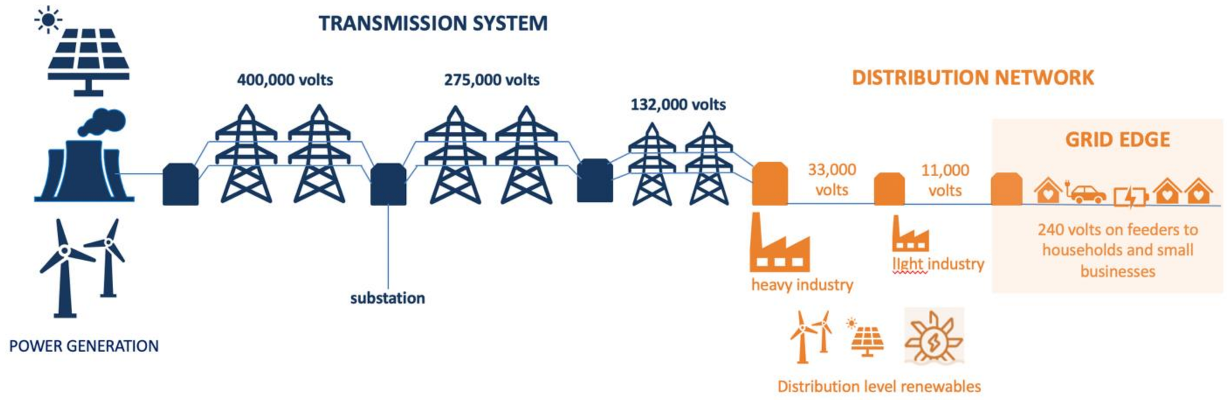

Figure 1: The grid edge: the primary substation, the secondary substation and the feeders connecting to every building

Some key research findings have also helped to crystallise our understanding. We can now follow the findings of the CREDS programme (www.creds.ac.uk)and be confident in saying that:

- If we are to meet the UK's legally binding carbon targets, we will need to move to an energy system primarily supplied by renewable electricity.
- This means that the major sectors of heat and transport, currently supplied by fossil fuels, will need to transition, largely to heat pumps and electric vehicles.
- The place where this enormous change will happen in on the low voltage network, right at the grid edge where the electricity system meets each household and each business.
- The change will require a doubling of electricity supply, but each household and business will be using half the energy they currently do because electricity delivers the work so much more efficiently than gas or oil.

[1] Note that all abbreviations are spelled out at the first mention in each section, then abbreviated. We also have included definitions of key concepts or terminology at the appropriate place. For key terms see also the online Project LEO glossary: https://project-leo.co.uk/glossary/.

- But, even if we could afford it financially, we do not have the time to double the capacity of the distribution network to cope with both a doubling of demand and a much more decentralized renewable electricity supply.
- So we must work with every household and business at the grid edge to reduce their demand as much as possible by combining energy efficiency, generation and storage technologies behind their meter and to move their demand away from peak times. This change could halve the energy demand of each customer.
- And we must help customers at the grid edge to work together, or trade between themselves and with local renewable energy generators, to balance use behind the secondary substation as far as possible and, again, to move it away from peak times.

We can also be confident in stating that such a 'hyperlocal' approach will achieve a much more efficient and cost-effective transition. Innovate UK's 'Accelerating Net Zero Delivery: Unlocking the benefits of climate action in UK city-regions' (March 2022)[2] identifies a clear benefit in place-based approaches to net zero delivery: their 'place-specific' scenario needs only £58bn of investment in comparison to £195bn for the 'place-agnostic' one but generates nearly double the amount of wider social benefits, £825bn in comparison to £444bn.

So action at the grid edge is vital to achieving our legally binding carbon targets and can deliver large amounts of local benefit at the same time. But how do we create new, repeatable and scalable ways of doing things, so that we can meet this urgent need for action and capture the benefits for our communities and our people? Our Smart and Fair Neighbourhood (SFN) projects are the Low Carbon Hub's attempt to work this out.

We set out the approaches we intended to take in our 'Community of MPANs' Project LEO report (Oct. 2021) produced in collaboration with Origami Energy.[3] In this, we described the concept, our approach to defining places and communities where we would develop SFN trials, and the learning outcomes we expected to achieve.[4] We also set out the ethical principles we intended to follow in developing and delivering the trials in our paper 'Developing an ethical framework for local energy approaches' (November 2020).[5]

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[2] www.ukri.org/wp-content/uploads/2022/03/IUK-090322-AcceleratingNetZeroDelivery-UnlockingBenefitsClimateActionUKCityRegions.pdf

[3] https://project-leo.co.uk/reports/community-of-mpans/

[4] Since the 'Community of MPANs' report was published, Low Carbon Hub have renamed the concept 'Smart Community Energy Scheme' (SCES). This was for two reasons:

- First, very few people understand the term 'MPAN' and so the name in itself could be a barrier to buy-in.
- Second, we are clear that place-based action on the energy transition needs to be carefully scaled, such that governance, planning and implementation happen at the appropriate geographic scale. There are current attempts to define a 'local' scale, through the Ofgem consultation on local energy institutions and governance, for example, and these tend to prefer larger-scale definitions at the city-region or tier 1 local authority scale. This is quite far away from the granularity required to work at the grid edge. So, Low Carbon Hub think it is important to understand what a SCES business model would be as distinct from 'Smart Local Energy Scheme' (SLES) models; what a 'Community Area Energy Plan' would be as well as 'Local Area Energy Plans' (LAEPs).

[5] https://project-leo.co.uk/reports/developing-a-ethical-framework-for-local-energy-approaches/

The present paper reports on the learning we have actually achieved through the hyperlocal SFN trials, sets out the key messages from our learning and describes further work we would like to do to bring the concept to market through viable, valuable, ethical, repeatable and scalable business models.

We are clear that much work remains to be done so that every household and business can easily balance energy demand and supply behind their own meter, and every community can plan, and take, action to balance its energy demand and supply behind the secondary or primary substation. But we are confident that we have made progress that can be refined further in future projects.

This work would not have been possible without the collaboration and support of the many communities, households and businesses taking part in the SFN trials. We would like to thank you all for working with us to help create a smart and fair local energy system for the benefit of all.

