Smart Energy System Options for Net Zero Neighbourhoods

Version 1.0

13 January 2025

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Contents

Glossary

AI	Artificial Intelligence
AMI	Advanced Metering Infrastructure
API	Application Programming Interface
BEMS	Building Energy Management System
BESS	Battery Energy Storage System
BM	Balancing Mechanism
BSC	Balancing & Settlement Code
CIC	Community Interest Company
CRM	Customer Relationship Management
DER	Distributed Energy Resource
DESNZ	Department of Energy Security and Net Zero
DFS	Demand Flexibility Service
DNO	Distribution Network Operator
DSO	Distribution System Operator
EaaS	Energy as a Service
ESCO	Energy Services Company
ESG	Environmental, Social, Governance
ESS	Energy Storage System
EV	Electric Vehicle
FIT	Feed-in Tariff
FCA	Financial Conduct Authority
GDN	Gas Distribution Network
GIS	Geographic Information System
GM	Greater Manchester
GMCA	Greater Manchester Combined Authority
HaaS	Heat as a Service
HEMS	Home Energy Management System
iDNO	Independent Distribution Network Operator
IP	Intellectual Property
IoT	Internet of Things
kW	Kilowatt
LA	Local Authority
LAEP	Local Area Energy Plan
LCNF	Low Carbon Networks Fund
LCT	Low Carbon Technology
LEM	Local Energy Market
LEO	Local Energy Oxfordshire (PFER project)
MW	Megawatt
NDA	Non-Disclosure Agreement
NESO	National Energy System Operator
NMP	Network Management Platform
NZIP	Net Zero Innovation Programme
NZN	Net Zero Neighbourhood
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
PFER	Prospering From the Energy Revolution
RESP	Regional Energy Strategic Plan (or Planner)
SLES	Smart Local Energy System
SPV	Special Purpose Vehicle
SSEP	Strategic Spatial Energy Plan
P2P	Peer-to-peer
P415	A modification to the Balancing & Settlement Code
PPA	Power Purchase Agreement
PV	Photovoltaic
SIF	Strategic Innovation Fund
V2G	Vehicle to Grid
VC	Venture Capital
VLP	Virtual Lead Party
VPP	Virtual Power Plant

1. Executive Summary

What is a smart, local energy system?

A number of initiatives in UK and internationally over the last decade have explored potential to integrate energy generation and demand within a local area. Google AI gives a good summary of the definition that has emerged from this work:

“A smart local energy system (SLES) brings together energy generation, storage, demand, and infrastructure at a local or regional level. These systems are designed to operate intelligently, using technology like software and artificial intelligence to optimize energy use and reduce reliance on traditional energy sources.”

SLES embed the following characteristics:

- **Locality**: they operate within a specific area
- **Smartness**: they use digital technology to monitor and coordinate energy flows
- **Integration**: they integrate energy sources such as batteries, solar & wind with demand-side management technologies
- **Community**: they involve local communities in decision making and in energy production and consumption

SLES aim to provide benefits such as:

- Reduced emissions of greenhouse gases
- Lower energy costs
- Increased energy resilience
- Empowered communities and greater social equity
- Economic development

Building Blocks for Net Zero Neighbourhoods

We have defined 8 “building blocks” for a smart, local energy system within West Midlands’ Net Zero Neighbourhood trials, as illustrated in the table overleaf. The blocks are:

1) Local Area Energy Planning
2) Project Marketplace
3) Collective Purchasing
4) Community Anchor Asset
5) Corporate Anchor Asset
6) Flexibility VPP (Virtual Power Plant)
7) Local Energy Market / Peer-2-peer Community
8) Self-Balancing Network

These blocks tend to progress from the least technically complex to ones with greater technical and regulatory complexity. However, in many cases the greatest complexity will lie in building engagement and coordinating diverse objectives across a community.

We have chosen to call these building blocks rather than archetypes to emphasise that they are not exclusive – a community might choose to combine several models, or to evolve from one model to another over time. So, for example, a community might initially develop a Solar PV array on common land and use it to anchor a VPP, then scale up the VPP over time by integrating collectively-purchased home battery systems as they become available.

1. Executive Summary – Building Blocks for a Smart Local Energy System

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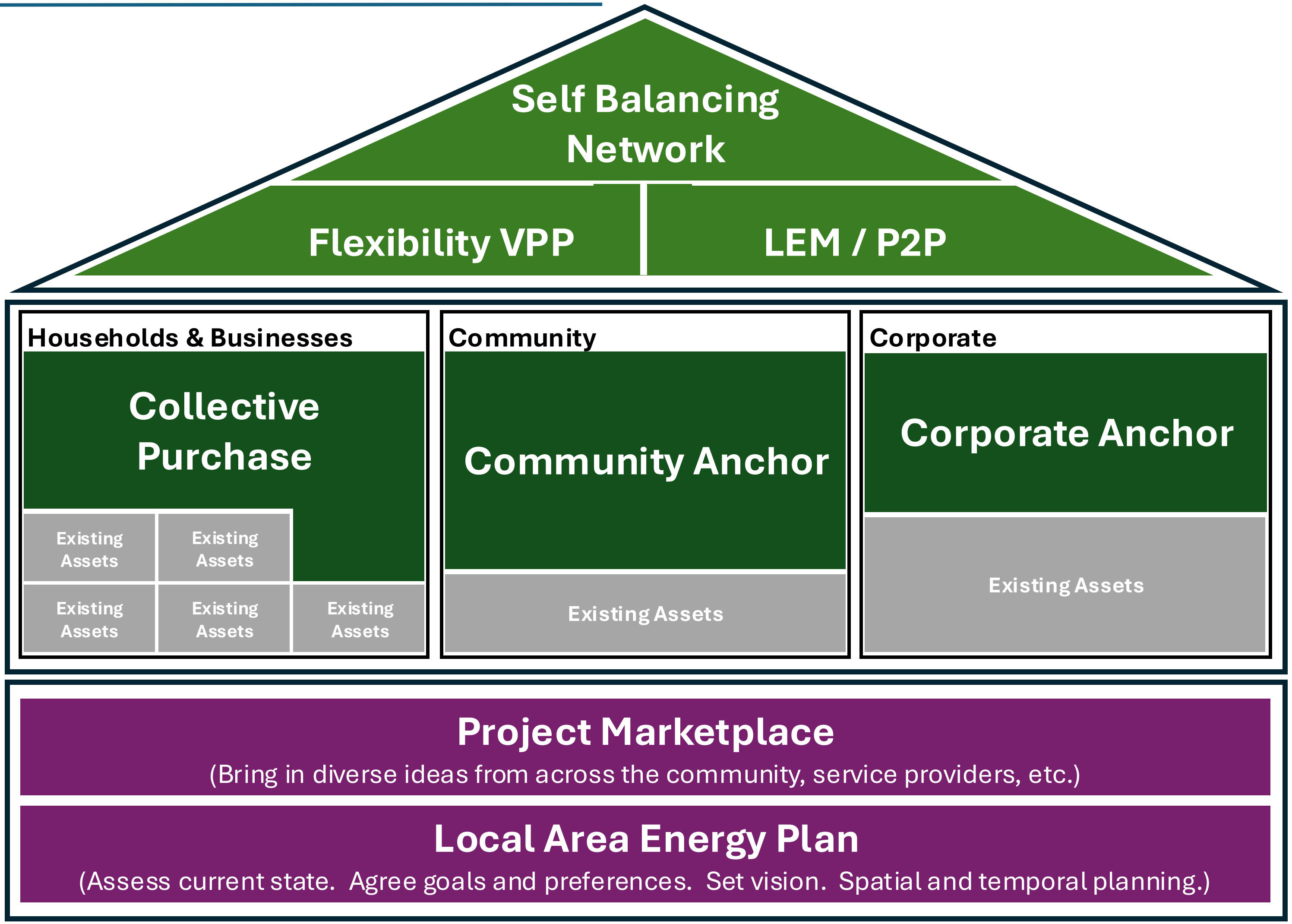
Build as high as you want. You can gain benefits by planning and managing existing assets. You don't have to buy more assets and build smart systems if you have other priorities.

Smart Systems

Assets

(Focus here is on physical & technical assets, but communities also have social and intellectual assets – community groups, knowledge and skills, etc. These also need to be considered.)

Foundations



Coordinate assets to gain additional benefits.

Build assets to help reduce individual households' energy costs and improve efficiency & quality of life.

Plan and ideate.
Identify what you want to do.

1. Executive Summary – Smart Energy Framework

	Foundations		Assets			Smart Systems		
								
	Local Area Energy Plan	**Project Marketplace**	**Collective Purchasing**	**Community Anchor Asset**	**Corporate Anchor Asset**	**Flexibility VPP**	**LEM / P2P Community**	**Self-Balancing Network**
Description	Spatial plan and roadmap for energy systems in the community.	A central place to share projects and connect to funding & delivery partners.	People band together to vet suppliers and negotiate better pricing.	People band together to purchase an asset for their community	Company builds an asset and shares benefits with the community	An aggregator coordinates smart appliances to sell flexibility services	"Prosumers" trade energy within a local area or community	Coordinate energy use within an area to minimise dependency on wider grid
Examples	Formal LAEP in local authorities. Hyperlocal LAEP in Eynsham, LEO.	Accelerators and Incubators. Crowdfunding platforms.	Solar Together, Your Home Better	Low Carbon Hub, GM Community Renew-ables, Lune Valley Hydro, Energy Local	District heating, Fan Club, Ripple, Shared assets in multi-occupancy buildings	Equiwatt, Levelise, GridBeyond, Flexitricity.	GM LEM, Urban Chain, Sitigrid, Energy Local?	Community DSO, Campus microgrids, Local Energy Market Alliance
Governance & Stakeholders	Hyperlocal plan is probably done by ad hoc enthusiasts, with wider engagement.	Central convenor sets rules, defines support levels and vets participants.	May self-organise, but benefits from a trusted, savvy central convenor.	Corporate owns asset: CIC, Co-op, etc. Energy sharing needs supplier.	Corporately driven; contractual relation-ship to other parties. ESG will influence.	Probably corporate VPP platform. Open source is possible.	Central market operator & platform. May be corporate, or public/private SPV.	Central micro-grid operator (& owner?). Corporately driven. (May be CIC or co-op.)
Technology & Systems	Formal LAEP needs data, GIS & modelling tools. Hyperlocal is more ad hoc.	May be very simple, but can also provide monitoring, support, acceleration, etc.	May need a procurement platform.	Basic asset O&M, monitoring, settle-ment. May anchor VPP or other platform.	Asset O&M. Needs full back office – settlement, billing, CRM.	Complex tech stack due to interoperability with wide variety of equipment & markets.	Trading is complex, but only need to integrate meters and have a single market.	Real time control of assets & trading, plus backoffice for billing, CRM, etc.
Finance & Benefits	Self-funded, or may be small grants available. Enables other building blocks.	Investors may have social goals, or may seek dividends and transaction fees.	Bilateral between household & supplier. May be transaction fee for convenor.	Likely crowdfunded. Benefits via dividend or energy sharing.	Corporate finance, to gain loyal customers. Community gets trusted partner.	Platform via VC & innovation funding. People earn share of flex revenue.	Platform via VC & innovation funding. Prosumers benefit via energy pricing.	Corporate finance for network plus platform funding. Benefits via energy services.
Regulatory & Markets	No regulatory restrictions, but also limited influence on wider system.	Financial regulation of crowdfunding. Regulatory sandboxes.	Mostly consumer protection & Trading standards. Trust in suppliers is key.	Crowdfunding needs FCA. Energy sharing has complex regulatory reqts.	Consumer protection legislation plus Ofgem licences. (Heat is emerging.)	DSO flex markets are relatively open. BM is complex. Need to stack multiple mkts.	Complex energy regulation; needs a supplier. P415 may open up VLP options.	Complex energy regulation, probably as a "complex site".

Area likely to have greatest complexity

1. Executive Summary

Possible Pathways

The building blocks are interlinked. As illustrated on the previous slide, they fall into three board groups:

1) **Foundations**: Assessing the current state, establishing local area energy plans and identifying projects that could build the capabilities that are of most interest and value to the community.
2) **Assets**: Building assets (generation such as PV, wind, micro-hydro; smart appliances, heat pumps, EV charging and other energy using techs; batteries and other energy storage systems) that can augment those already in place across the community. These may be owned by individual community members, by the community as a whole, or by corporate partners. They serve first to help individual homes and businesses reduce energy costs, improve comfort, etc; and second to provide a base for smart systems to coordinate activity across the community in order to create additional value through trading energy or flexibility.
3) **Smart Systems**: Systems to coordinate the portfolio of equipment across the community in order to undertake that trading and related activities.

Note that this layering is not intended to create some sort of merit order – communities don't have to build smart systems in order to succeed. People may be able to gain significant benefits simply by adjusting the way they configure and use their existing assets, and that may be sufficient. It's perfectly valid for people to decide that they just want to make their homes warmer and more energy efficient, and to be able to buy energy from the national system at a fair price. Smart assets and systems might add additional value, both financially and in terms of community cohesion and suchlike, but that entails effort and commitment and it's perfectly valid for people to decide to invest these on other priorities.

To illustrate how the building blocks might be linked together to develop a community's energy systems over time, we have built six scenarios describing possible journeys (shown overleaf):

1) Simple VPP (behavioural response)
2) Rooftop Solar (no coordination)
3) Advanced VPP (aggregating and integrating PV & batteries)
4) Community Energy Sharing (community asset)
5) Wind Farm Dividend (corporation pays community dividend)
6) Private Wire Network (self balancing village)

These are illustrations of possibilities, not definitive pathways. Communities can use them to help frame their own journey to a better local energy system. They follow the general narrative of:

a) Identify what assets (physical, financial, social, etc) you have
b) Identify where you want to get to (for now; this can evolve)
c) Build partnerships to help you progress
d) Augment your current assets as necessary
e) Optimise the way you coordinate and use the assets

1. Executive Summary – 6 Scenarios *(not exhaustive…)*

	Assess Current State Identify physical, financial social assets. Understand geographic constraints & options. Analyse energy flows.	**Agree Target** Clarify preferences & objectives. Negotiate trade-offs. Set out a common vision and develop spatial and temporal plans.	**Build Partnerships** Build links to businesses, local government, social organisations to bring in skills, finance, etc. Build community organisations.	**Build New Assets** Develop additional assets to augment the current state. Build a portfolio of generation, storage, demand to support the targets.	**Optimise Energy Flow** Build systems, commercial structures, processes to coordinate and optimise use of the assets.
Simple VPP A group of tenants on an estate with a common landlord.	**LAEP**: *People review their homes, energy use, etc, and decide their priority is to improve parks & natural spaces. But they see value in participating in schemes like DFS.*		**VPP**: *They form a community group to identify a VPP operator that can aggregate them and take them to markets like DFS and DSO flex markets, probably primarily via behavioural response but with capacity to integrate smart appliances over time. The group negotiates with the VPP operator and supports the community to engage with it as it builds and runs the VPP.*		
Rooftop PV A group of homeowners in an established housing development.	**LAEP**: *Enthusiastic residents in a neighbourhood form a group to develop a plan. However, many people are too busy to participate actively and there is little agreement on many of the ideas put forward. In the end, they can agree that rooftop PV would be attractive for many, if they could find a trusted supplier.*		**Collective Purchase**: *Core group works with local authority to set up a Solar Together scheme, & recruits homeowners to sign up. The LA vets local installers & helps people get PV at a good price.*		**Stop**
Advanced VPP A mixed group of tenants and homeowners in an area with a wide range of housing stock.	**LAEP**: *A core group of tenants, homeowners & representatives from larger landlords work with the local authority and DNO to build a plan. They run workshops & other events, obtain free support from a local consultancy, and so develop a vision to build a VPP from PV+batteries.*		**Collective Purchase**: *A large landlord procures PV for its houses & flats plus batteries in larger blocks (where it incurs common energy costs). It negotiates terms for local homeowners to buy PV & batteries at the same price.*		**VPP**: *VPP operator develops a commercial model for sharing flex revenues that makes the scheme viable for the landlord.*
Community Energy Share A group that has formed around concerns about a local piece of common land.	**LAEP**: *Members of a sports club see that land adjacent to playing fields is becoming derelict. They recruit others and form a group to explore uses for the land.*	**Project Marketplace**: *The group sponsors a call for ideas for the land. They scrape together funds to support a couple of feasibility studies for the best ideas.*	**Community Anchor Asset**: *The land is suitable for a small solar farm, and the landowner is amenable. A community group is formed to crowdfund & build the solar farm.*		**LEM/P2P**: *They work with a partner to set up a scheme to sell energy to local homes with a discount for fuel poor.*
Wind Farm Dividend A company with an interest to develop links to the community in the area where it operates.	**LAEP**: *A developer has identified a site for a wind farm. Recognising the need to gain community buy in for planning permissions, etc, they sponsor a collection of local groups to develop a LAEP. This identifies options where seed funding for community schemes would be useful.*		**Corporate Anchor Asset**: *Local groups form umbrella organisation to represent them with the developer. This works with the developer to set up & administer a fund from a proportion of the wind farm's profits, to invest in community projects.*		**Project Marketplace**: *The fund seeds feasibility studies for community assets, VPP & LEM.*
Private Wire Development A company that is interested to develop a new mixed housing / business site in an area.	**LAEP**: *A developer is building a new village with iDNO / private wire network. They explore ideas to increase property values by bundling equipment and selling EaaS.*	**Corporate Anchor Asset**: *The developer builds village, network, solar farm, shared loop heat pump array. It writes Energy-as-a-Service into leases / tenancies and sets up an ESCO to deliver the service. Governance of the ESCO includes involvement from tenants and community groups, to provide assurance on consumer protections.*			**Self-Balancing Network**: *ESCO operates the assets to maximise returns. This requires a high degree of self-balancing.*

2. Introduction

2.1 What is a Smart Local Energy System (SLES)?

A number of initiatives, in UK and internationally, over the last couple of decades have explored potential to integrate energy generation and demand within a local area. Google AI gives a good summary of the definition that has emerged from this work:

“A smart local energy system (SLES) brings together energy generation, storage, demand, and infrastructure at a local or regional level. These systems are designed to operate intelligently, using technology like software and artificial intelligence to optimize energy use and reduce reliance on traditional energy sources.”