Dr Barbara Hammond, MBE
Chief Executive, Low Carbon Hub

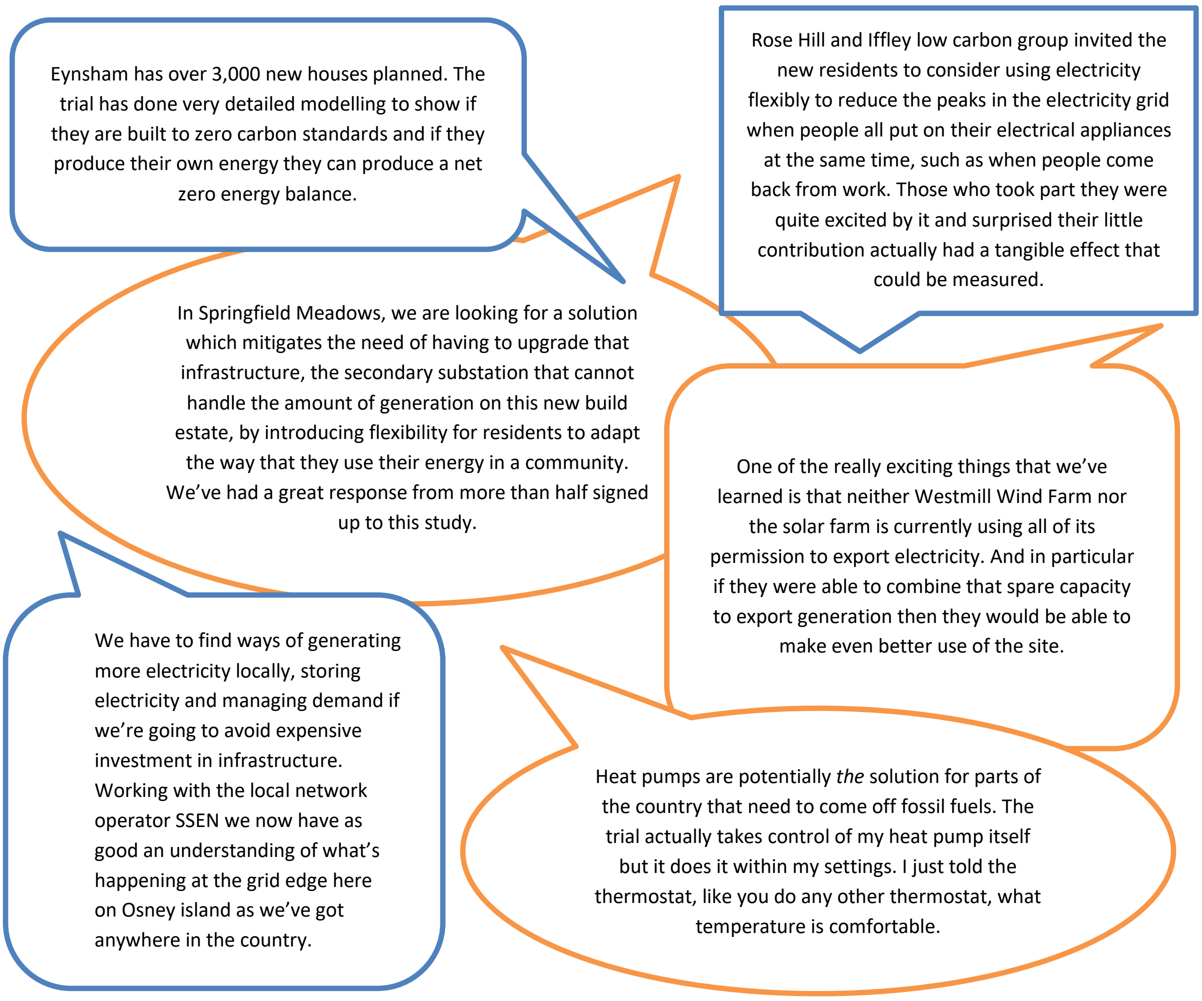

Figure 2: What the Smart and Fair Neighbourhood communities say

2 Introduction

2.1 Identifying the Smart and Fair Neighbourhood projects

The Smart and Fair Neighbourhood (SFN) projects are six trials (see Figure 3) that explore how Smart Community Energy Scheme (SCES) business models can:

- sit at the heart of a smart, low carbon, locally balanced energy system; and
- create opportunities and benefits in an equitable and fair way for everyone.

Deddington and Duns Tew SFN | Osney SFN | Rose Hill SFN | Springfield Meadows SFN | Westmill SFN | Eynsham SFN

Figure 3: The six LEO Smart and Fair Neighbourhood communities

Table 1 shows the typology of SCES business models developed by a team that was at Origami Energy and is now at Baringa.[6] These have an escalating level of complexity and intensity. The Low Carbon Hub's aim was to make as much progress as we could in implementing Virtual Private Wire and Virtual MPAN business models, and then explore how these might then scale up into the Local Energy Services Company (LESCO) and Microgrid business models.

SFN	Individual Self Consumption	Virtual MPAN (Passive)	Virtual MPAN (Active)	Local ESCO	Microgrid
Deddington and Duns Tew Heatsaver	n/a	Yes if energy allocation is required from local generation	Yes if energy allocation is required from local generation	No, not individually, but can be paired with another area	n/a
Osney Supercharge	Yes – per household and Osney Lock Hydro (OHL)	Yes – aggregated net from households and OHL	Yes – aggregated net and use of flexibility	May be if reach critical mass of participation	Yes with full enrolment of residents
Rose Hill SolarSaver	Yes (shared PV capacity and incentives)	Yes - aggregated net from households and PV	Yes with local tariffs (e.g. Time of Use)	Yes with Local tariffs (e.g. ToU) and critical mass of participation	May be if block become self-managed
Springfield Meadows	Yes (combination of PV,HPs, Storage, EVs)	Yes with local tariffs and carbon intensity information	Yes – aggregated net and use of flexibility for constraints.	No, not individually, but can be paired with another area	Yes (if local load balancing solution applied)
Westmills	n/a	Theoretically yes, if there is demand large enough in VMPAN to purchase available generation	Theoretically yes, if there is demand large enough in VMPAN to purchase available generation	Theoretically yes, if there is demand large enough in LESCO to purchase available generation	Only with suitably large enough storage on site

Table 1: A typology of potential Smart Community Energy Scheme models from simplest to most complex

[6] https://www.baringa.com/en/about/media-centre/baringa-bolsters-dso-consulting-arm/

Low Carbon Hub has a membership of community shareholder groups, 30+ when Project LEO started, now 40+.[7] We invited five of them to participate in the SFN trials based on our knowledge of their community group members, their goals and the nature of the challenges they are tackling, in order to develop a programme that would span a range of different contexts. While such a pre-existing level of engagement may not always be typical, it was important that the communities had sufficient capability and capacity to understand and commit to such projects at the cutting edge of innovation.

We were looking for a range of technical options and a range of socio-economic conditions. Table 2 shows the original starting position with the set of trials covering:

- different socioeconomic contexts, for example: affluent or deprived areas; different type of predominant property tenure; existing and new developments; and urban versus rural areas; and
- various technological solutions, such as heat pumps, solar panels, batteries, electric vehicles and microgrids. A further project was added later to fill a gap, Springfield Meadows, a new development of 25 'climate positive' households offering the possibility of developing at least a virtual MPAN and perhaps even a full microgrid.

Place-based context	Technical trial	Commercial viability	Social drivers
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 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.
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.
Rose Hill Estate including social housing; one of the most deprived areas in the UK.	**Optimising** and managing many small assets (PV, storage, appliances) to make a 'zero carbon estate'.	**How** many small amounts of flexibility and energy generation can be optimised and managed collectively.	**How** to benefit tenants in a dense urban area of multiple deprivation.
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 SCES – 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 SCES 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-operatives and a potential new social enterprise.
Eynsham Area A mixed area of five 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.

Table 2: Summary of Smart and Fair Neighbourhood characteristics: place-based context; technical trial; commercial viability; social drivers

[7] https://www.lowcarbonhub.org/community-members/

2.2 Identifying the individual components of a Smart Community Energy Scheme

As we were identifying and setting up the SFN trials, Low Carbon Hub worked with a set of householders, the HOPE group or 'House Owner Pioneers for Energy', to identify the basic set of components that would work together to achieve 'behind the meter' balancing of energy demand. Such balanced households would then become, along with local generation and storage assets, the basic components of a SCES.

The HOPE group households followed a process that could become the basic customer journey for all households in future:

- situational analysis
- options analysis
- relevant self-consumption business models
- action plan tailored to each household.

2.3 A fair and equitable approach

Critical to the SFN approach, and its success, were two sets of ethical principles. One set guided the design and delivery of our trials; the second set started supporting the design of flexibility services and products that were both smart and fair. This was important to Low Carbon Hub not only because we believe it is the right thing to do – but because fairness, in terms of who benefits and who carries the cost, is a key driver for mass participation at the grid edge.

These ethical principles were developed and implemented because any new system that is considered fair by a community is more likely to meet with social approval and therefore be successful.[8] So, the pursuit of fairness in the new energy system is not only the right thing to do, but also a key part of enabling the UK to meet its net zero goals. The principles used are set out in Figure 4.

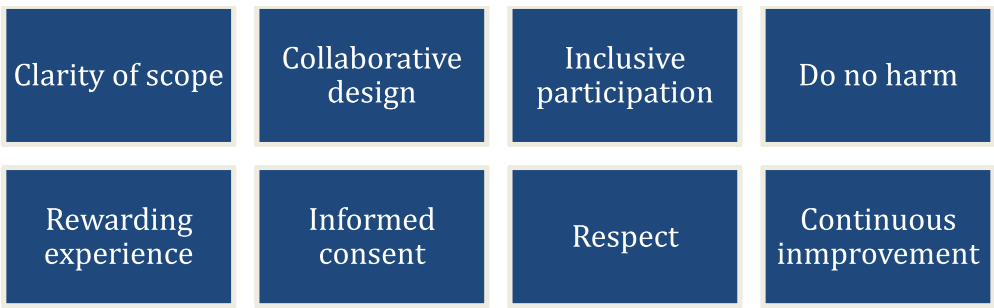

Figure 4: Principles for ethical Smart and Fair Neighbourhood trial delivery (taken from LEO report 'Developing an ethical framework for local energy approaches', November 2020)

[8] Personal communication by Professor Nick Eyre, University of Oxford, based on work done by the CREDS programme: www.creds.ac.uk.

2.4 Summary

In designing the SFN projects in this way, within Project LEO, Low Carbon Hub sought to:

- identify the basic components of 'behind the meter' balancing
- identify the basic components and typologies of a SCES
- explore fair and equitable approaches to the implementation of household and SCES projects (which become the components of the SCES as much as their DERs do)
- identify and test technically feasible solutions, commercially viable financial models and socially desirable value propositions that could together make replicable SCES products.

3 Key messages

We at Low Carbon Hub have derived the following key messages from our Smart and Fair Neighbourhood (SFN) trials as part of Project Local Energy Oxfordshire (LEO).

Key message 1: We need buy-in from every customer and every community

It is clear that the transition to a renewable electricity system is possible. But much of this transition requires a transformation of activity at the grid edge – particularly in moving to electric heat and transport. Everyone needs to take part in this transformation, and can derive many kinds of value from doing so.[9] But currently there is very low understanding of the need for change, and what the products and services are that need to be implemented by everyone, everywhere.

The SFN projects show that:[10]

- a shared understanding of the need for transition can be developed
- that households and businesses can and will optimise their energy use within their own property
- there is appetite to coordinate the use, generation and storage of energy within the community.

The SFN projects also support research that shows how important the perception of 'fairness' is to getting buy-in for change.[11] The ethical design and delivery of projects will be key to their success.

Key Message 2: Every building must be 'FutureFit'

Optimisation behind the meter is a key requirement for developing Smart Community Energy Scheme (SCES) models that can transform the grid edge. So, once households and businesses have bought into the need for change, we need to develop products and services that can together provide a simple and easy customer journey for them to make those changes.

We need to move on from retrofitting our buildings to be energy efficient to 'FutureFitting'[12] them to become microbusinesses making their own energy, balancing their demand and generation as far as possible and then using and exporting energy in a way that generates extra income.

Funding retrofit has been a problem so far because customers do not easily see the value of it: our SFN trials have shown that owner-occupier households are increasingly aware of the benefits to them of becoming FutureFit, both in terms of their energy security as well as reducing their energy bills.

[9] This can be done in a hands-off way, see Key message 3.
[10] See the companion piece to this report with detailed case studies of the SFNs.
[11] See the other companion piece to this report on designing the SFN trials ethically.
[12] Trademark pending

Key message 3: Every community needs a Smart Community Energy Scheme

FutureFit buildings can work together and with community-scale generation and storage assets to deliver flexibility services or trade electricity:

- within the SCES community behind the secondary substation; or
- beyond the SCES community at the primary substation level or the national system level.

It is highly unlikely that each building or asset owner will be actively engage with these flexibility services or trades themselves, and the full range of benefits for both owners and the network cannot be realised unless these owners and the network work together. As the 'Mission Zero' report (Jan. 2023) by Chris Skidmore MP puts it: 'Consumers will play an active role, taking up new tariffs and adopting smart appliances that reward flexibility and balance supply and demand variability in a hands-off way.'[13]

Key message 4: Optimisation behind the secondary substation brings a wide range of benefits but investment in data and digital by Distribution Network Operators (DNOs) is key to realising these

The SFNs have started to demonstrate the benefits of reducing electricity demand and balancing generation and demand behind the secondary substation. Investment is needed in data and digital for our electricity networks, especially on the low-voltage network at the grid edge, to enable access to data that is visible, including to the DNOs themselves. As well as being visible, data will also need to be understandable to those in the community beyond the Distribution System Operation (DSO) environment.[14] That in turn will mean that successful SCES models can be developed, repeated and then replicated everywhere in any network area.

Key message 5: A 'Local Convenor' is needed to catalyse action and unlock the value at the grid edge

A theme that emerged as Low Carbon Hub developed and delivered the SFN projects with our community groups was the need for a catalysing or convening role that could:

- identify opportunities for SCES development, and
- then bring individual energy customers and communities together with their DNO and local authority to share knowledge and learning at the grid edge in order to realise the projects (see also Section 6.2.4).

Figure 5 shows what we mean.

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13 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1128689/mission-zero-independent-review.pdf (p.100)

14 For the difference between DNOs and DSOs see Section 4.1.

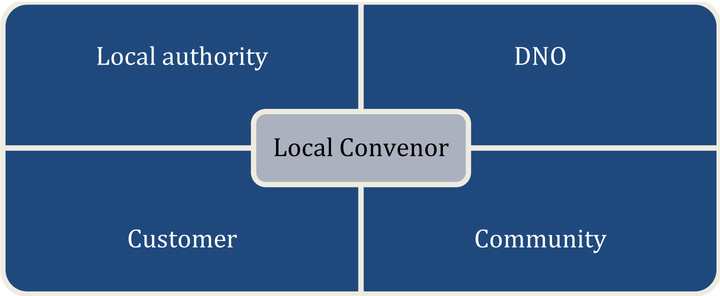

Figure 5: The mapping of the local convenor role in the context of the low voltage network

Low Carbon Hub is not yet sure whether this convenor role can or should be undertaken by a single actor, or whether it is actually a body consisting of a number of actors collaborating, learning and sharing knowledge freely. We are more certain that the role needs to be able to be entrepreneurial in identifying opportunities that can be delivered either as services to individual customers at scale or as commercially viable and repeatable SCES.

4 What you need to know about

4.1 The Distribution System Operator role and flexibility markets

The electricity network is split into two levels. The 'transmission' network is the central, 'backbone' of the network which is managed by National Grid in its role as Electricity System Operator (ESO). The local, or rather regional, 'distribution' networks are managed by different organisations in the role of Distribution Network Operator (DNO).

Traditionally the ESO managed the balancing of generation and demand on the whole electricity system because generation was located centrally on the transmission network, demand was (mostly) located on the distribution network and the task was to 'send' power from generation to demand.[15] However, now that we are decarbonising the electricity system, more renewable energy generation is needed and this kind of generation is located across both the transmission and distribution networks. As a consequence, there is a greater need for balancing activities to manage the performance of the system within the distribution network.

The electricity sector has therefore been exploring the possibility of a new role, at the distribution level, which mirrors the balancing role of the ESO: a Distribution System Operator (DSO). In practice the development of this role has been led by the DNOs. However, if the role were to be established in regulation, it is not yet determined whether it would be fulfilled by the DNOs or by another organisation. This is why the terms DNO and DSO are distinguished.

The Energy Networks Association's (ENA) definition is:

'A Distribution System Operator (DSO) securely operates and develops an active distribution system comprising networks, demand, generation and other flexible distributed energy resources (DER).

As a neutral facilitator of an open and accessible market it will enable competitive access to markets and optimal use of DER on distribution networks to deliver security, sustainability and affordability in the support of whole system optimisation.

A DSO enables customers to be both producers and consumers; enabling customer access to networks and markets, customer choice and great customer service.'[16]

The DNO for most of Oxfordshire is Scottish and Southern Electricity Networks (SSEN).[17] As part of the transition to a decarbonised energy system, SSEN is developing its business operations to include DSO activities. SSEN's Transition project has developed a market for procuring 'flexibility services' (i.e. paying organisations like Low Carbon Hub to turn up or down generation or demand to help

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[15] This is a high-level summary to introduce the roles. In reality it would always have been more complicated as some readers will of course be aware.

[16] Quoted from https://ssen-transition.com/dso/about/

[17] www.ssen.co.uk/about-ssen/delivering-a-smarter-electricity-system/

manage the network).[18] This market also facilitates approval of 'bilateral flexibility arrangements' in which two parties can coordinate how they turn up and/or down generation or demand to their mutual benefit, while ensuring network performance is maintained.

The Smart and Fair Neighbourhood (SFN) trials explored whether delivery of these services or approved coordination between owners of generation and storage and users of electricity could help deliver benefits to both customers and the low-voltage network. In addition, other 'flexible energy mechanisms' were also considered, such as 'Time of Use Tariffs' in which users of electricity are charged different amounts depending on the time of day to incentivise a shift in the demand for power (i.e., flexibility with respect to time of use).

4.1.1 Electricity System Operator Demand Flexibility Service

The Demand Flexibility Service (DFS)[19] has been developed to allow the ESO to access additional flexibility when national demand is at its highest – during peak winter days – which is not currently available to it in real time. This new innovative service allows consumers, as well as some industrial and commercial users (through suppliers/aggregators), to be incentivised for voluntarily flexing the time when they use their electricity. It is possible to deliver both ESO and DSO flexibility services from the same DER, and some local households may have been part of this trial via their energy supplier over the winter of 2022/23.

4.2 People's Power Station 2.0

Turning up or down generation or demand can be done as easily as by flicking a light switch or turning off any export limitation on a solar installation. However, for the benefits to be worthwhile, control of generation and demand assets (referred to in the energy sector as DERs) really needs to be much easier and, ideally, that means control is remote and automated as far as possible. This obviously raises a lot of questions – which is part of the reason for running the SFN trials in the way we did. This section explains how Low Carbon Hub controlled devices using a new cloud-based platform that was developed, called the People's Power Station 2.0 (PPS 2.0).[20]

The PPS2.0 platform interface is a secure website, into which we log in to then command our DERs to turn up or down with a schedule. It also has minute-by-minute electricity metering of the DER which is displayed and stored. This can be combined with other DERs to show a community dashboard' that is the foundation of Smart Community Energy Scheme (SCES) design. Low Carbon Hub used the PPS 2.0 platform to manage delivery of flexibility services from our DERs during the Project LEO Transition trial periods.