Examples of SLES include:

- **Community energy projects**: Projects that involve local residents in generating and sharing renewable energy.
- **Microgrids**: Small-scale electrical grids that can operate independently or in conjunction with the larger grid.
- **Virtual power plants**: Systems that aggregate distributed energy resources like rooftop solar and energy storage to provide grid services.

SLES embed the following characteristics:

- **Locality**: they operate within a specific geographic area, such as a region, city, town or neighbourhood.
- **Smartness**: they use digital technology to monitor and coordinate energy flows and flexibility, and to maximise the benefits for energy users, both financially and in terms of comfort, convenience, social benefits, etc.
- **Integration**: they integrate energy sources (solar, wind, hydro, etc) with energy storage (home batteries, thermal storage, EVs) and demand-side management technologies within smart appliances, space and water heating, EV chargepoints, etc.
- **Community**: they involve local communities in decision making and in energy production, storage, consumption and flexibility.

SLES aim to provide benefits such as:

- **Reduced emissions of greenhouse gases**: By promoting renewable energy sources and efficient energy use, SLES can help reduce greenhouse gas emissions.
- **Lower energy costs & risk**: By optimising energy consumption and generating energy locally, SLES can help reduce energy bills for consumers, and reduce their exposure to price volatility.
- **Increased energy resilience**: SLES can improve the reliability of energy supply, especially during disruptions like extreme weather events.
- **Empowered communities and greater social equity**: By facilitating local decision-making and engagement, SLES can empower communities and promote social equity.
- **Economic development**: SLES can create jobs in the installation, maintenance and operation of energy technologies. Combined with their potential to reduce energy costs fpr homes and businesses, this can stimulate local economies.

2.2 How have SLES emerged?

Early developments (pre-2010)

Development of SLES has been driven by two underlying trends:

- **Growing concern about the impact of the energy system**. Rising energy costs, increasing awareness of the environmental impacts of fossil-fuel based generation, concerns about the risks to energy security from geopolitical instability.
- **Advancing technology**. Cost reductions to a wide range low carbon technologies, growing use of IoT to integrate and manage smart appliances, emergence of AI to optimise these integrated systems.

Together, these have made it both possible and desirable to bring energy flows more closely under the control of local people and communities. Milestones in the early development of Local Energy Systems include:

Technology:

- **Distributed Renewable Generation**: Renewables such as solar PV and small wind turbines began to appear in energy networks, spurring interest in their ability to support local energy systems.
- **Digitalisation:** Advances in adoption of IT within the energy system enabled the first steps toward smart grid technology, supporting better integration of renewable energy.

Policy & Markets:

- **Policy Support**: The EU promoted renewable energy and energy efficiency through directives and funding programs. California emerged as a global leader in SLES, with ambitious renewable energy goals and supportive policies for community solar and microgrid projects (e.g. for for wildfire resilience).
- **Market support:** Development of microgeneration schemes, such as the Feed-In Tariff (FIT) program (introduced in UK in 2010), which encouraged small-scale renewables.

Example Projects:

- **Community Energy Projects**: Early pioneers set up community-led initiatives focused on renewable energy generation, such as solar and wind power. These projects often involved local residents and cooperatives investing in and managing their own energy systems. These projects demonstrated the potential for local energy generation and community empowerment.
- **Microgrid Development**: Initial concepts and pilot projects for microgrids emerged, particularly in remote and island communities. These established small-scale electricity grids that can operate independently of the main grid, integrate various energy sources, including renewable energy, storage, and traditional generation.
- **Smart Grid Initiatives**: Countries like the US and Japan invested in smart grid technologies to improve grid efficiency and enable the integration of distributed energy resources.

2.2 How have SLES emerged?

The rise of SLES (2010s part 1)

Technology:

- **Integration of IoT and AI**: Technologies began enabling real-time energy management and demand-response capabilities. IoT devices enabled real-time monitoring and control of energy systems, improving efficiency and reliability.
- **Decentralized Trading Systems**: Distributed tech supported a shift towards prosumer-driven energy systems, where consumers could generate and trade electricity.
- **Energy Storage**: Advances in battery storage technologies, particularly lithium-ion batteries, enabled more efficient and cost-effective energy storage solutions. The increasing deployment of energy storage technologies, such as batteries, enhanced the ability of SLES to balance supply and demand, improve grid resilience, and optimise energy use.
- **Smart Grid Technologies:** Continued development of smart grid technologies, such as advanced metering infrastructure (AMI), demand response programs, digital communication systems, facilitated the integration of distributed energy resources to create more efficient and flexible energy systems.
- **Electric Vehicles (EVs):** The integration of EVs into SLES offers opportunities for vehicle-to-grid (V2G) technologies, where EVs can store and discharge energy back into the grid.

Policy & Markets:

- **EU's Energy Union Strategy**: The EU's Energy Union strategy emphasized the importance of energy security, affordability, and sustainability, promoting the development of SLES. The Clean Energy for All Europeans Package (2019) formalized the concept of energy communities, allowing collective renewable energy projects. This supported peer-to-peer trading and citizen participation in local grids.
- **US State-Level Initiatives**: States like California, New York, and Massachusetts continued to drive SLES development through supportive policies and regulations.
- **Global Expansion**: SLES concepts spread to countries like Australia, Canada, and Japan, with varying levels of government support and market maturity.

2.2 How have SLES emerged?

The rise of SLES (2010s part 2)

Example Projects:

- **Prospering from the Energy Revolution** (2014-2021): Funded by the UK government, the PFER programme supported a wide range of projects. These encompassed community-led projects, microgrids, pilots for a several smart grid and energy storage technologies and a number of large demonstrators. Specific projects included:
  - **EnergyREV:** A research consortium focused on understanding the system impacts of SLES and identifying barriers to their deployment.
  - **Energy Superhub Oxford**: Combined a large battery storage system with electric vehicle (EV) charging, smart heating, and renewables.
  - **ReFLEX Orkney**: Demonstrated integrated renewable generation, hydrogen, and EV solutions on a remote island.
  - **LEO (Local Energy Oxfordshire)** focused on integrating renewable energy, storage, and demand-side response at a community level. Explored digital platforms, business models and market mechanisms for local energy trading and grid optimisation.
- Ofgem innovation funding via the Low Carbon Networks Fund (LCNF) supported early smart grid trials such as **My Electric Avenue**, testing demand-side management of EV charging.
- The **EU Horizon 2020 programme** funded numerous SLES initiatives, testing areas such as integration of Distributed Energy Resources (DER) with the grid, and flexible grid operations at scale across multiple regional contexts.
- EU funding also supported projects such a
  - **Cornwall Local Energy Market (LEM)**: (ERDF) Established one of the first local trading platforms. Integrated batteries, solar PV, and grid services.
  - **SmartEnCity (Denmark, Spain, Estonia)**: Developed carbon-neutral cities using SLES concepts.
  - **PARENT (Belgium, Netherlands, UK)**: Focused on engaging citizens with energy monitoring and local trading.
- **Brooklyn Microgrid** (USA): Demonstrated blockchain-enabled peer-to-peer trading.
- **Sendai Microgrid (Japan):** Resilient local energy system integrating local renewables and storage into a VPP, designed post-Fukushima.
- China emphasized **smart cities** and renewable energy integration with local networks.
- Innovations in pay-as-you-go solar systems and mobile payment platforms in countries like **Kenya** (e.g., M-KOPA).

2.2 How have SLES emerged?

Driving adoption (2020s & beyond)

Interest in SLEs has accelerated in the 2020's, driven by factors such as:

- **Net-Zero Targets**: Global commitments to decarbonisation are expanding deployment of solar, wind, and other renewables, creating impetus to accelerate SLES adoption.
- **Energy Storage**: Cost reductions in storage systems will support better integration of intermittent renewables onto the grid. Long duration storage technologies will enhance resilience and security of supply under the full range of operating conditions, enhancing the viability of SLES models.
- **Supply Chain Concerns**: The impact of decarbonisation on global supply chains and skills bases for renewable and grid technologies is beginning to raise concern. SLES require a different mix of technology and skills to grid-scale solutions, helping to allay these concerns by diversifying the supply chain and skills requirements.
- **Digitalisation**: Recognition of the scope for digital technologies to optimise energy flows and enhance system efficiency is growing. Ongoing developments in AI, machine learning and IoT are likely to create further opportunities for SLES to optimise the way people access and use energy.
- **Increasing Decentralisation**: The overall trend towards decentralised energy systems is expected to continue. This makes it more likely that communities and businesses will consider generating and consuming their own energy, creating further impetus to support integration of SLES with the wider grid, both technically and at market & commercial levels.
- **Consumer Engagement**: The need to empower consumers to actively participate in energy management and demand response, both to support decarbonisation and to gain their buy-in to the energy transition, aligns well with SLES.
- **Social and Economic Impacts**: SLES have significant potential to contribute to social and economic wellbeing, e.g. by creating jobs and supporting community engagement.
- **Policy, Regulatory & Market Frameworks**: Governments globally are recognising the level of consumer support for P2P trading and localised markets. This is leading to development and deployment of supportive policies and regulations.
- **Business as Usual (?)**: SLES concepts are starting to be built into the baseline for energy markets, system operators, etc. For example, Feed-in-Tariffs introduced as a special support in 2010 were replaced with the requirement that suppliers provide export tariffs under the Smart Energy Guarantee in 2020. And the Demand Flexibility Service introduced as an emergency measure in 2022 was integrated with other NESO services in 2024. The timing and implementation of these moves has sometimes been questionable, e.g. are they removing subsidies before a service has been full established? Are certain groups (e.g. vulnerable & fuel poor) especially disadvantaged by this? Are markets and system operators fully able to account for the social and environmental benefits of such services? But the message that the energy system needs to treat smart, local energy as part of the norm is to be welcomed.

These trends can be expected to continue, as evidenced by targets for renewable generation, storage and flexibility in the recent Clean Power 2030 plans, and especially in discussions about the government's Local Power Plan.

2.3 An Example – Ynni Cymru

Illustrating these trends, Ynni Cymru recently set forth the following principles for a Smart Local Energy System:

> *"A SLES joins up different energy generation, storage, demand, and infrastructure assets in a local area, making them operate more intelligently and deliver local benefits. [A SLES is:]*
>
> ***Smart** - projects utilise data and controls to ensure that energy is used more efficiently and effectively, at the right place and at the right time (e.g. control systems and software for monitoring, automation, artificial intelligence, and/or trading energy).*
>
> ***Local** - projects will be locally owned, they will recognise that different places and communities in Wales have different needs, and benefits will accrue locally (e.g. local ownership, carbon, financial and wider environmental and social benefits).*
>
> ***Energy System** - projects use multiple types of technology (e.g. a combination of local renewable energy generation to facilitate renewable power use, low carbon heating, cooling and hot water, ultra-low emission transportation, demand reduction, co-located renewable energy generation technologies, optimised use of grid capacity, and energy storage).*

Ynni Cymru then set out the following examples, to illustrate how these SLES principles might be put into practice. (Noting that these examples are illustrative, not exhaustive.)

Example 1	A building (e.g. office, community centre, leisure centre etc) installs solar photovoltaic (PV) panels, battery storage, air source heat pump and smart controls and meters. The configuration of technologies has been designed to maximise onsite self-consumption and reduce carbon emissions from the building.
Example 2	A group of SME businesses working with a community organisation to install solar PV, heat pumps, batteries, and electric vehicle charging infrastructure across a small business park. The configuration of technologies has been designed to maximise onsite self-consumption and reduce carbon emissions from the business park.
Example 3	A battery energy storage system (BESS), complementary renewable electricity generator (e.g. a wind turbine), and electric vehicle charging infrastructure co-located with an existing solar farm to deliver both grid flexibility and resilience and a direct use for generated renewable electricity. The system could also access new revenue markets via the BESS.
NOTE: In each of the examples above, the importance of thorough feasibility work and modelling must be emphasised. Evidence of feasibility, design, modelling (and underlying assumptions) associated with your project will be required to support	

3. Smart Energy Building Blocks

3.1 Why Building Blocks?

We have defined 8 “building blocks” for a smart, local energy system within West Midlands’ Net Zero Neighbourhood trials, as outlined over the next few pages.

These blocks tend to progress from the least technically complex to ones with greater technical and regulatory complexity. However, in many cases the greatest complexity will lie in building engagement and coordinating diverse objectives across a community.

We have chosen to call them building blocks rather than archetypes to emphasise that they are not exclusive – a community might choose to combine several models, or to evolve from one model to another over time. So, for example, a community might initially develop a Solar PV array on common land and use it to anchor a VPP, then scale up the VPP over time by integrating collectively-purchased home battery systems as they become available.

Note also that the blocks tend to build on each other – having strong planning and a track record of successful community projects builds vision and trust, and capability to build more sophisticated assets and systems over time.

The balance of this section focuses on analysing each of the building blocks from a number of perspectives – what scale it operates at, how it is governed and financed, what technologies it needs, how it sits with current energy regulation & markets, etc.

3.1 The Building Blocks

Local Area Energy Planning

People work together to create a local spatial plan and temporal roadmap for developing energy assets, systems and community engagement within the area.

Project Marketplace

An organisation takes the lead in finding local projects and linking them to community, investors and supply chain.

Collective Purchasing

People join together to negotiate bulk discounts on supply and installation of assets such as solar PV, batteries, etc, typically via a centrally-coordinated tendering process.

Community Anchor Asset

Build and operate a common, community-owned asset.

Corporate Anchor Asset

Build community around a corporately owned and operated asset.

Flexibility VPP

Coordinate and aggregate people's energy usage to create a Virtual Power Plant (VPP) that can sell flexibility to DSO, for its local flexibility market, and NESO, for ancillary services.

Local Energy Market / Peer-to-Peer Community

Trade energy between members of the community, enabling them to agree on tariffs that benefit both producer and consumer.

Self-Balancing Network

A virtual balancing system optimises generation and demand within a network segment (e.g. microgrid) to balance locally as far as possible. The system manages both flexibility (as with VPP) and energy (as with LEM/P2P) by coordinating equipment to maintain balance within the network.

3.2 Analysis Perspectives

Anchors

What anchors need to be in place for the model to operate effectively, achieve viable scale, etc? Anchors may be assets, or they may be organisational capabilities or systems.

Scale

What is the natural scale for the model? (This can be measured on dimensions such as geography, number of people or households, financing.) Are there upper or lower bounds to when it might be feasible or viable?

Maturity & Examples

How close is this model to widespread deployment? Does it require further innovation, or is it ready for communities to adopt now? Where has it been tried?