Furthermore PPS2.0 can schedule the DERs included in it individually or aggregated in groups to deliver services to the DSO. So, if the DSO wants us to turn down by 100kW between 1pm and 2pm at a section of the grid where we have five solar PV rooftops, we can simply enter the command to

[18] https://ssen-transition.com/
[19] www.nationalgrideso.com/industry-information/balancing-services/demand-flexibility
[20] https://project-leo.co.uk/blog/explaining-the-peoples-power-station-2-0/

turn down by 100kW into a single calendar which has the five sites aggregated. The PV installations will turn down in proportion to their maximum generation.

PPS2.0 is being designed to automate as much of the process of delivering flexibility as possible to improve the business case of small assets participating.

Ultimately, PPS2.0 is planned to enable smart communities to manage all DERs within the community to optimise the use of generation and imports to meet demand using flexibility and storage. This would allow communities to then interact with adjacent communities, the regional network or the national system to manage the transition towards net zero.

4.3 The concept of a Smart Community Energy Scheme

From the late 1990s, community energy schemes played a critical role in engaging people with the changes to the electricity system needed to mitigate climate change and deploy more renewable generation. At a time when political action was limited, community energy schemes implemented generation schemes that contributed to reducing emissions and offered economic benefits to the local community and individuals that wanted to put their money into action on climate change. Community energy groups gave people a sense of agency and ownership of projects that were implemented in or near where they lived.

Since then, the challenge of decarbonisation of the energy system has moved from 'simply' deploying more renewable generation to adapting the system to manage the implications of distributed generation assets. Many community energy organisations have recognised this and have a desire to move their own efforts towards this challenge. While community energy projects have been able to sell electricity via bilateral contracts (called Power Purchase Agreements), there is a strong desire for members of these groups and their wider local community to be able to buy electricity as householders or business owners from 'their' local renewable energy installation. This is not currently possible due to the way in which the supply of electricity is regulated.

Through Project LEO, and with many thanks to the team then at Origami Energy, now at Baringa, for their support on this, Low Carbon Hub has developed a concept that we call a SCES. As presented in our report 'D3.8 Community of MPANs' (October 2021), we started with the fundamental building blocks and built it up from there.[21] We define a SCES as:

'A collaborative scheme between energy system users who coordinate 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.'

Turning this concept into a feasible business model for community energy is still a work in progress. We mention it here because where the SCES concept is our theory, the SFN trials are the practice. By learning through doing in the SFN trials we are informing the development of this idea for a future community energy business model.

[21] https://project-leo.co.uk/reports/community-of-mpans/

4.4 Local Area Energy Planning

Local Area Energy Planning (LAEP) is a method that Ofgem commissioned the Centre for Sustainable Energy (CSE) and the Energy Systems Catapult (ESC) to develop. A joint report by the two organisations explains it well:[22]

'Local area energy planning (LAEP) is a process which has the potential to inform, shape and enable key aspects of the transition to a net zero carbon energy system.

If done well, LAEP can provide sound foundations for effective and sustained local action to cut carbon emissions taken by well-informed local leaders and initiative-takers. They will have a shared purpose and a clear plan outlining the changes needed over time to achieve local commitments on net zero carbon emissions. And they will understand what others – such as national government, regulators and energy networks – need to do (and when) alongside them to establish the conditions for success.'

ESC has developed modelling tools that it had so far applied to LAEPs being produced for areas with populations of hundreds of thousands of people.[23] Looking in from the grid edge, this scale does not feel local to Low Carbon Hub or our community group members. So we commissioned ESC to apply its tools to a primary substation area to feed into Eynsham SFN and its Smart and Fair Futures project, so at a much smaller and more truly local population scale. The community wanted to produce a Zero Carbon Energy Action Plan that would hold developers to account in delivering net zero carbon new housing and enable those in existing settlements to understand how to play their part in the transition.

We have a tentative name for this sort of community-based, grid edge action planning process, to make the distinction from LAEPs; this is the CAPZero, or '**C**ommunity **A**ction **P**lan for **Zero** Carbon Energy'. Targets for the CAPZero were derived from the 'Pathways to a Zero Carbon Oxfordshire' (PazCo) report (2021),[24] from which a Route Map is being developed along with a Mapping Toolkit for Oxfordshire that is becoming the LAEP for Oxfordshire.

Further information is provided in the case study in the companion piece to this paper that gives more detailed descriptions of all the SFNs.

[22] 'Local Area Energy Planning: The Method' (July 2020), available from: www.cse.org.uk/downloads/file/LAEP-method-final-review-draft-30-July-2020.pdf
[23] https://es.catapult.org.uk/tools-and-labs/our-place-based-net-zero-toolkit/local-area-energy-planning/
[24] www.eci.ox.ac.uk/publications/downloads/PazCo-final.pdf

5 Smart and Fair Neighbourhood trial achievements in brief

This section provides brief introductions to our six Smart and Fair Neighbourhood (SFN) trials, with descriptions and images of their main achievements. This is for ease of reference here, as our discussion of learning outcomes in Section 6 below, we refer to specific SFN trials; full descriptions are contained in the companion piece to this paper with all the SFN case studies. The six SFN trials are ordered from least to greatest complexity and broadest geographic scale.

The trials were designed and delivered following the ethical principles developed in our report 'Developing an ethical framework for local energy approaches' (November 2020).[25] A report on our learning and key insights from this work is described in the second companion piece to this paper: 'Designing Smart and Fair Neighbourhood trials ethically'.

5.1 Deddington and Duns Tew Heatsaver

Key activity

- Installation of smart controls to new and existing heat pumps.

Figure 6: Heatsaver trial participants with their smart heat pump and using their control dashboard (photo credit: Low Carbon Hub)

Main achievement

- Delivery of flexibility trial services: Sustain – Peak Management and Sustain – Export Peak Management (see Table 3).

DER name	Date of event	DSO Service	Percentage delivered (%)	Flex amount (kW)	Price (£/kWh)	Revenue (£)
1	15-Nov	SPM	27	1	0.65	0.00
1	18-Nov	SPM	50	1	0.65	0.10
1	22-Nov	SEPM	169	1	0.85	0.85
2	15-Nov	SPM	2	1	0.65	0.00
2	18-Nov	SPM	4	1	0.65	0.00
2	22-Nov	SEPM	132	1	0.85	0.85
3	15-Nov	SPM	49	1	0.65	0.00
3	18-Nov	SPM	80	1	0.65	0.57
3	22-Nov	SEPM	330	1	0.85	0.85

Table 3: Heat pumps delivered Sustain – Peak Management and Sustain – Export Peak Management flexibility services in LEO Transition trials

[25] https://project-leo.co.uk/reports/developing-a-ethical-framework-for-local-energy-approaches/

5.2 Osney Supercharge

Key activities

- Coordinated monitoring and visualisation of data from multiple smart meters and DERs (hydro, solar PV, battery storage)
- Installation of 10 solar PV systems and 4 battery systems.