Governance

How is the model governed? What organisational models (e.g. company, co-op, CIC, etc) are commonly employed? How are strategic and operational decisions made? Who's accountable?

Stakeholders and Skills

What parties are involved in the model? Which are essential, which optional? What skills do they need to bring?

Technology and Systems

What energy techs are involved? What systems are needed, both to coordinate and manage energy assets, and to operate the model (e.g. for settlement, billing and CRM)?

Service Delivery

What operational and administrative processes need to be performed? (e.g. for asset operation & maintenance, to access markets, to manage customers & members, for compliance)

Finance & Benefits Distribution

How is the model financed? How are benefits distributed to participants?

Regulatory and Markets

What are the key regulatory issues affecting this model? How well does it fit with current market arrangements?

When to consider it

A brief checklist of the circumstances that favour, or militate against, this model.

Delivery Checklist

A brief checklist of things to consider when setting up and delivering this model.

3.3 Smart Energy Framework

	Foundations		Assets			Smart Systems		
								
	Local Area Energy Plan	**Project Marketplace**	**Collective Purchasing**	**Community Anchor Asset**	**Corporate Anchor Asset**	**Flexibility VPP**	**LEM / P2P Community**	**Self-Balancing Network**
Description	Spatial plan and roadmap for energy systems in the community.	A central place to share projects and connect to funding & delivery partners.	People band together to vet suppliers and negotiate better pricing.	People band together to purchase an asset for their community	Company builds an asset and shares benefits with the community	An aggregator coordinates smart appliances to sell flexibility services	"Prosumers" trade energy within a local area or community	Coordinate energy use within an area to minimise dependency on wider grid
Examples	Formal LAEP in local authorities. Hyperlocal LAEP in Eynsham, LEO.	Accelerators and Incubators. Crowdfunding platforms.	Solar Together, Your Home Better	Low Carbon Hub, GM Community Renew-ables, Lune Valley Hydro, Energy Local	District heating, Fan Club, Ripple, Shared assets in multi-occupancy buildings	Equiwatt, Levelise, GridBeyond, Flexitricity.	GM LEM, Urban Chain, Sitigrid, Energy Local?	Community DSO, Campus microgrids, Local Energy Market Alliance
Governance & Stakeholders	Hyperlocal plan is probably done by ad hoc enthusiasts, with wider engagement.	Central convenor sets rules, defines support levels and vets participants.	May self-organise, but benefits from a trusted, savvy central convenor.	Corporate owns asset: CIC, Co-op, etc. Energy sharing needs supplier.	Corporately driven; contractual relation-ship to other parties. ESG will influence.	Probably corporate VPP platform. Open source is possible.	Central market operator & platform. May be corporate, or public/private SPV.	Central micro-grid operator (& owner?). Corporately driven. (May be CIC or co-op.)
Technology & Systems	Formal LAEP needs data, GIS & modelling tools. Hyperlocal is more ad hoc.	May be very simple, but can also provide monitoring, support, acceleration, etc.	May need a procurement platform.	Basic asset O&M, monitoring, settle-ment. May anchor VPP or other platform.	Asset O&M. Needs full back office – settlement, billing, CRM.	Complex tech stack due to interoperability with wide variety of equipment & markets.	Trading is complex, but only need to integrate meters and have a single market.	Real time control of assets & trading, plus backoffice for billing, CRM, etc.
Finance & Benefits	Self-funded, or may be small grants available. Enables other building blocks.	Investors may have social goals, or may seek dividends and transaction fees.	Bilateral between household & supplier. May be transaction fee for convenor.	Likely crowdfunded. Benefits via dividend or energy sharing.	Corporate finance, to gain loyal customers. Community gets trusted partner.	Platform via VC & innovation funding. People earn share of flex revenue.	Platform via VC & innovation funding. Prosumers benefit via energy pricing.	Corporate finance for network plus platform funding. Benefits via energy services.
Regulatory & Markets	No regulatory restrictions, but also limited influence on wider system.	Financial regulation of crowdfunding. Regulatory sandboxes.	Mostly consumer protection & Trading standards. Trust in suppliers is key.	Crowdfunding needs FCA. Energy sharing has complex regulatory reqts.	Consumer protection legislation plus Ofgem licences. (Heat is emerging.)	DSO flex markets are relatively open. BM is complex. Need to stack multiple mkts.	Complex energy regulation; needs a supplier. P415 may open up VLP options.	Complex energy regulation, probably as a "complex site".

Area likely to have greatest complexity

3.4 Analysis Summary – What is the ideal SLES?

Smart Local Energy Systems are still emerging – some of the technologies are mature but others are evolving rapidly; the regulatory environment needs realignment to accommodate them; markets struggle to capture the full value of flexibility (e.g. the optionality it creates for the wider system) and local energy (e.g. the value people place on known, local provenance for the energy they consume). We haven't yet converged on a clear answer to the question of what an ideal SLES might look like.

Furthermore, the ideal SLES will vary by location. Each place has different resources – varying availability of solar, wind and hydro; different topology of energy & transport networks; wide ranges of skills, employment, access to finance, etc; different demographics. Communities have different preferences and priorities. A "one size fits all" model of a SLES may never appear.

We should always remember that the goal isn't to be as smart, local and self-sufficient as possible. It's for people to have a good quality of life – to be warm, comfortable, healthy, etc. It's perfectly valid for people to decide that they just want to make their homes warmer and more energy efficient and to be able to buy energy from the national system at a fair price. SLES have potential to give them added value beyond this, both financial and social, but that entails effort and commitment. It's perfectly valid for people to decide to invest these elsewhere.

In setting up plans for a SLES, I would suggest:

- **Start where you are now**. Assess your current state. Make simple interventions to improve it – improve energy efficiency, invest in well-proven techs that can provide cheap, clean energy. Develop a LAEP.
- **Go as far as you need to**. You can then decide whether a more sophisticated model adds sufficient extra value to be worth pursuing. Smart systems can be interesting in their own right. They can reduce energy costs further. But they need investment and commitment. You don't have to be smart just for the sake of it. You may have other priorities.
- **There isn't one perfect model**. The assets that will work best in an area depend on geography, demographics, expertise, etc. The way you coordinate them depends on the extent to which you want to play with the various technical, market and regulatory complexities – VPP, P2P and self-balancing networks all have different concerns.
- **Build over time**. The blocks can be combined & configured for different circumstances. Tech costs and complexities will probably reduce over time. Regulatory & market structures will change, perhaps becoming more amenable to SLES.

Over the next few slides, we have built some very simple models to position the scale, governance, finance needs, and technical complexity of the building blocks against each other. These are rough illustrations, dependent on just what tech you're dealing with, types of organisation involved, etc. There's a huge range of possibilities and no simple model fits them all. But if you see these models as a starting point for thought and discussion, we hope they might give some insight as to where you could focus.

3.4 Analysis Summary – Scale

Approximate Number of Homes

	10s	100s	1,000s	Regional / National
LAEP		Hyperlocal LAEP	Natural scale for Local Authority LAEP	NESO FES & RESP DSO DFES
Project Marketplace	Could work at pretty well any scale			
Collective Purchasing	Complex or emerging technologies, e.g. deep retrofit, innovative appliances	Natural scale for standard assets.	Viable at this scale, but needs good coordination	
Community Asset	Complex or emerging technologies, e.g. shared loop ground source heat pump array	Natural scale for community PV, hydro, etc	Larger renewable assets, crowdsourcing	
Corporate Asset	Complex or emerging techs	Natural scale for many assets and networks	Needed to give economies of scale for heat networks, large renewable assets	Natural scale for many corporate assets, e.g. wind farms, large storage facilities
VPP	Only works for DSO markets; unlikely to be viable in itself	Minimum scale to access national markets	Needed to be really viable in national markets	Platforms operate at this scale to be commercially viable, but could be partitioned more locally
LEM / P2P		Minimum scale to have any sort of liquidity	Decent scale to give liquidity	Gives good liquidity, but difficult to establish trust at this scale
Self-balancing Network	Off-grid sites can do this, but energy is expensive for them	Good scale for a microgrid, but may lack liquidity	Decent scale to give liquidity	Would be challenging to operate at this scale – is role of DSO / NESO

3.4 Analysis Summary – Governance

	Ad Hoc (People self-organise)	**Convenor** (A central coordinator)	**Community** (A community group or organisation such as a Co-op or CIC leads)	**Corporate** (A company, local authority, public body, SPV or similar organisation leads)
LAEP	Could be led by an ad hoc group of interested local people	Benefits from facilitation by a skilled convenor. (Could be from community group, DSO, LA, etc)		
Project Marketplace		Requires a central convenor to operate the market. (Could be local authority or corporate)		
Collective Purchasing	Conceivably done by ad hoc group, but that will be difficult to do at any sort of scale	Benefits from central convenor to coordinate procurement. (Could be local authority or corporate)		
Community Asset			Inherently a community-led model	
Corporate Asset				Inherently a corporate model. Can be moderated by including community and LA in an SPV.
VPP			Can be a strong role for community group in recruitment and support	Platform needs corporate model. Can be moderated by including community and LA in an SPV.
LEM / P2P			Can be a strong role for community group in recruitment and support	Platform needs corporate model. Can be moderated by including community and LA in an SPV.
Self-balancing Network				Probably a corporate model. Can be moderated by including community and LA in an SPV.

3.4 Analysis Summary – Finance Needs

	£1-10k	£10-100k	£100k-1M	Lots
LAEP	Hyperlocal planning could be done at this scale	Formal local authority LAEP are in this range	Regional plans	
Project Marketplace		Probably needs some funds to seed and operate, but can scale up from there		
Collective Purchasing		Needs funds to run the procurement, recruit participants, etc.	NB actually financing the assets is separate – either for the buyers or a separate finance partners. This could be very substantial.	
Community Asset		Sweet spot is probably in this range.		
Corporate Asset			Commercial ownership enables larger assete, (And probably requires them to deliver required scale of returns for most companies.)	
VPP				Needs significant funds to build and operate platform. But this can be spread across multiple VPPs.
LEM / P2P				Needs significant funds to build and operate platform. Again, can spread across multiple markets.
Self-balancing Network				Needs a platform, and probably corporate assets.

3.4 Analysis Summary – Technology

	Simple / None	OK	Specialist	Complex / Innovative
LAEP	Can be done with a strong focus on community engagement rather than tech	Gains credibility with deeper data analysis and understanding of energy system		
Project Marketplace		Benefits from basic platform to operate the market	Can be a good route to address innovative and emerging tech	
Collective Purchasing		Works best for established, easily specified techs		
Community Asset		Works best for reasonably well established techs		
Corporate Asset		Works best for reasonably well established techs, but corporate support enables operation of more specialist and innovative tech		
VPP			Specialist platform, with challenging tech for asset integration, portfolio and market optimisation, etc. Can operate a basic VPP without this, but will gain much lower value form it.	
LEM / P2P			Specialist platform with complex regulatory / energy system implications. Needs to operate reliably at high scale of trading.	
Self-balancing Network			Specialist platform with complex regulatory and technical implications.	

3.4 Analysis Summary – Regulatory Issues

	Simple / None	OK	Specialist	Complex / Innovative
LAEP	Basic plan has few implications, but need to engage with energy system to have influence.			
Project Marketplace		Basic marketplace is easy to operate, but projects may have regulatory implications.		
Collective Purchasing		Need to manage FCA regulation. Energy system implications depend on tech being purchased.		
Community Asset		Smaller & more common assets are easy enough. Larger or specialist assets may need deeper understanding and engagement. Gets complex if targeting an energy sharing model.		
Corporate Asset		Smaller & more common assets are easy enough. Larger or specialist assets may need deeper understanding and engagement. More likely to get into energy supply issues, as selling to community.		
VPP			Needs good understanding of markets, but relatively lightly regulated.	
LEM / P2P				Tough to integrate with supplier hub regulatory model.
Self-balancing Network				Needs to fit with regulation around supplier hub, networks – likely to rely on derogations / exemptions.

3.4 Analysis Summary – Benefits

	Primarily Social	Small Cost/Revenue Benefits – Primarily Social	Marginal Cost/Revenue Benefits – Long Payback	Decent Financial Payback
LAEP	Builds engagement. Builds base for other models.			
Project Marketplace	Opens access and innovation. Other benefits come from the projects themselves.			
Collective Purchasing			Depends on the tech, but can be a good way to enable access to techs that can provide attractive returns, e.g. solar PV	
Community Asset		Depends on community objectives – some schemes can be commercially attractive, but also likely to place some emphasis on community benefits.		
Corporate Asset				Likely to require decent returns
VPP				Likely to be commercially operated. (But often on edge of viability...)
LEM / P2P			May be driven by community preferences & engagement. But likely to need to a commercially operated platform.	
Self-balancing Network				Likely to be commercially operated.

3.5 Possible Pathways

The building blocks are interlinked. As illustrated overleaf, they fall into three board groups:

1) **Foundations**: Assessing the current state. Establishing plans and identifying projects that could build capabilities that are of most interest and value to the community.
2) **Assets**: Building assets (generation such as PV, wind, hydro; smart appliances, heat pumps, EV charging and other energy using techs; batteries and other energy storage systems) that can augment those already in place across the community. These may be owned by individual community members, by the community as a whole, or by corporate partners. They serve first to help individual homes and businesses reduce energy costs, improve comfort, etc; and second to provide a base for smart systems to coordinate activity across the community.
3) **Smart Systems**: Systems to coordinate the portfolio of equipment across the community. This can then enable people to gain additional value, e.g. through trading energy and flex amongst themselves or with the wider system.

Note again that this layering is not intended to create some sort of merit order – communities don't have to build smart systems in order to succeed. People may be able to gain significant benefits simply by adjusting the way the configure and use their existing assets, and that may be sufficient. Smart assets and systems might add additional value, but it's perfectly valid for people to decide to focus elsewhere.

To illustrate how the building blocks might be linked together to develop a community's energy systems over time, we have developed 6 scenarios illustrating possible journeys (shown in the slide after next):

1) Simple VPP (behavioural response)
2) Rooftop Solar (no coordination)
3) Advanced VPP (aggregating and integrating PV & batteries)
4) Community Energy Sharing (community asset)
5) Wind Farm Dividend (corporation pays community dividend)
6) Private Wire Network (self balancing village)

Again, these are illustrations of possibilities, not definitive pathways. Communities can use them to help frame their own journey to a better local energy system. They follow the general narrative of:

a) Identify what assets (physical, financial, social, etc) you have
b) Identify where you want to get to (for now; this can evolve)
c) Build partnerships to help you progress
d) Augment your current assets as necessary
e) Optimise the way you coordinate and use the assets

Good luck with the journey!

3.5 Possible Pathways – Building Blocks for a Smart Local Energy System

Build as high as you want. You can gain benefits by planning and managing existing assets. You don't have to buy more assets and build smart systems if you have other priorities.

Smart Systems

Coordinate assets to gain additional benefits.

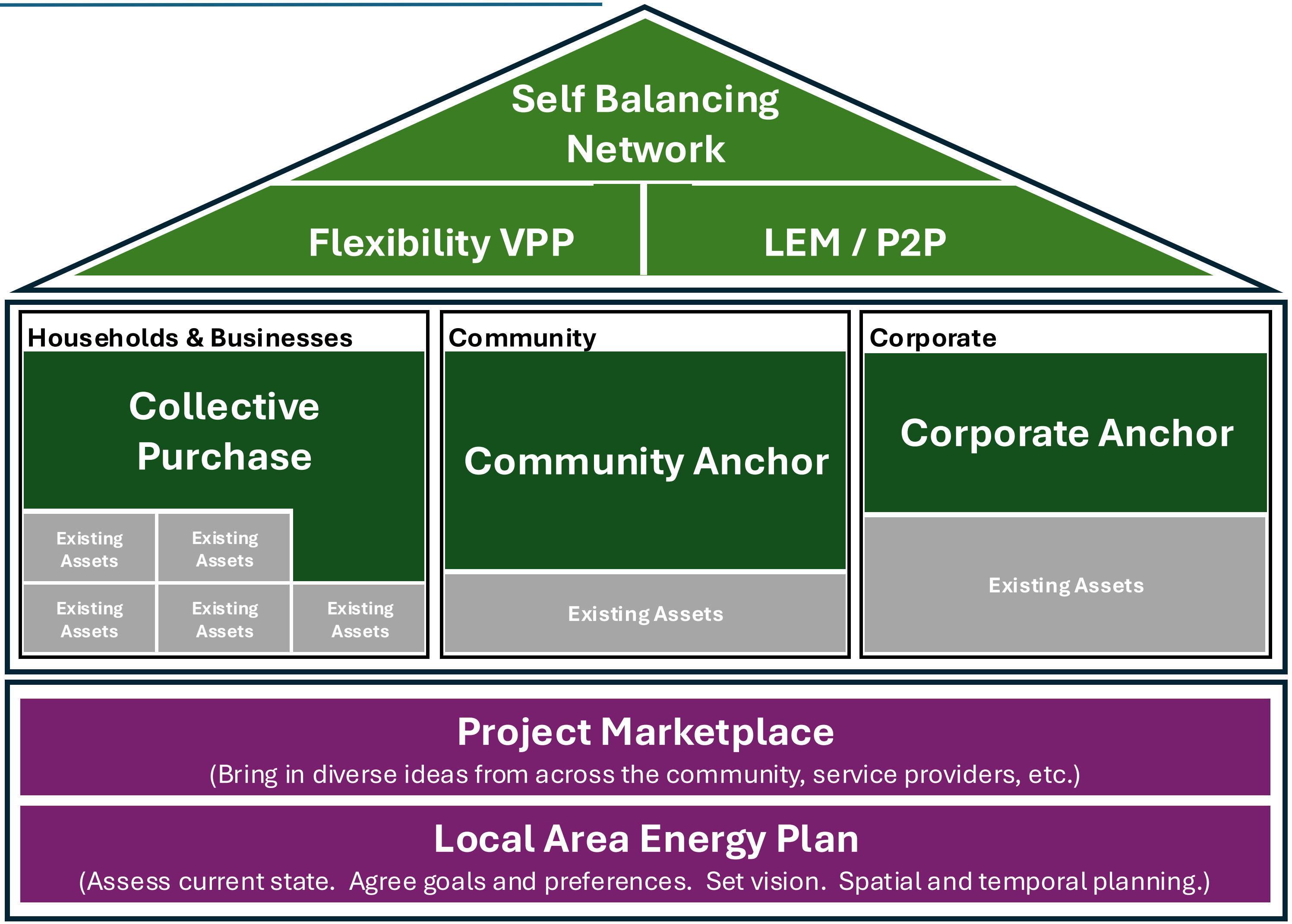
Assets

(Focus here is on physical & technical assets, but communities also have social and intellectual assets – community groups, knowledge and skills, etc. These also need to be considered.)

Build assets to help reduce individual households' energy costs and improve efficiency & quality of life.

Foundations

Plan and ideate.
Identify what you want to do.



3.5 Possible Pathways – 6 Scenarios *(not exhaustive…)*

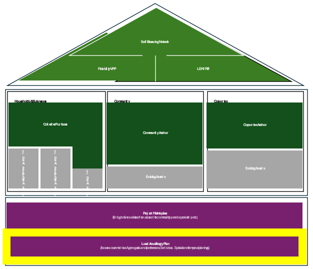
	Assess Current State Identify physical, financial social assets. Understand geographic constraints & options. Analyse energy flows.	**Agree Target** Clarify preferences & objectives. Negotiate trade-offs. Set out a common vision and develop spatial and temporal plans.	**Build Partnerships** Build links to businesses, local government, social organisations to bring in skills, finance, etc. Build community organisations.	**Build New Assets** Develop additional assets to augment the current state. Build a portfolio of generation, storage, demand to support the targets.	**Optimise Energy Flow** Build systems, commercial structures, processes to coordinate and optimise use of the assets.
Simple VPP A group of tenants on an estate with a common landlord.	**LAEP**: *People review their homes, energy use, etc, and decide their priority is to improve parks & natural spaces. But they see value in participating in schemes like DFS.*		**VPP**: *They form a community group to identify a VPP operator that can aggregate them and take them to markets like DFS and DSO flex markets, probably primarily via behavioural response but with capacity to integrate smart appliances over time. The group negotiates with the VPP operator and supports the community to engage with it as it builds and runs the VPP.*		
Rooftop PV A group of homeowners in an established housing development.	**LAEP**: *Enthusiastic residents in a neighbourhood form a group to develop a plan. However, many people are too busy to participate actively and there is little agreement on many of the ideas put forward. In the end, they can agree that rooftop PV would be attractive for many, if they could find a trusted supplier.*		**Collective Purchase**: *Core group works with local authority to set up a Solar Together scheme, & recruits homeowners to sign up. The LA vets local installers & helps people get PV at a good price.*		**Stop**
Advanced VPP A mixed group of tenants and homeowners in an area with a wide range of housing stock.	**LAEP**: *A core group of tenants, homeowners & representatives from larger landlords work with the local authority and DNO to build a plan. They run workshops & other events, obtain free support from a local consultancy, and so develop a vision to build a VPP from PV+batteries.*		**Collective Purchase**: *A large landlord procures PV for its houses & flats plus batteries in larger blocks (where it incurs common energy costs). It negotiates terms for local homeowners to buy PV & batteries at the same price.*		**VPP**: *VPP operator develops a commercial model for sharing flex revenues that makes the scheme viable for the landlord.*
Community Energy Share A group that has formed around concerns about a local piece of common land.	**LAEP**: *Members of a sports club see that land adjacent to playing fields is becoming derelict. They recruit others and form a group to explore uses for the land.*	**Project Marketplace**: *The group sponsors a call for ideas for the land. They scrape together funds to support a couple of feasibility studies for the best ideas.*	**Community Anchor Asset**: *The land is suitable for a small solar farm, and the landowner is amenable. A community group is formed to crowdfund & build the solar farm.*		**LEM/P2P**: *They work with a partner to set up a scheme to sell energy to local homes with a discount for fuel poor.*
Wind Farm Dividend A company with an interest to develop links to the community in the area where it operates.	**LAEP**: *A developer has identified a site for a wind farm. Recognising the need to gain community buy in for planning permissions, etc, they sponsor a collection of local groups to develop a LAEP. This identifies options where seed funding for community schemes would be useful.*		**Corporate Anchor Asset**: *Local groups form umbrella organisation to represent them with the developer. This works with the developer to set up & administer a fund from a proportion of the wind farm's profits, to invest in community projects.*		**Project Marketplace**: *The fund seeds feasibility studies for community assets, VPP & LEM.*
Private Wire Development A company that is interested to develop a new mixed housing / business site in an area.	**LAEP**: *A developer is building a new village with iDNO / private wire network. They explore ideas to increase property values by bundling equipment and selling EaaS.*	**Corporate Anchor Asset**: *The developer builds village, network, solar farm, shared loop heat pump array. It writes Energy-as-a-Service into leases / tenancies and sets up an ESCO to deliver the service. Governance of the ESCO includes involvement from tenants and community groups, to provide assurance on consumer protections.*			**Self-Balancing Network**: *ESCO operates the assets to maximise returns. This requires a high degree of self-balancing.*

4. Building Block Descriptions

4.1 Foundations
- 4.1.1 Local Area Energy Plan
- 4.1.2 Project Marketplace

4.2 Assets
- 4.2.1 Collective Purchasing
- 4.2.2 Community Anchor Asset
- 4.2.3 Corporate Anchor Asset

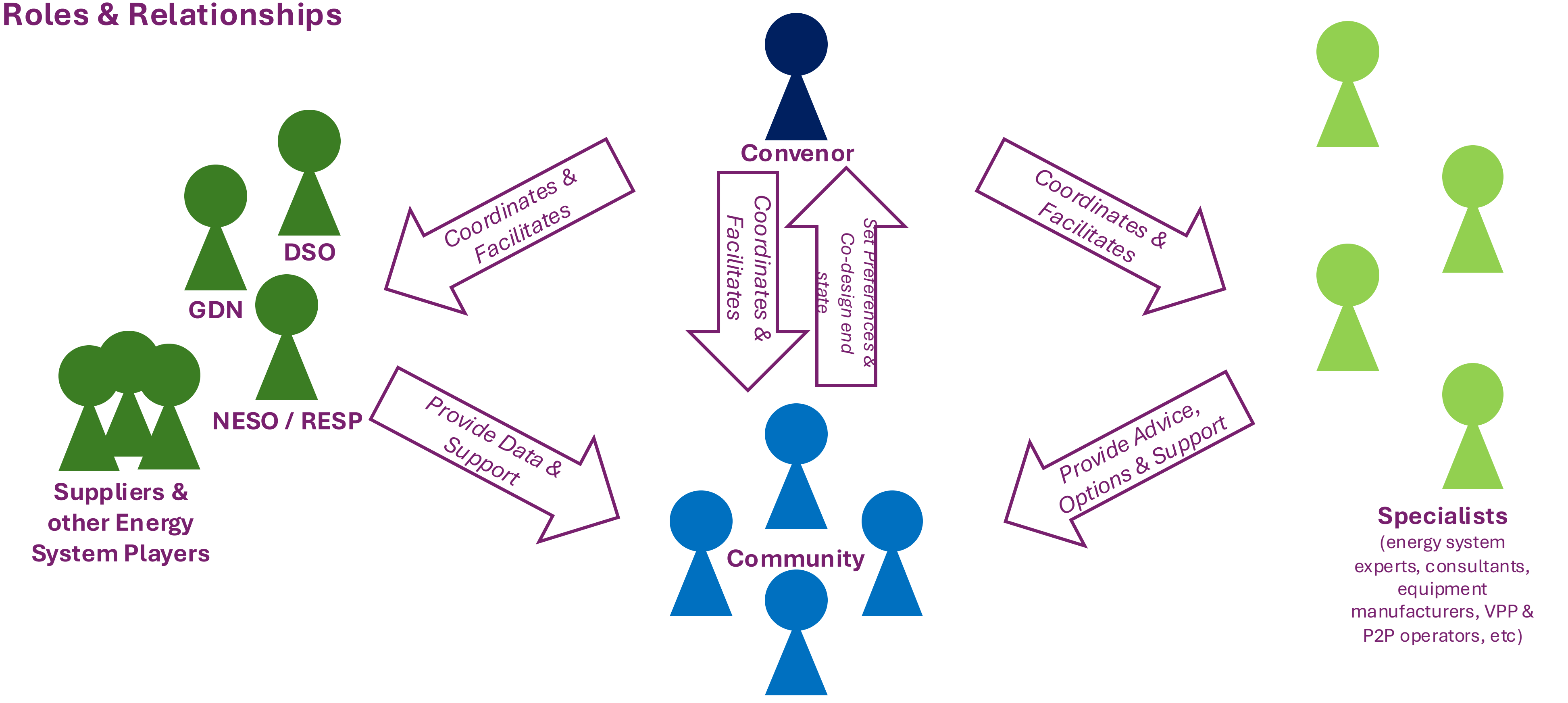
4.3 Smart Systems
- 4.3.1 Flexibility VPP (Virtual Power Plant)
- 4.3.2 Local Energy Market / Peer-to-Peer Community
- 4.3.3 Self Balancing Network

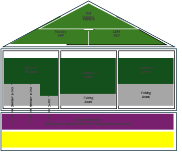


4.1.1 Local Area Energy Planning

Work together to create a local spatial plan and temporal roadmap for developing energy assets, systems and community engagement within the area. Many Local Authorities (e.g. borough or county councils) are developing LAEP to cover their area, but plans can also be developed for smaller areas, e.g. where people are especially interested or where specific local assets provide a distinct focus. These hyperlocal plans might be prepared with different degrees of rigour, depending on the interest, skills and assets in the area. They can then feed into wider plans being prepared by Local Authorities, Regional Energy Strategic Planners, etc.

Roles & Relationships





4.1.1 When to Consider Local Area Energy Planning

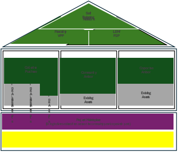
When to consider doing this
Community engagement and planning almost always makes sense – it's hard to think of a circumstance where you shouldn't do it. The question is more about how much planning you should do, e.g. how much rigour is needed in the data analysis and system modelling.

For hyperlocal LAEP, I'd focus on the community engagement aspects – helping people understand their options, clarify their preferences, resolve differences in objectives and priorities, etc. This then provides a clear and valuable steer to the project, and to wider planning processes at Local Authority and RESP level which can then cover the more technical aspects.

Of course, if people in the community are interested and have the skills to drill deeper into the data and modelling, then go for it. There's a lot that can be done with open data and commonly available tools such as spreadsheets, and doing this deeper analysis will lend weight to your input to the wider plans.

When to avoid it
It's hard to think of circumstances where you shouldn't be doing this at some level. The question, as discussed at the left, is how much to do and how much technical detail to get into.

What scale do you need to make it viable?
Formal LAEP tend to be done by a Local Authority (e.g. a town or county). Hyperlocal LAEP could be a lot smaller – Eynsham's LAEP was done for a village of about 5,000 people. There's no reason why you couldn't develop a plan for a much smaller village or community, although it'd be a lot less formal than one developed for a Local Authority.



4.1.1 Delivery Checklist for Local Area Energy Planning

Roles & Responsibilities

1) **Convenor**: Assembles participants. Coordinates project. Facilitates discussions. Helps disseminate results.
2) **Network & System Operators (DNO, GDN, RESP)**: Provide data on current systems and networks. Describe planned network development, possible future scenarios, etc. Support community to understand energy system.
3) **Specialists (Energy, Technical, Commercial)**: Identify technical & commercial options. Analyse impact on local environment & energy system. Support community to assess options & trade-offs, build business case, etc
4) **Community**: Define goals and preferences. Co-design options with specialists. Assess trade-offs. Agree target end state.

Activities

- Assemble core team to undertake the planning
- Identify stakeholders in community and plan activities to engage with them, co-design options, gather feedback, etc
- Engage with local energy network and system operators to access their data, development plans, future scenarios, etc
- Gather and analyse data on current state – energy networks, housing, consumption & generation patterns, transport, etc
- Engage with tech developers, equipment manufacturers, VPP & P2P operators, to get info on options, costs, commercials, etc
- Co-design future state options. Identify impact on community, energy system, environment. Assess feasibility, business case.
- Assess trade-offs between options, community preferences, etc, and hence identify preferred options
- Develop pathway(s) to implement preferred options. Probably very high level – enough to demonstrate feasibility, deliverability
- Disseminate findings and use them to influence wider plans

Knowledge & Intellectual Property

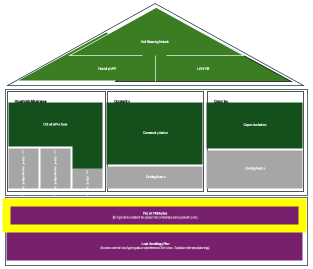
- Needs knowledge of energy system, technology & commercial options, etc. Some of this may be proprietary (e.g. for tech, commercial services), but owners will probably share sufficient to support co-design and business case development.
- Most key data is open, although some may be proprietary

Data

- Local network capacity, headroom, health, etc
- Local generation and demand profiles (current & projected)
- Housing, transport, etc
- Geospatial

Tools & Systems

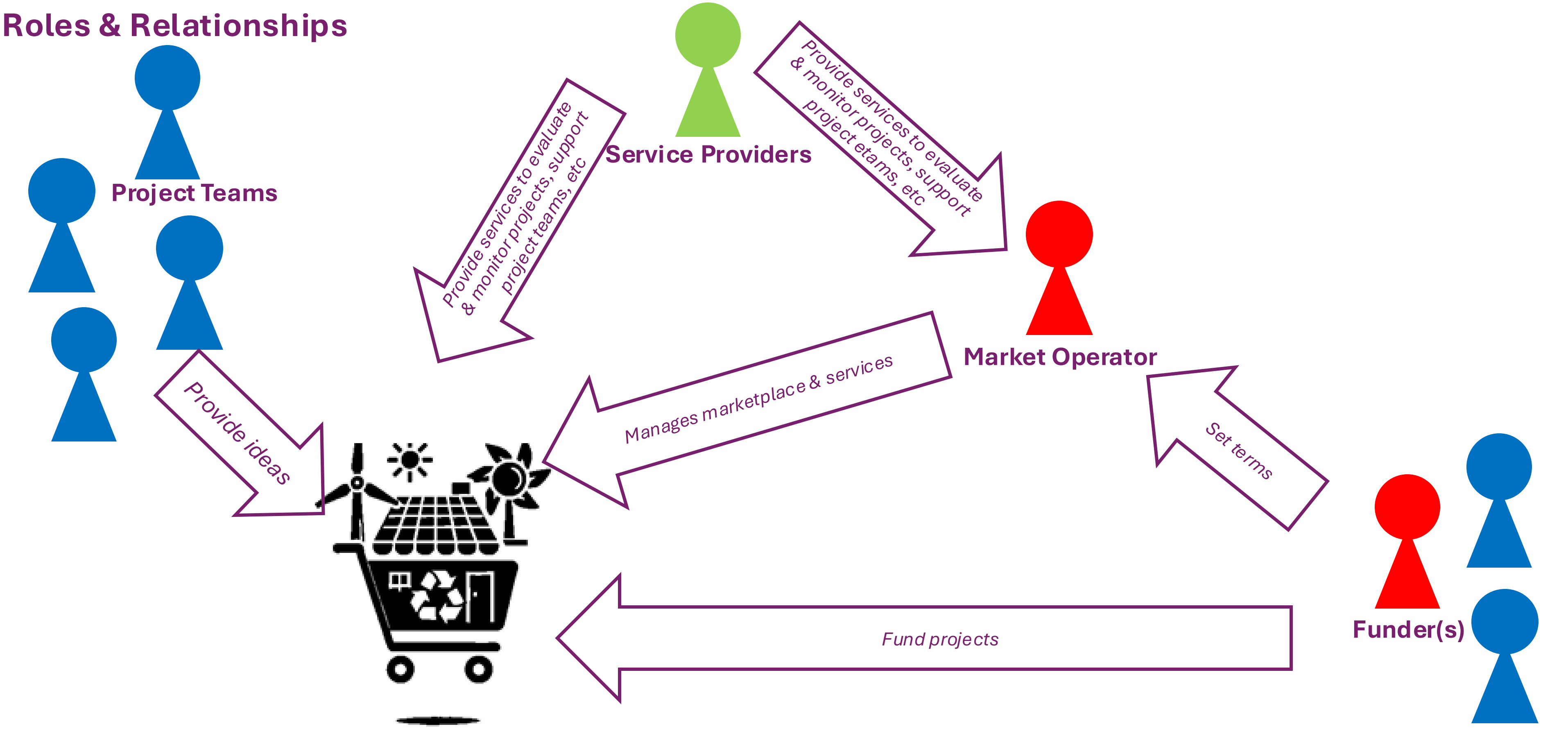
- Basic data analysis tools (spreadsheets, etc)
- Basic maps / geospatial tools. LAEP+ tool.
- Can do deeper analysis with advanced tools for analytics & energy modelling. That's probably overkill for hyperlocal LAEP.