Figure 7: Osney Supercharge Smart Community Energy System elements (photo credits: Low Carbon Hub)

Main achievements

- Complete low-voltage network model for the secondary substation and its feeders carried out by SSEN project team (see Figure 8)

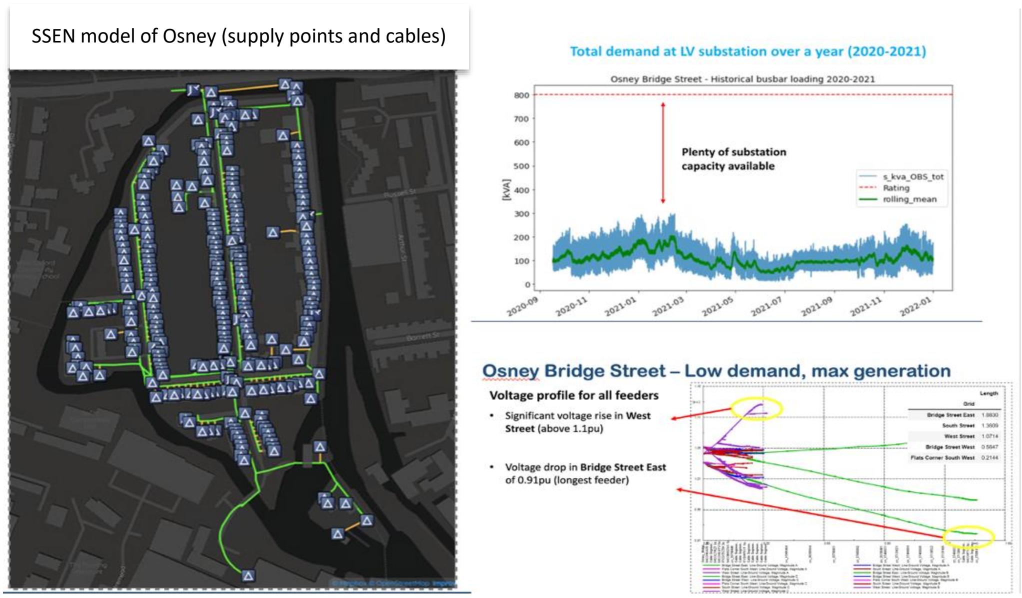
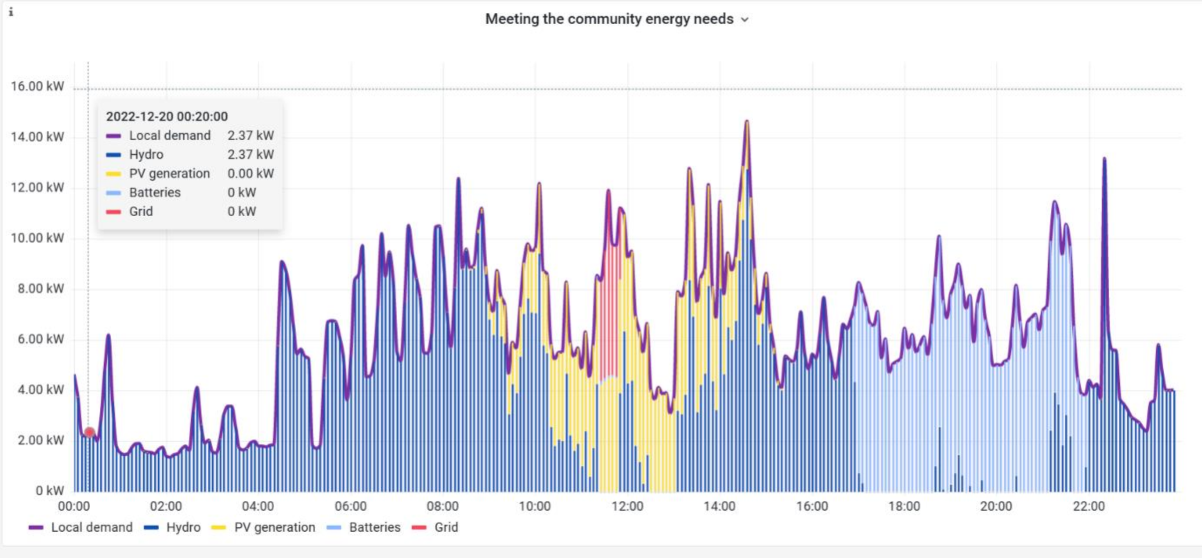


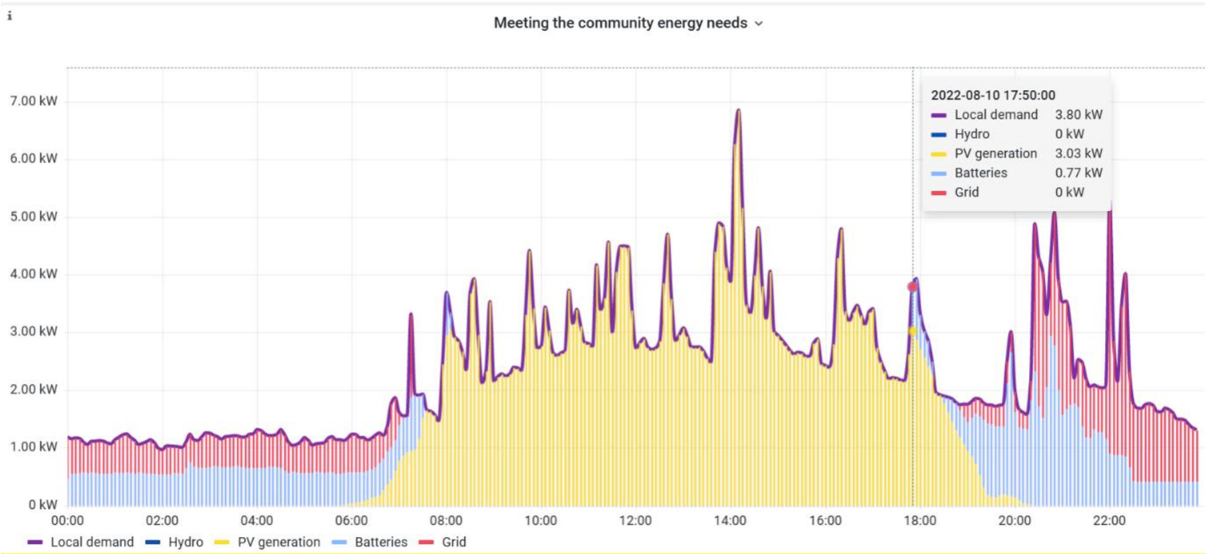
Figure 8: SSEN low-voltage network modelling for Osney Supercharge (credit: SSEN)

- Individual and community dashboards[26] showing patterns of energy generation and use that could support the development of a Virtual MPAN SCES model (see Figure 9, Figure 10).



Winter: Osney Lock Hydro generation meets much of the Osney Supercharge participants' demand, and discharge of its battery at peak use time helps to reduce grid intensity further

Figure 9: Graph from the People's Power Station 2.0 community dashboard for Osney Supercharge – winter



Summer: demand of the Osney Supercharge participants is largely met by their solar PV and batteries working together

Figure 10: Graph from the People's Power Station 2.0 community dashboard for Osney Supercharge – summer

5.3 Rose Hill SolarSaver

Key activity

- Implementation of a Time of Use Tariff to encourage social housing tenants (inc. shared ownership) to shift energy use to times of peak generation from community-owned solar on two blocks of flats.

[26] Dashboards developed in a strategic partnership with [Fractal Networks R&D](#).

Figure 11: Rose Hill SFN Local Steering Group members with Low Carbon Hub solar PV installation

Main achievement

- Tenants shifted their electricity use successfully to times of peak solar PV generation (see Figure 12.

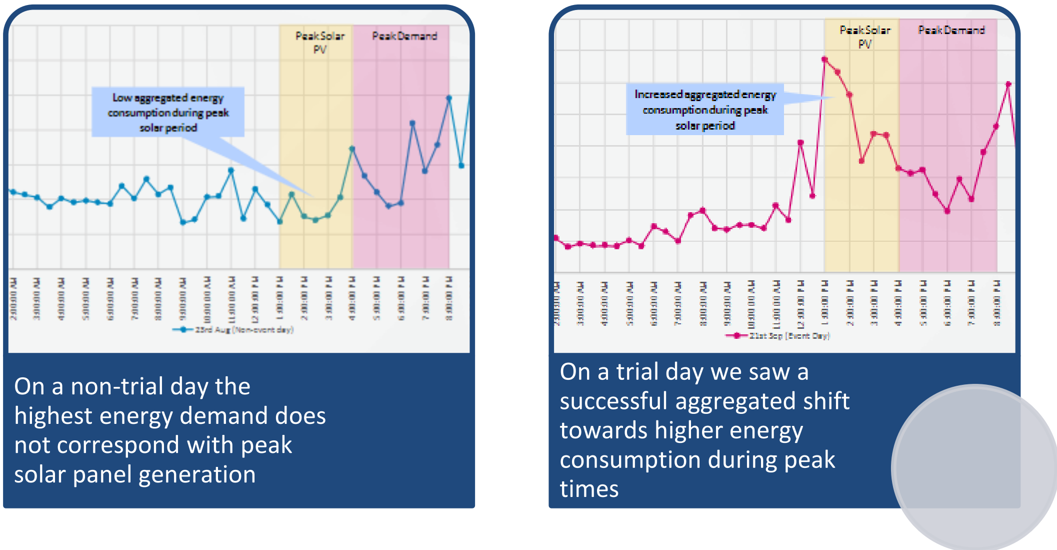


Figure 12: Graphs showing the shift in time of use by participants in Rose Hill SolarSaver trial

5.4 Springfield Meadows Local Load Balancing

Key activity

- Options analysis to work out how over-sized solar PV on 25 newly built, climate-positive houses (see Figure 13) could export to the grid without an expensive substation upgrade.