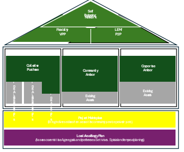


4.1.2 Project Marketplace

An organisation or digital platform that takes the lead in finding local projects and linking them to community, investors and supply chain. Having a single port of call enables a more coordinated approach to delivery. It also increases economies of scale and reduces risk for investors and suppliers. The marketplace might support other models (e.g. to build capacity for a VPP or LEM), or evolve into one of them, but in the early stages the focus may be more about delivering new renewable capacity and energy efficiency rather than about integrating and optimising the local energy system.

Roles & Relationships





4.1.2 When to Consider Project Marketplace

When to consider doing this

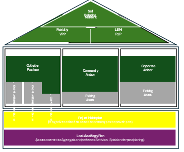
- If people in the community have ideas that they'd like to explore and develop. Even a small amount of funds can make a big difference in the early stages of developing an idea. Availability of funds may also attract people who wouldn't otherwise engage.
- If you want fresh input. People in the community may be able to generate creative ideas that are well matched to local concerns and that could be integrated into the existing project plan.
- To drive engagement and ownership. Enabling people to define and run their own projects, both through funding and through wider support (mentoring, access to trusted experts and service providers, etc), will help build ownership in the wider outcomes.
- To provide wider support. The marketplace doesn't have to be about providing funding – it could be about connecting people with expertise or assets to people who can make good use of them. That support might come from within the community, or it might be provided by the project or its partners.

When to avoid it

- If your project is already very clear in what it is doing. There is no point in raising people's hopes about getting support for their ideas if most ideas are going to be rejected because they don't fit the existing project plan.
- If you can't operate the marketplace effectively. There can be a lot of work required to define criteria for participation in the marketplace, evaluate applications and allocate funding, explain your decisions, monitor and support projects, etc. (The amount of work will depend on how formal the marketplace is, whether and how much funding you are making available, what partners are involved, etc, so you can tune this in the marketplace design. But don't underestimate how much effort will be involved even for a fairly simple, informal marketplace.)
- If you can't follow through. If you are providing seed funding for people to develop initial ideas, for example, then there needs to be a route for them to implement those ideas if they prove viable. (This might be via your project, or it might be by steering them towards funding and support from other sources.)

What scale do you need to make it viable?

The marketplace can be tuned to the funds you have available and the support you can provide. Small charitable foundations can disburse a few grants per annum, amounting to a few thousand pounds. DESNZ' NZIP portfolio funded £1bn worth of projects.



4.1.2 Delivery Checklist for Project Marketplace

Roles & Responsibilities

1) **Market Operator**: Administers marketplace. Sets up calls for projects. Vets users, projects, funders. Manages processes to evaluate, monitor and support projects. Reports on projects and outcomes.
2) **Funder**: Provides funds to operate marketplace and deliver projects. Sets terms for the type of projects they are interested in.
3) **Service Providers**: Provide services to marketplace (e.g. project evaluation, monitoring, support) and project teams (e.g. specialist expertise, incubation, etc).
4) **Project Teams**: Develop & submit ideas for projects. Undertake projects in accordance with agreed terms if funded.

Activities

- Agree marketplace objectives with funders
- Set up calls for projects that align to these terms
- Engage with potential project teams, support providers, etc, to engage them with the market and support them to submit ideas
- Record project proposals and track their progress through evaluation, funding, execution & delivery
- Engage service providers to evaluate & monitor projects, support project teams, etc
- Provide information to potential funders (e.g. for crowdfunding) and manage their funding and associated regulatory reporting
- Agree terms with successful project teams
- Disburse funds and track use of these funds to ensure they align to agreed terms
- Capture project deliverables and outcomes, and hence report on progress in delivering marketplace objectives

Knowledge & Intellectual Property

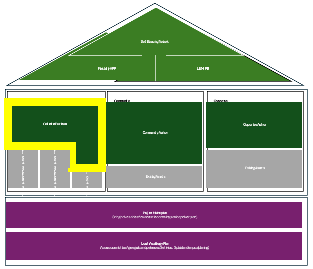
- No special knowledge or IP is required to run a marketplace in general, but the objectives for a specific project call may mean that specific expertise is needed to evaluate and support it
- Crowdfunding marketplaces need a platform, which will be subject to licensing for the software, etc

Data

- Main need is to record project and funding data appropriately
- It's also important to record project outcomes (deliverables and assessments of the impacts of these deliverables) and lessons learned, and to plan for wider dissemination of key lessons.

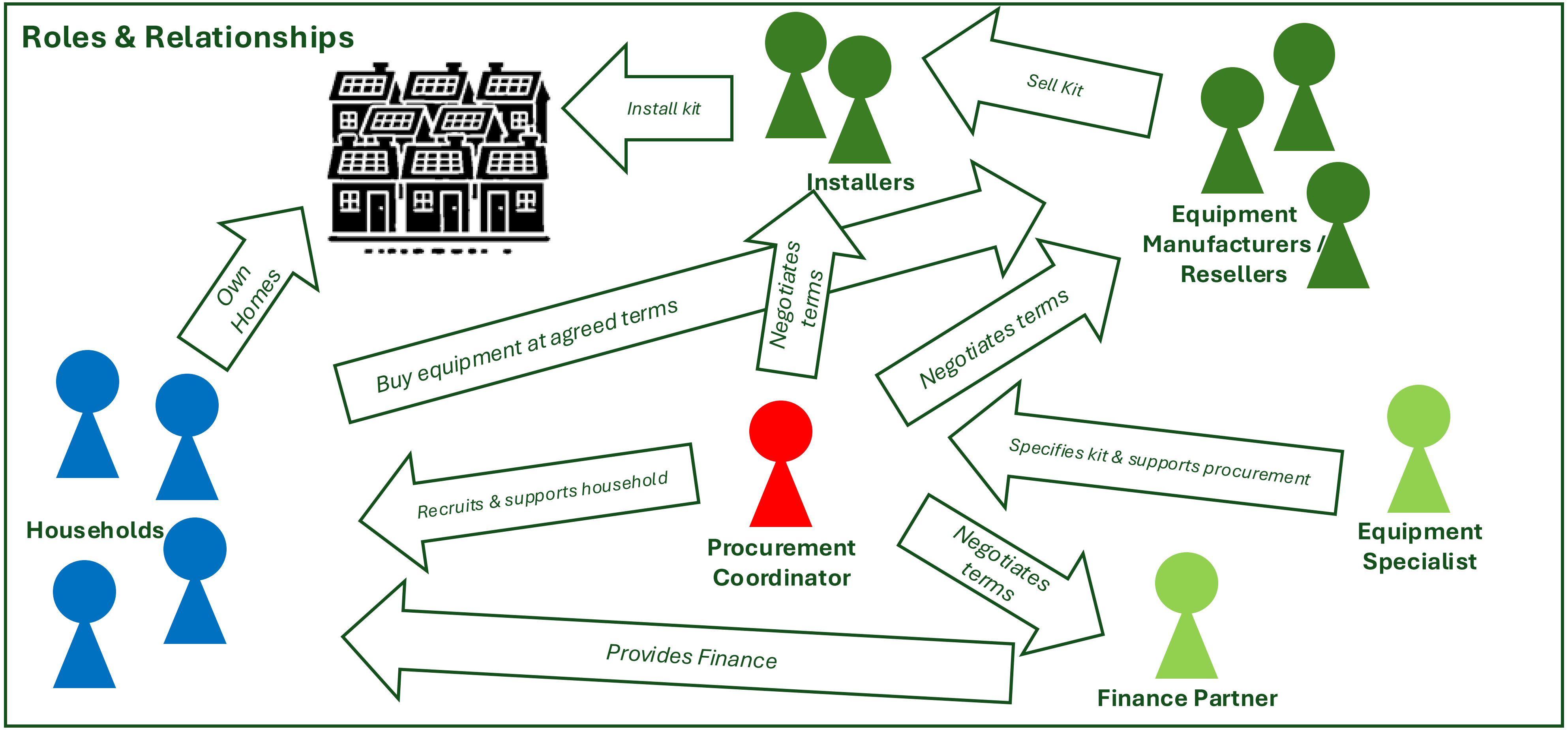
Tools & Systems

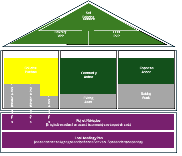
- Small marketplaces with few projects can be managed with simple tools – spreadsheets and document stores. As the volume of projects and funds grows, there is greater need for more rigorous recording and tracking. For crowdfunding, with FCA requirements, a specialist platform is likely to be required.



4.2.1 Collective Purchasing

People join together to negotiate bulk discounts on supply and installation of assets such as solar PV, batteries, etc, typically via a centrally-coordinated tendering process. These assets are fairly standard so bulk buying works well (although installation is site-specific), but the model could be extended to more complex interventions (e.g. retrofit) with thought and a body of suitable suppliers. It could also be extended to assets such as EV chargepoints. You could even envisage collective negotiation of energy tariffs with suppliers, although that'd be a significant change to the UK norm. The model can also include development of financing options to support purchase of major assets.





4.2.1 When to Consider Collective Purchasing

When to consider doing this

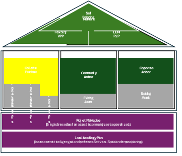
- If there are a significant number of owner / occupiers in the community, especially for those who are able-to-pay or if you have a suitable financial partner lined up
- There is interest in LCTs, but low trust of installers and resellers, so providing access to vetted suppliers adds a lot of value.
- There is low penetration of LCTs in the area, so supporting an initial group of people to deploy them could seed further growth by enabling people to see them in action.
- You have plans for a model such as VPP or P2P trading, but need to create capacity to participate in it.

When to avoid it

- If most people in the community are tenants so don't control the fabric of their buildings. In this case, working with the landlords is essential. Social landlords should be able to purchase in bulk already. If there is a large number of small, private landlords than a collective purchasing scheme for them is conceivable, but I don't know of any examples.
- If there are few able-to-pay households in the community, and you cannot line up a financial partner who is willing to provide suitable financing for people in the community.
- If the building stock is generally in a poor state or otherwise unsuitable for addition of LCTs. It may be possible to set up a scheme to address retrofit and other fabric improvements, but that's likely to be more complex than a simple Solar Together style of scheme.
- If you can't get sufficient interest from a range of installers, resellers or equipment manufacturers. You need sufficient participation to run a meaningful procurement.
- If you don't have access to sufficient expertise to specify equipment, vet installers, monitor installations, etc.

What scale do you need to make it viable?

Solar Together campaigns may involve 5,000+ registrations, leading to ~1,000 installations. You might run a viable scheme with only 100 installations, or fewer for a complex solution such as retrofit, but you lose interest from and negotiating leverage with suppliers as the numbers go down. If you are building a VPP, you probably need 1MW of capacity, which means at least 200 homes and preferably 1000.



4.2.1 Delivery Checklist for Collective Purchasing

Roles & Responsibilities

1) **Procurement Coordinator**: Sets objectives. Recruits households, manufacturers, installers, etc. Negotiates specs and terms.
2) **Equipment Specialist**: Supports coordinator to specify kit, quality assure manufacturers & installers, support households, etc.
3) **Household**: Buys and operates equipment.
4) **Finance Partner**: Provides cash to support households to buy expensive equipment. May be a partner or competitively procured.
5) **Equipment Manufacturer / Reseller**: Recommends products that meet specification. Negotiates pricing & terms. Provides kit.
6) **Installer**: Installs kit. May be a partner or competitively procured.

Activities

- Set objectives for procurement
- Specify equipment and services to be procured
- Recruit households, equipment manufacturers, installers, etc
- Support households to understand equipment and terms
- Track applications from households and any associated tasks (e.g. surveys to check equipment suitability)
- Run procurement process (e.g. invitation to tender, auction) to set pricing and agree terms
- Coordinate activities for households to sign up with manufacturers and installers (e.g. introductions, surveys, final price agreement, setting up installation plans, agree financing)
- Support households to manage and quality assure equipment installation, configuration, handover, integration with other services (e.g. VPP) and operation
- Resolve disputes / misunderstandings
- Track delivery against original objectives

Knowledge & Intellectual Property

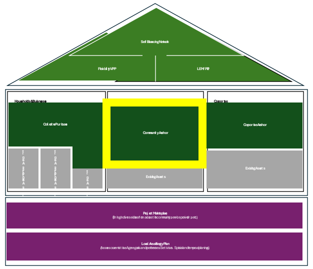
- Needs good understanding of the equipment being procured, so that it can be specified and quality assured effectively.
- If kit is going to be integrated with a VPP, LEM or other system, then will need to agree APIs, etc. These may be proprietary, so may need agreements & NDAs with relevant parties.

Data

- No specific data needed, although individual types of equipment and service may require data (e.g. household meter data, DNO network capacity, etc)

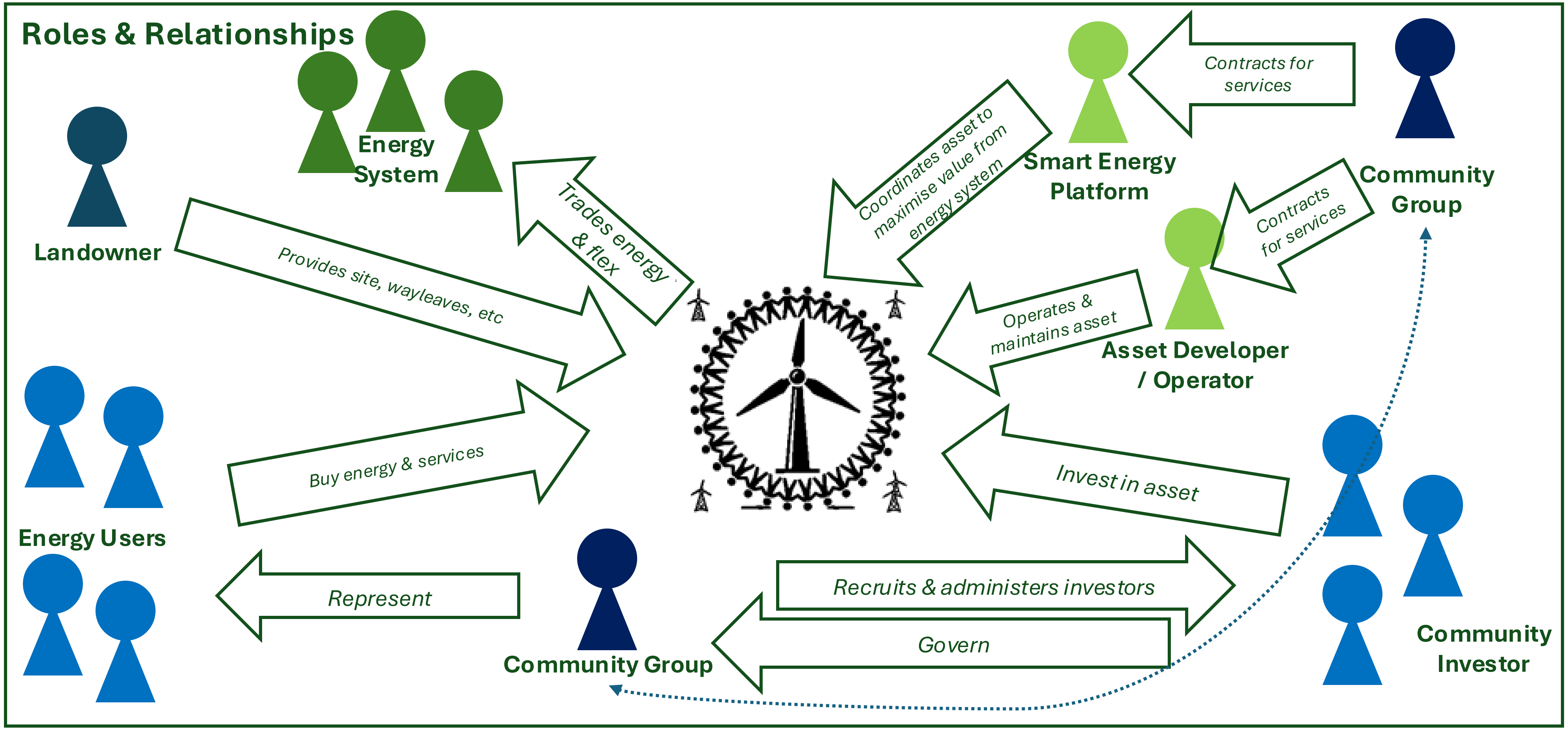
Tools & Systems

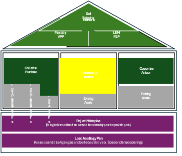
- Probably needs some sort of procurement platform to track the process, record invitations, bids and tenders, etc, especially if buying in large quantities or under public sector rules. If buying in smaller quantities, then may be able to run the process without special tools or systems.



4.2.2 Community Anchor Asset

Build and operate a common, community-owned asset. This is common for renewable generation (e.g. solar PV on community land or roof of a community building; wind turbine), which may be installed locally or remotely. It's also possible for heat networks (e.g. shared loop ground source array), EV chargepoints, batteries, etc. Ownership may be direct (via crowdfunding) or mediated by a community organisation (school, church, club, etc). Benefits may be shared as revenue from energy sales (e.g. as dividends) or by sharing energy generated by the asset (although that has regulatory issues). The asset might also create scale for other models, e.g. VPP or Self-Balancing Network.





4.2.2 When to Consider Community Anchor Asset

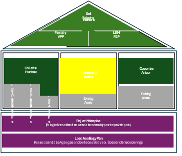
When to consider doing this

- You can't develop individual assets. (e.g. because people don't own their homes or are in multi-occupancy buildings. If roofs are in poor condition or poorly oriented. If there are planning issues associated with developing household assets.)
- You have a suitable natural resource (river, site for wind turbine or PV array) with an amenable landowner, suitable physical and network access, etc. This is ideally close to the community, e.g. to help build a sense of ownership and engagement, but it's also possible to build assets some distance from the community.
- You have public or community land that could be used (e.g. waste land associated with a park, field, transport corridor, etc)
- You have a community-centred organisation (school, club, place of worship, etc) that has a suitable building or land
- You have a source of funds, via some mix of crowdfunding, grant and financial institution. (Crowdfunding can work with quite small numbers of people, and financial institutions can be vey amenable to asset-backed investments.)

When to avoid it

- No site is available, either because of lack of land or because the available land has difficulties with access, networks, etc
- It's difficult to obtain sufficient consensus across the community – you probably need a segment that is enthusiastic about the asset, and for others to at least not be actively resistant.
- No-one is prepared to be actively involved in setting up the community vehicle to own and operate the model. Again, you need a level of enthusiasm somewhere in the community, and willingness to engage in the complexities of establishing the asset. Advisors can be found to do the specialist work, but they need someone to work with and make the final decisions.

What scale do you need to make it viable?
Assets can range from a few tens of kW to tens of MW. They probably need to be large if standalone but can be much smaller if connect-ed to a suitable building as the cost savings against energy tariffs are large. e.g. GM Community Renewables has placed 30kW PV arrays onto schools. Heat networks require 100s of homes to be viable, but shared loop arrays can be smaller if land for the array is available.



4.2.2 Delivery Checklist for Community Anchor Asset

Roles & Responsibilities

1) **Community investor**: Agrees objectives & terms. Provides funds. Participates in governance. Receives dividends or interest.
2) **Community group**: Acts on behalf of community members and investors to specify, procure and operate asset. Manages funds.
3) **Energy user**: Buys energy or services from the asset, if that's made available via LEM, P2P or other scheme. May participate in governance of community group.
4) **Asset developer / operator**: Builds and operates the asset.
5) **Smart Energy Platform (VPP, LEM or P2P)**: Coordinates asset operation, settlement, etc, if it's being integrated into a full SLES.

Activities

- Agree objectives
- Identify & survey site for asset. Negotiate with landowners for access, wayleaves, etc.
- Specify asset, operating model, business model (e.g. what markets it will access / revenues it will earn)
- Develop and agree business case
- Set up community group to own and operate the asset, with appropriate governance model
- Recruit investors and engage with wider community
- Negotiate with equipment manufacturers, resellers, installers, EPCs, etc, to agree terms to build and operate the asset
- Manage project to build, commission and hand over asset
- Operate the asset, collect revenues and disburse benefits to investors and community after covering costs
- Govern and manage asset operation, benefits distribution, etc, via community group

Knowledge & Intellectual Property

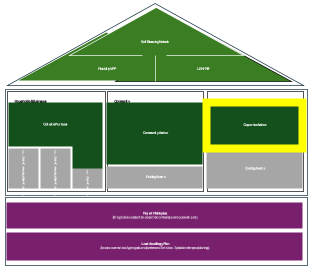
- Needs good understanding of assets, markets, regulations
- Needs good understanding of community governance models
- Needs good understanding of relevant financial regulations
- If integrating into full SLES, will need APIs, etc. These may be proprietary, requiring agreements & NDAs.

Data

- Will probably need data on potential production from the asset, markets and pricing, etc, to build a business case for the asset
- May need data on network capacity, connection queues, etc, to build case, plan project, specify equipment needed, etc

Tools & Systems

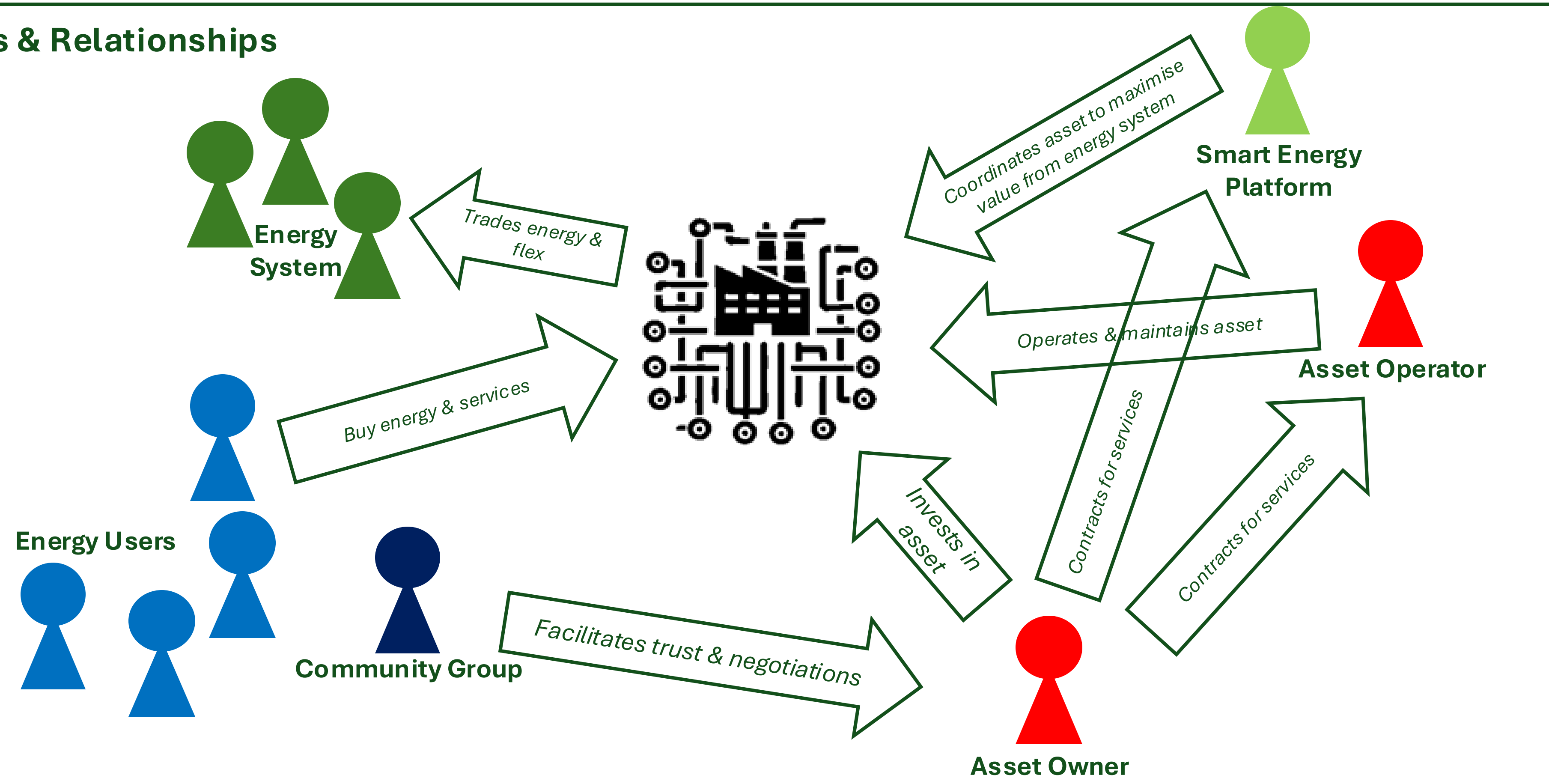
- Assets will need tools for configuration, monitoring, operations, so these need to be covered by the initial spec
- If integrating into full SLES, will need to agree how the asset will integrate and interoperate with the relevant platform(s)

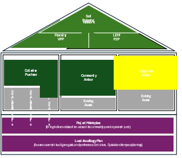


4.2.3 Corporate Anchor Asset

Build community around a corporately owned and operated asset. This might be renewable generation, a heat network, or even an industrial site that buys excess energy generated by the community. Benefits may flow to the community via corporate ESG (e.g. funding for to community projects, drawn from profits from the asset), or they may come as discounts on energy or heat. Or they may simply be in creating scale to help make other community schemes (e.g. VPP) viable. The model is similar to the community-owned model, but corporate ownership changes the governance and benefits-sharing arrangements, while opening potential to invest in and operate larger assets.

Roles & Relationships





4.2.3 When to Consider Corporate Anchor Asset

When to consider doing this

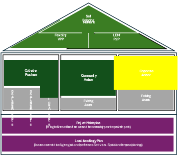
- A company that owns an asset or plans to build one wants to build community buy-in, either to gain a customer base or to make it easier to obtain planning permission
- A company with a strong social mission or ESG commitments is looking to establish links to the community
- You have a site that is suitable for a substantial asset (e.g. it has wind or hydro or geothermal resources) but it is too expensive to develop with community finance alone
- The community cannot access finance
- The community aspires to build a VPP, LEM or similar model so needs access to expertise, technical platforms and operational capability to make the model work

When to avoid it

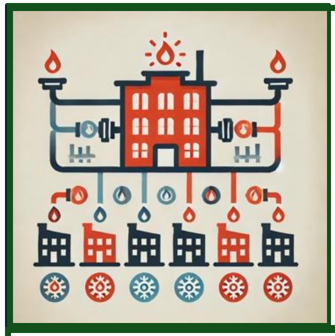
- The community has low trust in potential corporate partners
- The community has the resources (finance, skills, etc) to do it themselves and would prefer to avoid corporate involvement
- You cannot agree on a governance structure and associated articles / agreements that creates sufficient long-term community (or trusted third party) involvement in oversight and decision making
- You cannot agree on individual customer terms, e.g. in standard customer agreements, that make it sufficiently attractive to community members to participate, and that provide them suitable protections

What scale do you need to make it viable?

The considerations are pretty much as for a community-owned asset, but corporate ownership may enable (and require) assets at the larger end of the scale. May also work for more complex assets / business models, as the company can bring expertise and operational depth to execute them. Can also work for smaller assets that are naturally scaled to the size of a given site, e.g. housing development.



4.2.3 Delivery Checklist for Corporate Anchor Asset



Roles & Responsibilities

1) **Asset Owner / Investor**: Provides site, finance, etc. Specifies asset. Manages build and operations. Delivers services to users.
2) **Asset Operator**: Operates asset on behalf of owner.
3) **Energy User**: Buys energy and services from the asset owner.
4) **Community Group**: Represents users in negotiations about terms, community benefits, etc. Oversees deliver of benefits.
5) **Smart Energy Platform (VPP, LEM or P2P)**: Coordinates asset operation, settlement, etc, if it's being integrated into a full SLES.

Activities

- Agree objectives. This will entail some sort of negotiation between company and community representatives.
- Agree governance model and set up community group to interact with corporate asset owner on behalf of community.
- Agree terms for contracts between asset owner and people using energy and services from the asset).
- Specify, build & operate asset. (Similar activities to those for a community asset, but likely to be conducted by the company. It may agree some parameters with community, but is likely to reserve much for itself, reflecting the finance it's providing.)
- Recruit users to buy energy and services from the asset. Sign contracts and set up services.
- Manage service delivery to energy users. Provide support, manage issues and disputes.
- Operate community group to interact with company on behalf of the community, help resolve issues and disputes, oversee community benefits, etc.