Figure 13: Springfield Meadows housing development and householder meeting

Main achievement

- A set of 10 possible options triaged and reduced to three for full technical and commercial exploration.

Solution	Timeframe (0-3,3-6..)	Cost (<£50k =G, 50-100=A, £100k+=R	Scalability (R-A-G)	Ease of Delivery (R-A-G)	Complexity
Household Batteries	G	A	A	G	G
Site Level Batteries	R	R	A	R	A
Dynamic Connection Agreement	G	G	G	A	G
Local Load Balancing	G	A	G	A	G
Dynamic Export Reallocation	A	A/R	G	A	G
SolarEdge Inverter / G100 Timing Changes	TBC	TBC	TBC	TBC	TBC
Resizing SolarEdge Inverters	G	G	A	G	G
Upgrade Infrastructure	A	G	R	G	G
Market Access via Social Aggregator	TBC	TBC	TBC	TBC	TBC
Modelling of solar					

Table 4: Springfield Meadows load-sharing options analysis: the options shown in green are those being pursued with those in amber being the fallback options

5.5 Westmills Shared Capacity Agreement

Key activity

- Options analysis for optimising grid connections owned by middle-aged wind and solar farms.

Figure 14: Westmill wind and solar farms

Main achievement

- Whole-site vision and future plant scenarios, including a potential Shared Capacity Agreement.

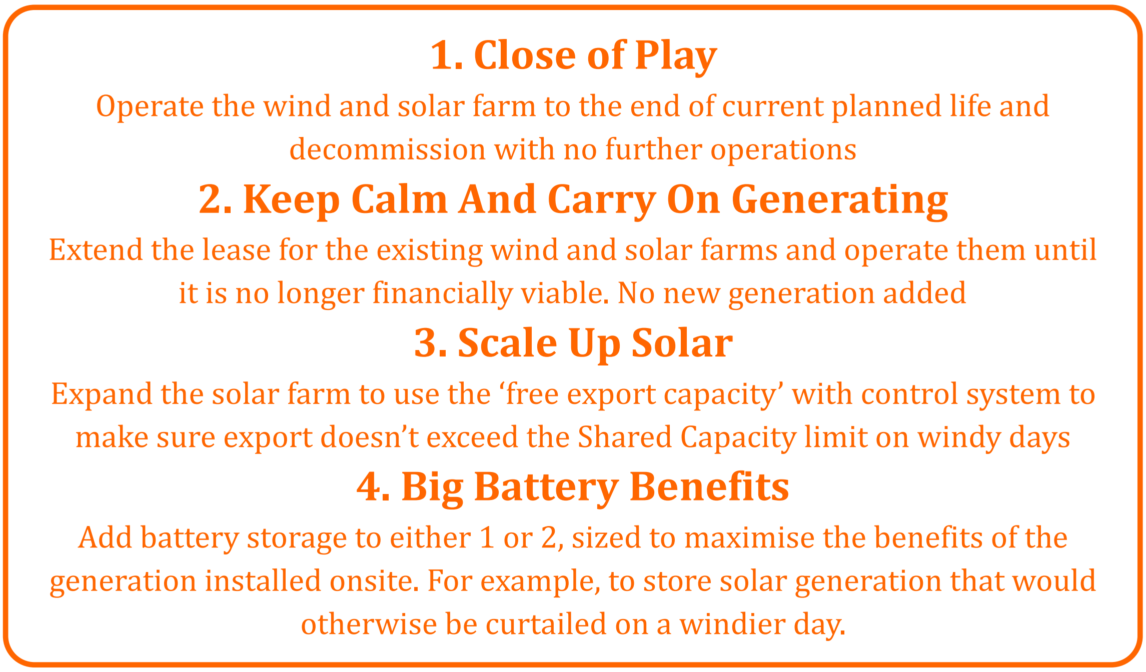


Figure 15: Westmill future scenarios

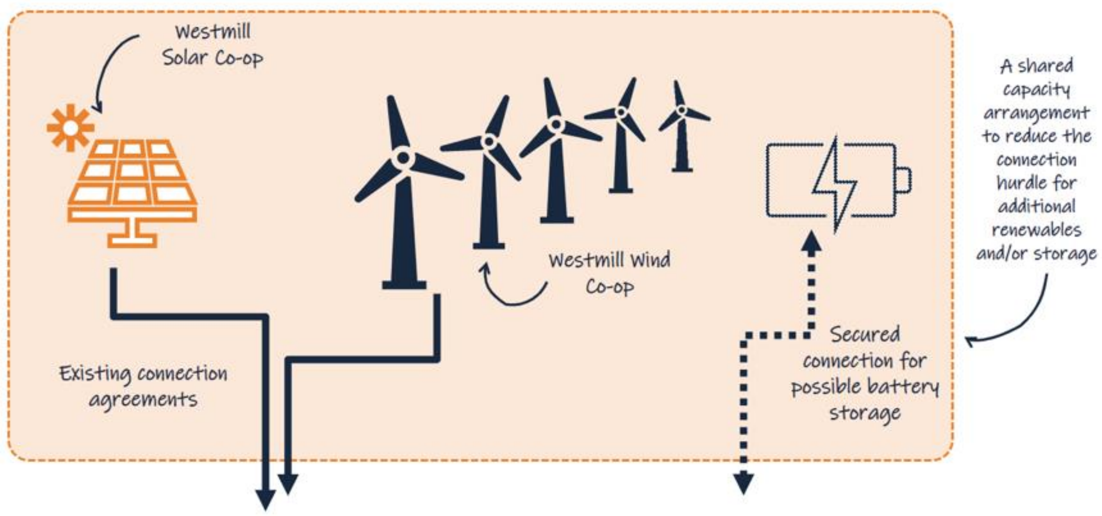


Figure 16: Potential Shared Capacity Agreement for Westmills

5.6 Eynsham Smart and Fair Futures

Key activity

- Developing a Zero Carbon Energy Action Plan for a primary substation area (see Figure 17) where new development will double the size of the existing population and number of houses.

Figure 17: Eynsham Local Steering Group during Great Big Green Week 2021 and their local primary substation area

Main achievement

- The first pilot CAPZero, '**C**ommunity **A**ction **P**lan for **Zero** Carbon Energy', shows what is needed to net off supply and demand behind the primary substation with community-scale renewable energy and potential SCES business models (see Figure 18), including shared loop heat pumps, microgrids for new developments, community-scale battery storage and power purchase agreements and financing models for installing domestic solar PV and battery storage.

Figure 18: Potential Smart Community Energy Scheme models identified in the CAPZero, '**C**ommunity **A**ction **P**lan for **Zero** Carbon Energy'

6 Learning outcomes

We developed the learning outcomes that we wanted to achieve with our SFN trials under two different headings:

1. those for Low Carbon Hub as a community energy business exploring the outlines of a new type of community energy business model, and
2. those we wanted to achieve in order to develop full business model canvases for a range of Smart Community Energy Scheme (SCES) models.

This section sets out the key learning outcomes under each of these headings. The obvious conclusion to draw is that there is still a long way to go in describing commercially viable value propositions that are likely to scale quickly to produce both benefit for customers and for the low voltage network at the grid edge. However, we have made some significant progress in:

- busting technical barriers
- engaging participation from customers and communities
- demonstrating the potential value of the models for both customers and the network.

The tables at Appendix 1 and Appendix 2 set out in detail the Low Carbon Hub's direct and extrapolated learning outcomes from the SFN trial delivery phase which are summarised in the following sections.

6.1 Low Carbon Hub direct learning outcomes

In terms of our direct learning, the Project LEO SFN trials have helped us to outline new products and services which Low Carbon Hub potentially has the capability to deliver at scale. However, we cannot yet say that these can form the foundation of a new phase of business planning for a community energy business like Low Carbon Hub. Nor can we yet describe the full business model and role for our People's Power Station platform, PPS 2.0. It may be that some potential products and services opportunities have sufficient environmental and social impact that would justify a fully funded model supported by our community benefit income, or a hybrid model where some aspects are commercially viable while others require community benefit funding. An obvious example of the former would be the CAPZero, '**C**ommunity **A**ction **P**lan for **Zero** Carbon Energy', approach developed in the Eynsham SFN project.

In terms of our learning we have extrapolated, however, we can:

- create a set of relatable case studies that help us make a compelling case for continuing to develop SCES models as a way of delivering a zero-carbon energy transition at the grid edge (available as one companion piece to this paper)
- use our Project LEO 'Power-Change' matrix (Figure 19) to explain the roles individuals and communities can play and the benefits and opportunities that participation might bring
- describe and use a set of ethical principles by which we can ensure that any trials, and then SCES implementation, can be both smart and fair (available as another companion piece).

LOW Degree of Power HIGH	KEYHOLDERS	All keyholders need to say yes for an activity to take place. Keyholders requiring the greatest degree of change from business-as-usual are those requiring the greatest level of engagement.
	AMPLIFIERS	These influential groups or individuals can help or hinder your project. Their buy-in isn’t crucial but can impact on the success or otherwise of activity.
	LEARNER-ACTORS	Learner-actors are unlikely to have a big influence on the direct delivery of an activity, but may have a significant influence on its long-term impact in terms of supporting dissemination, replication or scaling.
	LOW Degree of Change HIGH	

Figure 19: Project LEO Power-Change matrix (from the D3.10 companion piece ‘Designing Smart and Fair Neighbourhood Trials Ethically’)

6.2 Direct experience of delivering Smart Community Energy Schemes

Low Carbon Hub’s direct experience of delivering SCES models has been limited mainly to technical feasibility, governance and social desirability. This is because there proved to be many technical barriers to address, which took most of the time available in Project LEO to solve, and because key barriers to commercial viability remain. These barriers are:

1. The DSO flexibility services trialled in Project LEO are not financially valuable enough to justify setting up the full organisational and operational systems required to run a SCES.
2. Innovate UK rules do not allow direct grant funding of new assets in households to counteract this issue and so limited numbers of new assets could be installed as part of Project LEO.
3. Regulation governing the electricity system in the UK does not currently allow direct trading of electricity that, in combination with flexibility services, could potentially allow a full business model to be developed.

The direct experience we have been able to get in Project LEO has, however, allowed us to describe and demonstrate a number of considerations, as the next section set outs.

6.2.1 Technical feasibility

Low Carbon Hub has gained a good understanding of:

- the technical requirements needed to make a SCES work
- the information, data and modelling of the low voltage network required to enable us to assess the potential network benefits of implementing a SCES
- the real impacts of new DERs on the low-voltage network which might enable a more streamlined connections regime to be developed
- the benefits of the PPS 2.0 in monitoring and coordinating data between multiple assets; this understanding allows us to have some degree of confidence that PPS 2.0 can act as a technical aggregator for multiple DERs, whether acting individually or as a SCES.

6.2.2 Commercial viability

Low Carbon Hub has gained useful insights including:

- that behind-the meter-optimisation (self-consumption models) gives benefits to the customer and to the network in themselves; it is especially valuable in making capacity available on the low-voltage network if combined with conventional fabric retrofitting (note: developing this approach into a full service, currently named FutureFit, is needed anyway, whether or not such FutureFit buildings then form part of a wider SCES)
- business models that include the ability for customers to buy local renewable energy directly are likely to be very attractive and may enable SCES to be commercially viable; we need to understand more about what is possible here within the current regulations, what could be added if Elexon widened its definition of 'complex sites' and what might be added by the proposals currently contained in the Local Electricity Bill.

6.2.3 Social desirability

We have learned that:

- the strongly collaborative approach we are used to using when working with our community group members is highly effective in explaining SCES and the importance of the grid edge to community members, achieving the required levels of participation, and helping us to describe effective and trusted customer journeys
- scaling this approach up may be difficult to resource and so we will need to understand further how to keep the best aspects of this way of working, as we start developing scale; the Minimum Viable System approach developed in Project LEO may be helpful here.

6.2.4 Governance

- A key aspect to our success in developing SCES trials so far has been our ability to 'convene' community actors, local authority and DNO resources. We have been able in this way both to identify and take opportunities, which are often brought to us by our community group members, and also rally the resources required to bust barriers quickly and effectively.
- The 'local convenor' role we therefore hypothesise from this experience seems to fill a gap in the emerging local energy institutional architecture, although we recognise that more work is needed to define and test different options for fulfilling the role (see Key message 5, **A 'Local Convenor' is needed to catalyse action and unlock the value at the grid edge**, with Figure 5).

7 Conclusions

The Smart and Fair Neighbourhood (SFN) projects that Low Carbon Hub designed and delivered as part of Project Local Energy Oxfordshire (LEO) have enabled us to develop a narrative around the urgent need for transformation in the electricity network at the grid edge that people can understand and that is inspiring to them. From project partners to people in the community, it is a narrative that people can converge around, both experts and non-experts working together.

As identified by the 'Accelerating Net Zero Delivery' report published by UK Research and Innovation (UKRI) (March 2022),[27] there is huge financial, environmental and social value to be unlocked at the local level. We think a local convenor role may be a key to unlocking this value by convening local partners to take rapid and scalable action: the local authorities, the DSO, low carbon technology developers, low carbon technology suppliers and most importantly people and businesses at the grid edge.

UK government figures in the 'Net Zero Strategy: Build Back Greener' (October 2021)[28] estimate that 82% of all UK emissions are within the scope of influence of local authorities, and so action needs to be organised in a way that reaches right out to the low-voltage network. In Oxfordshire, this means:

- planning for action at the regional/county level through the 'Pathways to a Zero Carbon Oxfordshire' (2021) local area energy planning process, and
- then being able to take comprehensive action behind every single one of its c.7,500 secondary substations.

The Smart Community Energy Scheme (SCES) models Low Carbon Hub are developing out of our work with the Smart and Fair Neighbourhood trials in Project LEO could give us some of the answers to being able to do this.

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27 www.ukri.org/publications/accelerating-net-zero-delivery/

28 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf

Appendix 1: Low Carbon Hub learning outcomes

Direct learning		What we know	What we can do
Project output	To develop a viable and replicable SCES model with clearly defined features and benefits for key stakeholders.	We know the components of a SCES at the level of the individual household (HOPE group) We know the potential SCES business models: - Virtual Private Wire - Virtual MPAN - Local ESCO - Microgrid.	We can describe 'behind-the-meter' options for optimising the energy use of a household. We can identify and describe the key building blocks of a SCES. We have worked on developing schematics for: - Virtual Private Wire - Virtual MPAN - Microgrid.
Process	To use our practical experience of participation in flexibility markets and P2P trials to develop the SCES model.	We know how to deliver flexibility services from: - Heat pumps in the Heatsaver trial - Batteries in the Osney Supercharge trial. We know how to gather the data from a number of SCES participants and show it as a dashboard for each participant and as a collective SCES dashboard.	We can describe the key steps in the process for setting up and managing the delivery of flexibility services from heat pumps and batteries. We can describe the key steps in how to get and coordinate data from a number of SCES participants.
Barriers to participation	To identify the role of Low Carbon Hub and the potential for PPS 2.0 to support open access to flexibility markets and provide a means for collective decision making. To learn how we can help overcome barriers that prevent: - participants realising potential benefits - uptake amongst an identified target market - - full accessibility to the service by other system users.	We know about technical barriers: - metering - access to monitoring data from individual assets - access to network data. We know about regulatory barriers: - planning - connections - GDPR - imbalance in pricing between ESO and DSO flexibility markets - the inability to trade electricity directly. We know about barriers to participation and how important a simple, easy route to market is through the following stages: - becoming aware of the service - developing an interest - wanting to use it - committing to using it - getting ready to use it - using it - sustained participation.	We have proposed and implemented solutions to technical barriers: - metering - access to monitoring data - access to network data. We have proposed and implemented solutions to some regulatory barriers: - planning - connections - GDPR. But there are key barriers remaining that make commercial realisation of SCES models difficult: - imbalance in pricing between ESO and DSO flexibility markets - the inability to trade energy directly. We have developed customer journeys that have resulted in individuals and community groups installing smart assets: - heat pumps - solar PV - hydro - battery storage - EV charging. We have developed customer journeys that have resulted in individuals delivering flexibility services (SPM and SEPM) from heat pumps and battery storage.
Capabilities	What are the minimum capabilities required to participate in flexibility markets and peer2peer services? Does Low Carbon Hub have these capabilities and, if not, can we get them?	We know that Low Carbon Hub and PPS 2.0 can help: - individuals to take part in behind the meter optimisation - assets and individuals to share data that would enable a SCES to be implemented commercially.	So far, we have relied heavily on local knowledge and very committed local community members to help us set up the SFN trials: - We have not yet used a community lens approach to identify or support selection strategies.