Knowledge & Intellectual Property

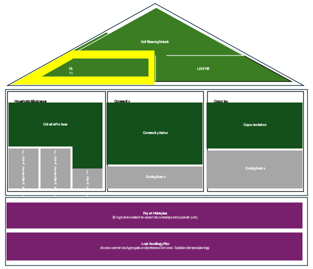
- Assumes company brings necessary knowledge & IP for assets, markets, regulations, integration with SLES, etc
- Needs good understanding of community governance models
- Needs good understanding of commercial terms and options to be able to negotiate effectively with company

Data

- Assumes company manages most data requirements
- Agreement between community group and company should consider what data about asset operation, markets & financials, etc, should be made available to community to give appropriate transparency of asset operations

Tools & Systems

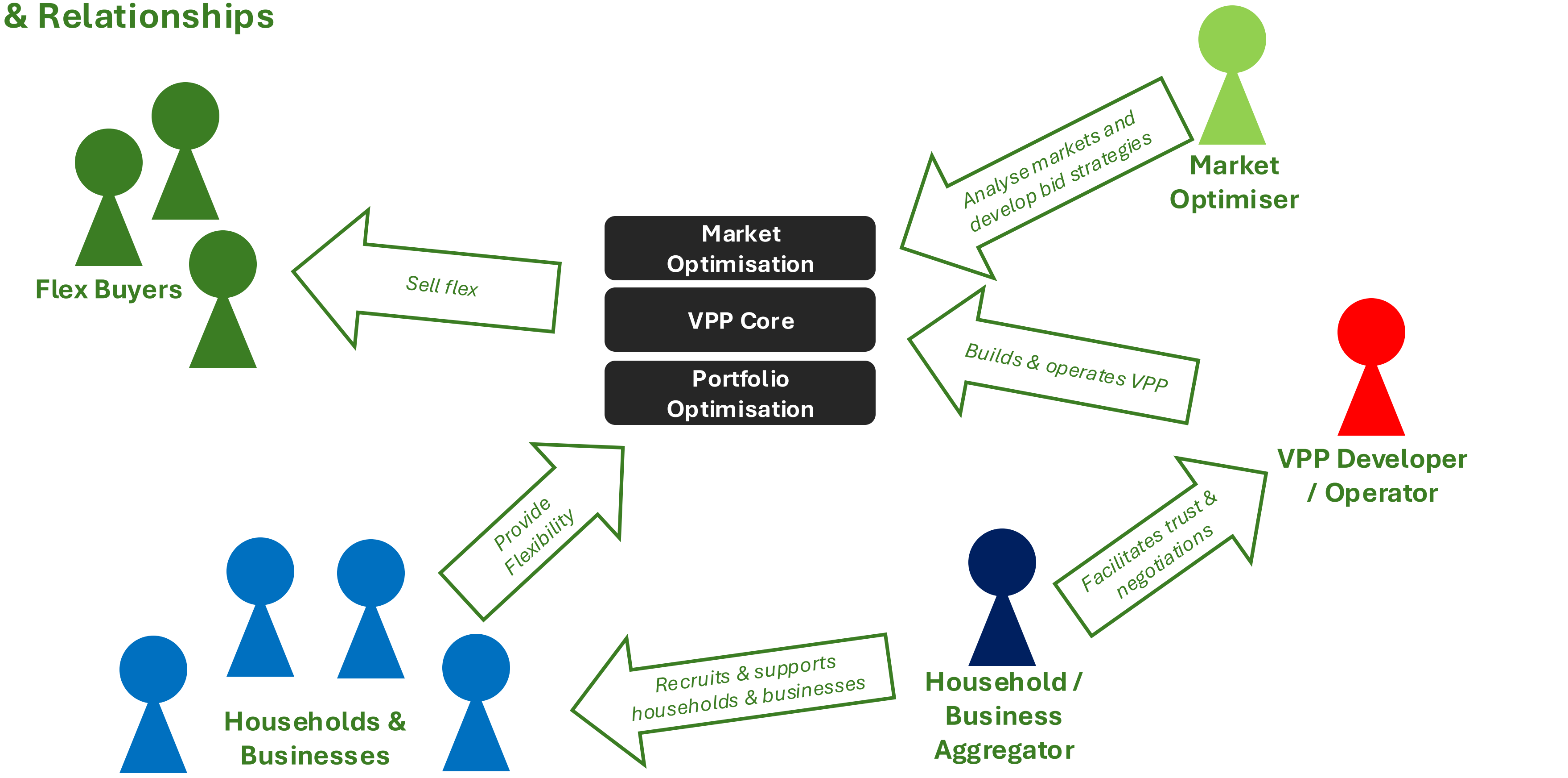
- Assumes company brings necessary tools and systems, either itself or via service providers it engages

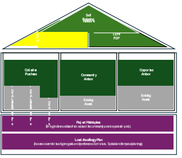


4.3.1 Flexibility VPP

Coordinate and aggregate people's energy usage to create a Virtual Power Plant (VPP) that can sell flexibility to DSO, for its local flexibility market, and NESO, for ancillary services. Flexibility may come from behavioural response (e.g. people reducing energy use in response to a message) or automation of smart appliances. In either case, it can be sold to the system operator to help manage the system / network. Flex may also enable trading on Balancing Mechanism or wholesale energy markets, but that has more regulatory complexity (e.g. requiring P415 code mod, which has only just gone live). The number of markets also creates technical complexity, e.g. to optimise returns.

Roles & Relationships





4.3.1 When to Consider Flexibility VPP

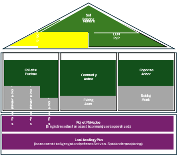
When to consider doing this

- People are considering buying equipment (collective purchase, anchor asset) for other reasons, and need additional revenue to make them attractive (or even viable)
- People have assets (EVs, batteries, heat pumps), so added revenue is attractive
- People have heard of schemes like DFS and want to participate
- People have low trust in energy suppliers, so would prefer to access DFS and other markets via a community group
- A technical partner is interested to work with the community
- The local DSO is looking for flex in the area. (DSOs don't pay a lot, but they are very keen to work with people to help them participate in their flex markets.)
- There is a lot of generation in the area. (DSOs are starting to develop demand turn-up services, which essentially give good discounts to consume local energy at peak times.)
- There are connection queues in the area. (Matching demand to supply can help work around curtailment issues. This links to the self-balancing network model.)

When to avoid it

- If you don't have a VPP platform operator lined up. The amount a household can earn from DSO and DFS isn't likely to be very high, but they are easy enough to access if you have a decent partner to manage the technical & market issues. So you should probably be considering them if you can line up a partner.
- If most people in the area are already participating in DFS via their energy supplier. This may make it challenging for a separate VPP to add full value.
- People have a low level of interest, trust or engagement in the energy system. Flex is complex to understand, so it probably isn't the place to start the journey.
- Note that homes will need smart meters and to be half hourly settled to participate in some flex markets. (e.g. Balancing Mechanism and wholesale trading. These are more complex markets than DSO or DFS, but potentially much higher value.) Very few homes are half hourly settled right now, so this can be a significant barrier unless they are prepared to switch to a suitable supplier. This will change as mandatory HHS eventually rolls out (much delayed, currently set for 2026).

What scale do you need to make it viable?
DFS and DSO flex is viable for small capacity (10kW), but a VPP really needs to access markets such as BM, wholesale, etc, which means 1MW minimum to participate and substantially more to be viable (e.g. to support costs of developing and operating a platform). Can partner with aggregators who have capacity in other areas to create scale, but most of them will only be interested it you have 1MW.



4.3.1 Delivery Checklist for Flexibility VPP

Roles & Responsibilities

1) **VPP Developer / Operator**: Builds & operates platform to aggregate assets and sell flex to markets identified by Market Optimiser.
2) **Household / Business Aggregator**: Recruits & supports parties to participate in VPP. Negotiates terms with VPP operator. (May be a community group, or this could all be performed by the VPP operator itself.)
3) **Market Optimiser**: Analyses market data and identifies best strategy to sell flex across multiple markets. (May be part of VPP operator, or may be a separate specialist.)
4) **Flex Buyers**: NESO, DSO, energy traders, etc, that buy flex. (Markets are fragmented, hence need for optimiser.)
5) **Household / Business**: Provides flex to integrate into the VPP. May be behavioural, or via automated control of smart kit.

Activities

- Set up VPP platform. This will entail choosing the platform / operator / partners, commercial negotiations, technical configuration, establishing governance and reporting structures, etc.
- Set up community group to recruit and support households.
- Recruit households & businesses to participate. Often requires education, as flex isn't well-understood / intuitive.
- Integrate smart appliances with VPP platform, either direct or via HEMS / BEMS or manufacturers' cloud platforms. Standards are weak, but promising options are emerging (e.g. Mercury).
- Gather data and use it to predict availability of flex from appliances & optimise this across the portfolio.
- Bid available flex into flex markets. May be simple initially, with a focus on a single, simple market such as DSO or DFS. Likely to grow complex as optimise value across multiple markets.
- Manage settlement processes. Covering both flow of meter data to flex buyer, and of cash from them to VPP operator and hence to households and businesses participating in the VPP.

Knowledge & Intellectual Property

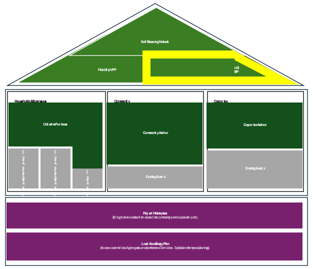
- Needs good knowledge of flex markets, appliance capabilities & interoperability, ways to maximise behavioural response. Much of this is probably embedded in proprietary algorithms & APIs.
- Needs VPP platform. May be open source, but likely to be proprietary. Either way, it will need to be licensed.

Data

- Algorithms to optimise market pricing are dependent on historical data, etc. Some is open, but much is proprietary.
- Algorithms to forecast household flex and optimise portfolio response require historical household data. This takes time to acquire. May need to start with fairly generic models.

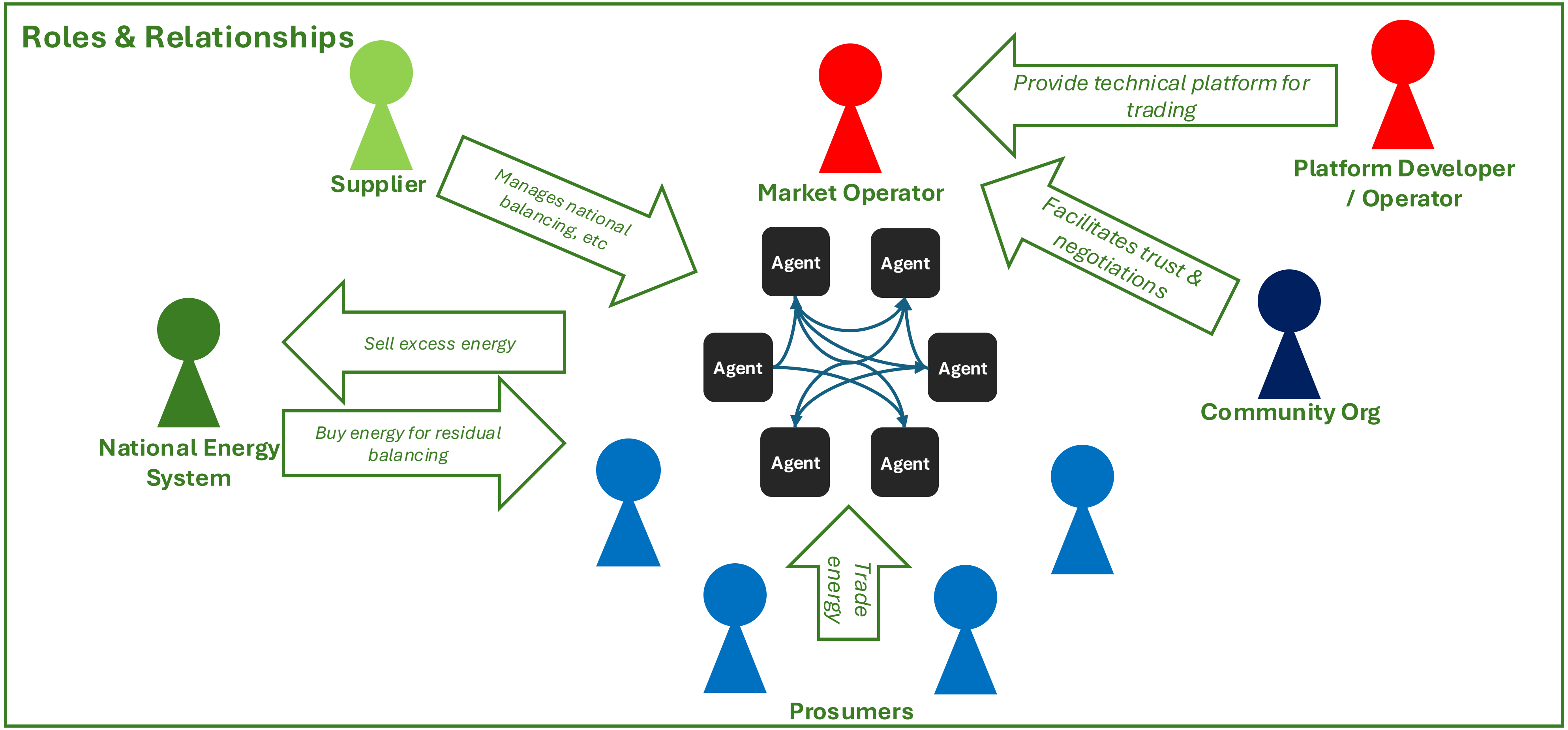
Tools & Systems

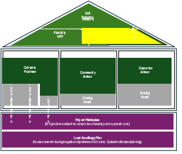
- Core VPP platform to coordinate assets reliably at scale
- Analytics platforms for market and portfolio optimisation
- Tools to connect & integrate appliances in homes / businesses
- Gamification and comms tools for behavioural response



4.3.2 Local Energy Market / Peer-to-Peer Community

Trade energy between members of the community, enabling them to agree on tariffs that benefit both producer and consumer. Conceptually, this creates less need to share profits with an intermediary; in practice there still needs to be someone to manage imbalance, credit risk, etc. And trading, whether via a central marketplace or peer-to-peer, requires a technical platform that is built, maintained and operated by someone. So the benefit is often in people's ability to set prices specific to their individual circumstances. The market may also enable flex, e.g. via dynamic pricing of energy trades. Anchors (large generators and loads; network operator) may also participate in the market.





4.3.2 When to Consider Local Energy Market / Peer-to-peer Community

When to consider doing this

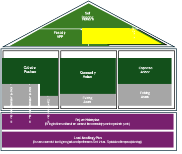
- You have a platform operator interested to support the market, and they have a supplier lined up to work with them. (Or they are engaging with regulatory changes such as P415, that may let them act as a VLP to support market balancing.)
- People in the community value the social benefits of a local market – community cohesion and resilience; ability to steer benefits towards local causes & vulnerable members of the community; ability to buy energy of known, local provenance; etc. They are willing to tolerate the innovative nature of a local market (e.g. in terms of the regulatory changes needed, the continuing evolution of p2p platforms, etc) in order to access these benefits.
- There is excess generation within the community (via a community anchor asset or via rooftop PV or similar) or a willingness to invest in such generation, and a desire / need to gain additional revenue by selling this excess energy locally.

When to avoid it

- You don't have a platform lined up, and don't have the technical and energy system expertise to select one with confidence
- You don't have a trusted supplier lined up to support the market. (Note that people need to be prepared to switch to this supplier, so unwillingness to switch is also a barrier. As P415 rolls out, they may be able to remain with their existing supplier and simply sign up to a common VLP.)
- There isn't any significant amount of generation available locally
- People in the community aren't interested / savvy enough to be involved with the market, which will probably entail effort to switch suppliers, set up a trading app / agent, etc. (Some people may simply value convenience and low cost so far above control and insight into the provenance of their energy that they have no interest in a local market / p2p.)
- People have a low tolerance for market uncertainty and risk – they just want / need to pay a clear, firm price for their energy. (The market will probably set a cap to the price via its link to a supplier, who can offer a fixed tariff, but the trading inherently creates uncertainty to pricing. If people don't want to engage with this, then there is little reason for them to participate.)

What scale do you need to make it viable?

Unlike flex markets, which set a minimum capacity, there is no firm minimum limit. But the market needs to be sizable to have sufficient liquidity and to cover platform costs. The latter means choosing a commercial operator that supports multiple local markets. GM LEM suggested individual markets can be viable at regional scale; smaller markets are feasible if people value provenance sufficiently highly.



4.3.2 Delivery Checklist for Local Energy Market / Peer-to-peer Community

Roles & Responsibilities

1) **Market Operator**: Oversees market operations; provides transparency on trading & other activities; provides trust and assurance to market participants; sets trading costs & transaction fees; vets market participants.
2) **Platform Developer / Operator**: Provides platform for market trading and supporting functions (backoffice, etc)
3) **Supplier**: Undertakes licensed functions for balancing, network charging, etc, on behalf of market operator & participants.
4) **Prosumer**: Trades energy on the market.
5) **Community Group**: Represents prosumers in market governance, negotiations on trading conditions and fees, etc. Helps build consumer trust in the market.

Activities

- Set up trading platform. As for VPP, entails choosing platform / operator / supplier, commercial negotiation, technical configuration, establishing governance and reporting structures, etc.
- Set up community group to recruit and represent households.
- Recruit households & businesses to participate. Support them to switch to the supplier supporting the market, get smart meters installed if they don't already have them, set up trading preferences / strategies (e.g. via app or agent), etc.
- Set up facilities to gather meter data to support settlement. This is simpler than for VPP, which may need to integrate with a wide range of kit, but still non-trivial and potentially costly if it can't be done via the supplier's existing processes and systems.
- Manage settlement and billing. This probably entails integrating trading data (or at least resulting balances) into the supplier's billing system so that prosumers' costs/revenues are integrated into their bills. (Separate settlement is also feasible, in which case cash flows, credit balances, etc, need to be managed.)