Direct learning		What we know	What we can do
	What role can PPS 2.0 play in providing these capabilities?	We don't yet know about helping a community to host a SCES and what makes the difference between having the potential to, and actually creating, a thriving SCES.	- We have not yet developed our starting understanding of market segments excluded from participation.
Scalability potential	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 Oxfordshire and explore Low Carbon Hub'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 a net zero energy system.	We can use local knowledge to identify potential participants in a SFN trial but we have not yet used a full capability lens approach. We have developed a prototype CAPZero, '**C**ommunity **A**ction **P**lan for **Zero** Carbon Energy', at the primary substation area scale that derived its targets from the prototype LAEP for Oxfordshire, Pathways to Zero Carbon Oxfordshire. We know how to describe a compelling case for local and community approaches to net zero transition.	We can identify a pool of potential participants in a given community if we work with experienced community group members of Low Carbon Hub. We can use the experience of working in the Eynsham Primary Substation Area to calculate resourcing across Oxfordshire needed to repeat the exercise for all 63 PSAs. We cannot yet fully describe the required stewarding role for the next 30 years and so we cannot yet calculate the resourcing required to steward 63 CAPZero-maps. We cannot yet demonstrate with evidence from implementing them what contribution SCES could make to achieving the net zero transition.
Extrapolated learning			
Replication potential	Champion the concepts of 'grid edge' SCES in making a compelling case for the very local in the future in balancing the grid from the edge up to the centre Make Low Carbon Hub the go-to partner for post-LEO partnership projects on local energy 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 specific area.	We know why the grid edge is so important to the net zero energy transition and why acceptance and buy-in from individuals and communities is critical to achieving the transition. We know Low Carbon Hub can play a 'convening' role in bring SFN and SCES projects together. We know what the tools are for producing CAPZero-maps and what the resource requirement is. We know what the drivers are that might make our community group members want to trial a SCES.	We can create a compelling case for community SCES in achieving the change. This has resulted in two follow-on bids to Project LEO where Low Carbon Hub is a main partner: - LEO-N – LEO at the neighbourhood scale; and - FOSS – the FutureFit One Stop Shop. We can describe the Eynsham case study to help inspire others to replicate it. We can create relatable case studies of our SFN projects that can inspire others to replicate our activities.
Actors	What roles can individuals and communities 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	We know how to segment actors into 'keyholders', 'amplifiers', 'learner-actors' We know that communities need a lot of help and support to work together on local smart and fair energy solutions.	We can use this 'Power-Change' matrix to explain the roles individuals and communities can play and the benefits and opportunities that participation might bring. We can start to describe the role and resources Low Carbon Hub might provide over the long-term to meet these needs.

Direct learning		What we know	What we can do
	community energy can flourish and strengthen the Oxfordshire low carbon community network,	We know the key components of an 'enabling environment' nationally and locally.	We can explain the benefits and opportunities for SCES in contributing to the development Oxfordshire plans and toolkits: - Pathways to a Zero Carbon Oxfordshire - Oxfordshire Mapping Toolkit.
Ethical delivery of trials	To test our proposed ethical principles, and the tools and techniques to guide the delivery of ethical trials and equitable service offerings.	We know that the ethical principles guided trial and service design.	We can confirm that trials met our ethical principles in the delivery phase.
Smart and fair energy systems	Identify which market segments are excluded from participation. Identify groups that are left behind or disadvantaged and the capabilities they lack that causes this.	We have not yet used formal tools to segment communities.	We cannot yet identify which market segments are excluded from participation or identify groups that are left behind or disadvantaged.

Appendix 2: Direct experience of delivering Smart Community Energy Schemes

Dimension	Low Carbon Hub outcome	What we can do	Wider insights
Technical feasibility	Support the technical development of PPS 2.0 Assess and enhance the technical capability of Low Carbon Hub assets to participate in flexibility and P2P services Assess whether the role of PPS 2.0 is as a technical or commercial aggregator.	Set out the practical steps to connect DERs to the PPS 2.0 Capture near real-time data from DERs Establish bi-directional communications with multiple types of DER Create real-time visibility over some of the low-voltage network Remotely monitor and control a range of assets Measure the generation, consumption, storage and capacity of a number of different system users and their assets Estimate the potential flexibility a system user is able to contribute to a SCES Remotely deliver flexibility services (SPM and SEPM) from heat pumps and batteries Model and manage intra- and inter-MPAN energy profiles We cannot yet describe or model the commercial role of the PPS 2.0.	We know: - what the crucial sets of data are in making decisions about local energy and flexibility - the degree to which an asset needs to be remotely controlled to participate in a SCES - the importance of speed of dispatchability and the degree of automation. We are beginning to understand the relative importance of resource mix (generation/demand/storage/capacity). But we have not yet had enough experience of implementation to be able to assess whether the role of the PPS 2.0 is as a technical or commercial aggregator.
Commercial viability	Develop the commercial relationship between: - DER owners and PPS 2.0 - PPS 2.0 and wider markets. Identify a potential business model for PPS 2.0 and key barriers that would prevent the full potential of the PPS service offering, including accessibility Consider the opportunities for PPS 2.0 and flexibility services as both a marginal or strategic new post-subsidy business activity for Low Carbon Hub and community energy Have tangible examples 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.	This is all work outstanding for future phases of Project LEO where we will want to: - Understand what is needed to set up and coordinate a SCES in terms of: commercial arrangements; capital and revenue requirements; breakeven and payback points; opportunity costs of participaction; and regulatory costs - So that we can propose the minimum viable operating size for a SCE.S	Insights we have gained from practical experience so far are that: We need to minimise the transaction costs of participating in flexibility markets. We know that behind the meter 'self consumption' models are becoming viable for households and businesses. If combined with fabric retrofit and highly efficient and smart lighting and appliances, we know that these models in themselves can deliver radical demand reduction by reducing demand for heating and capturing most of any generation on-site. Rolling out a full 'FutureFit' service that combines fabric retrofitting with smart appliances and energy assets is therefore a benefit to both customers and networks in itself. We know that people are highly motivated by the idea of being able to buy energy from what they see as 'their' local generators. We think this would be a much more natural entry point to participating in DSO flexibility services for most people, if they started by moving their demand to times of peak local generation.
Governance	Learn how long-term stewardship of local energy plans can be resourced, both in terms of governance		

Dimension	Low Carbon Hub outcome	What we can do	Wider insights
	arrangements, and funds for project delivery Promote the concept of 'stewardship' of local energy plans,		
Social desirability	Understand the needs and drivers of domestic and SME service users Understand how marketing techniques and messaging can enhance participation in local energy offerings Understand the value of mapping tools for engagement at the grid edge	We can describe an implement a successful customer journey for installing assets in individual households and businesses. We can use existing relationships and community networks to achieve participation in monitoring and date sharing activities that are the precursor to setting up a fully commercial SCES. We have not used mapping tools for engagement, relying instead so far on strong existing relationships. We have achieved participation in delivering flexibility services and taking up a Time of Use Tariff, but this has been through using strong, existing inter-personal relationships, not a full marketing exercise. We have not yet communicated the features and benefits of a full SCES model.	Our approach so far has relied on a strongly collaborative approach with community leaders to describe the project and then achieving the required levels of participation. For this reason we have focused on well-established Low Carbon Hub community group members with proven track records of successful implementation. We have the tools to use in working with less well-known and established community groups, but have not yet tried implementing them. This local convening role Low Carbon Hub has played, however, in bringing communities and customers together with key actors in their local authorities and DNO suggests that this may be a requirement for successful neighbourhood-level activity to happen at scale. The convening role can also be about helping to make the most of relationships and networks that communities bring into projects.
Value creation	Develop SCES value propositions for: - third party energy assets - catalysing communities (i.e., those that help develop an SFN) Test if the 'off-market' benefits created through SCES are sufficiently motivating to drive participation Learn how communities can identify which are the most appropriate opportunities and assess the potential value PPS 2.0 could create for them Understand the role of consolidation of local area data and information to create value.	This is mainly work for future phases of Project LEO given the lack of progress in describing and implementing commercially viable business models. A full business model canvas for a SCES would include: - the environmental and social benefits created - the comparative benefits of working on- or off-market - the potential benefits of a SCES for individuals and communities. We do, however, know the role and benefit of local area data and information to create value through the Eynsham CAPZero, '**C**ommunity **A**ction **P**lan for **Zero** Carbon Energy', map development and the Osney Supercharge network modelling exercise.	As with our insight on social desirability above, being able to describe and capture non-financial benefit is likely to depend on strong collaboration between community leaders and a trusted local convenor. Consolidation and use of up-to-date and reliable local area data and information will be really crucial in enabling full SCES value propositions to be developed with certainty.