Knowledge & Intellectual Property

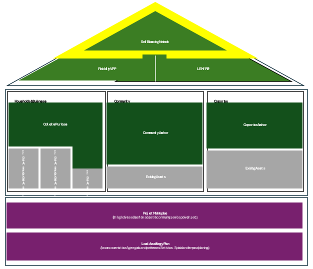
- Needs good knowledge of regulations for energy supply, e.g. scope for licence exemptions. Also need to track & influence relevant code mods, e.g. P415 to allow VLPs to trade energy.
- Needs trading platform. May be open source, but likely to be proprietary. Either way, it will need to be licensed.

Data

- Trading is done by users, so market operator doesn't need to forecast demand, pricing, etc. But if it wants to make this info available to users, it needs relevant data and analytics.
- Key requirement is to be able to record and process potentially large volume of trades accurately for settlement.

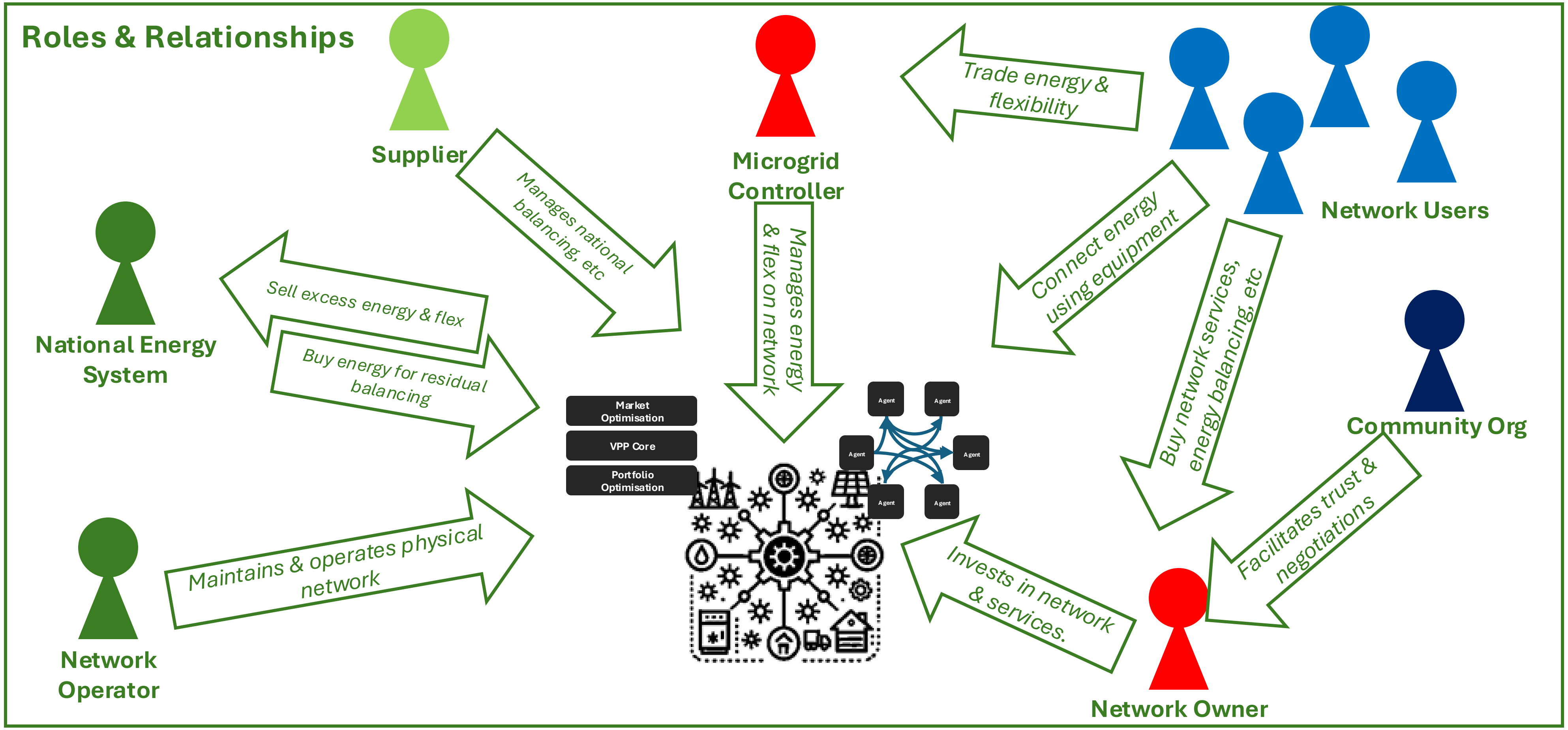
Tools & Systems

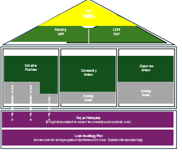
- Core platform to handle trading reliably at scale
- Backoffice systems to capture and settle trades, manage CRM, etc. These need to interoperate with supplier systems if trades are to be integrated with people's bills, and to support management of residual balancing with wider energy system.



4.3.3 Self Balancing Network

A virtual balancing system optimises generation and demand within a network segment (e.g. microgrid) to balance locally as far as possible. The system manages both flexibility (as with VPP) and energy (as with LEM/P2P) by coordinating equipment to maintain balance within the network. A key focus may be to avoid network constraints on sharing energy with the wider grid. This may also enable commercial models such as Energy- or Heat-as-a-Service, allowing the system to flex equipment without disadvantaging its owners. People benefit from cost savings due to this flex, plus convenience, reduced pricing risk, etc. Service charges may also cover financing for the equipment.





4.3.3 When to Consider Self-Balancing Network

When to consider doing this

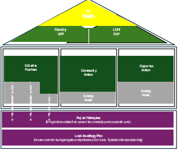
- You have an islanded network, e.g. remote community not connected to the grid
- You have a well-defined network segment, e.g. private wire microgrid on an estate or communal development, and the owner is willing to explore this model, e.g. to work around constraints and curtailments due to connection queues, or to sell energy- or heat-as-a-service.
- You have a community that would like to build independence and resilience and the local DNO is willing to explore this model (probably as an innovation project).
- There is a sufficient mix of generation (PV, wind, hydro), demand (EVs, heat pumps) and storage on the network to enable a reasonable degree of self-balancing. (And people are pragmatic about the degree of self-balance they are aiming for. 100% self balancing is feasible but is likely to be expensive.)
- You have access to advice on the regulatory issues of complex sites, exempt supply, etc. And all parties are prepared to accept the consequences of operating under these models (e.g. in who is responsible for dealing with network outages)

When to avoid it

- Your community isn't associated with a reasonably clearly defined network segment
- There isn't sufficient generation or storage on the segment to be able to provide a reasonable level of self-balancing
- You don't have, and can't easily access, expertise needed to set up the model. A range of expertise is required – to understand regulatory and market issues, to build and operate the physical network, to build and operate the microgrid control systems and integrate them with equipment on the network.
- People aren't willing to accept the consequences of operating under these models, e.g. in the level of reliance they are placing on the microgrid controller to maintain and operate the network, deal with outages, etc.
- You don't have a clear point of ownership & governance for the network. You will need clear ownership (by a single party, or a set of parties with clear agreement of responsibilities) of balancing, network maintenance and operations, etc.

What scale do you need to make it viable?

Trades off scale with depth of control – requires deeper control of assets than VPP or LEM, so may work best for a smaller, well-defined network on an estate, etc. If generation & demand is distributed, then may need several hundred homes to achieve a decent level of balance. If there is anchor generation or storage, might work with a smaller network (e.g. Owen Square in Bristol has about 100 homes).



4.3.3 Delivery Checklist for Self-Balancing Network

Roles & Responsibilities

1) **Network Owner**: Invests in and owns the physical network. (DNO, iDNO, or property developer with private wire network)
2) **Network Operator**: Operates and maintains the physical network.
3) **Microgrid Controller**: Operates system to coordinate assets to balance the network (this probably combines VPP and LEM/P2P trading). Sells residual flex to energy system (direct or via a partner market optimiser). Manages residual balance between n etwork and wider energy system (via a **supplier** or with own supply licence / licence exemptions.) Charges network users for services.
4) **Network User**: Use equipment (generation, demand, storage) connected to the network. Pay for network services (possibly EaaS).
5) **Community Group**: Represents network users in collective negotiations with Microgrid Controller.

Activities

- Define scope of the network – what network segments & sub-stations; which properties are connected to it; etc.
- Assess amount of generation, demand, storage on or planned for the network. Hence model degree to which self-balancing is feasible. Develop business model and case for self-balancing. Develop plans to integrate additional kit if needed for balancing.
- Define & set up governance structures if there is to be any degree of community involvement in governance. (If not, define what consumer protections will be in place. NB this may be determined by existing agreements, e.g. tenancies.)
- Set up network management platform (NMP). As for VPP & LEM, this entails selection, negotiation, tech set up, etc.
- Integrate equipment from households/businesses with NMP, and sign appropriate commercial terms. Make arrangements for people opting out of the self-balancing scheme.
- Set up settlement, billing and other backoffice systems & processes (e.g. CRM and customer support), either by the microgrid controller or via partner supplier or other parties.

Knowledge & Intellectual Property

- Needs good knowledge of network operations, equipment capabilities & interoperability, regulations for energy supply / applicable exemptions, energy & flex markets
- Needs network management platform. That's likely to be proprietary, so will need to be licensed.

Data

- Historical data on generation, demand, etc, to help establish business case, manage risk on EaaS models, tune forecasting & balancing algorithms, etc. External market data to support trading on national wholesale and flex markets.
- Ongoing data management for billing and to refine algorithms

Tools & Systems

- Network management platform
- Backoffice systems for settlement, billing, CRM, etc
- Analytics platforms to refine algorithms, trading strategies, etc
- User apps to monitor usage, control EaaS/HaaS settings, etc

Thank You

Appendices

A) Resources & Further Reading

B) Building Block Details

- B.1 Local Area Energy Plan
- B.2 Project Marketplace
- B.3 Collective Purchasing
- B.4 Community Anchor Asset
- B.5 Corporate Anchor Asset
- B.6 Flexibility VPP (Virtual Power Plant)
- B.7 Local Energy Market / Peer-to-Peer Community
- B.8 Self Balancing Network

C) Technical and Financial Notes

- C.1 Local Area Energy Plan
- C.2 Project Marketplace
- C.3 Collective Purchasing
- C.4 Community Anchor Asset
- C.5 Corporate Anchor Asset
- C.6 Flexibility VPP (Virtual Power Plant)
- C.7 Local Energy Market / Peer-to-Peer Community
- C.8 Self Balancing Network

Appendix A – Resources & Further Reading

https://www.energyrev.org.uk/outputs/insights/ – Insights from the EnergyRev research consortium that was part of the PFER progamme. Contains a large body of analysis of results from PFER and related projects.

https://es.catapult.org.uk/case-study/energy-revolution-integration-service/ – Findings from the Energy System Catapult's ERIS service, which was also part of the PFER programme. A further body of analysis, case studies and recommendations generated by PFER.

https://www.regen.co.uk/project/pfer-review-insight-briefs/ – Regen analysis of findings from the PFER programme.

https://es.catapult.org.uk/what-we-do/net-zero-places/ – Energy Systems Catapult recommendations and case studies for Net Zero Places.

https://energy.ec.europa.eu/news/focus-energy-communities-transform-eus-energy-system-2022-12-13_en – EU overview on Energy Communities.

https://energycommunityplatform.eu/ – Collection of EU resources for energy communities.

https://energy.ec.europa.eu/topics/markets-and-consumers/energy-consumers-and-prosumers/energy-communities_en – Links to further EU resources on energy communities.

https://www.rescoop.eu/ – European federation of Energy Communities.

https://www.lema.energy/ – Local Energy Market Alliance

https://www.sciencedirect.com/science/article/pii/S1364032123000217 – Recent analysis of business models for energy communities

https://www.sciencedirect.com/science/article/pii/S2352467723001959 – Recent review of trends in energy communities

https://www.energyfuture.uk/_files/ugd/48302b_150ef893bca44712b1bb06f670a1dd70.pdf – Enabling Decentralised Energy Innovation

https://proseu.eu/sites/default/files/Resources/PROSEU_D4.1_Business%20models%20for%20collective%20prosumers.pdf – Business models for prosumers in EU

Appendix B

Building Block Details

B.1 Local Area Energy Plan
B.2 Project Marketplace
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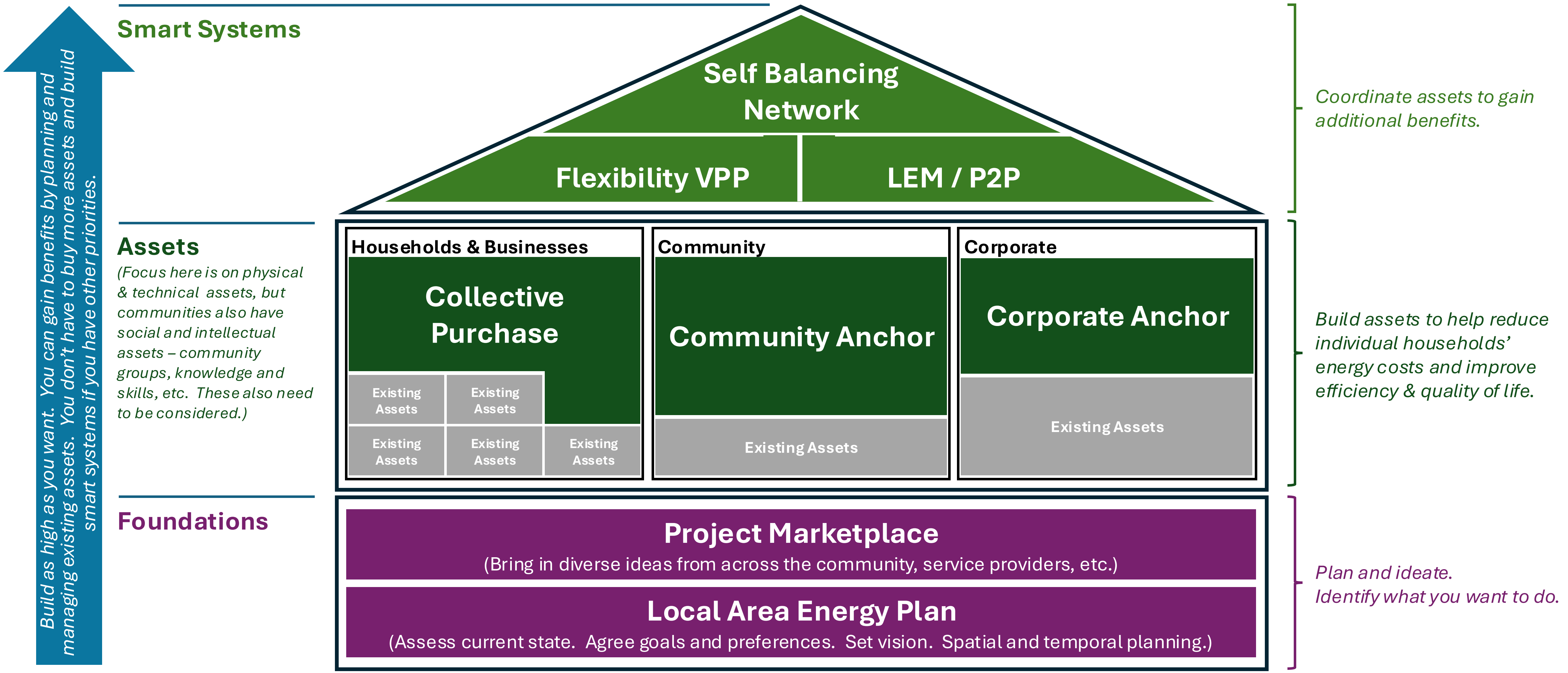
B.8 Self Balancing Network

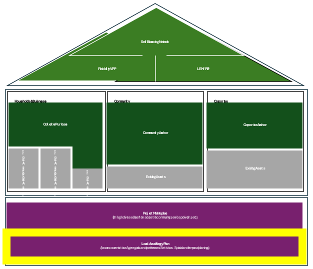
Appendix B – Building Blocks for a Smart Local Energy System



Appendix B – Smart Energy Framework

	Foundations		Assets			Smart Systems		
								
	Local Area Energy Plan	**Project Marketplace**	**Collective Purchasing**	**Community Anchor Asset**	**Corporate Anchor Asset**	**Flexibility VPP**	**LEM / P2P Community**	**Self-Balancing Network**
Description	Spatial plan and roadmap for energy systems in the community.	A central place to share projects and connect to funding & delivery partners.	People band together to vet suppliers and negotiate better pricing.	People band together to purchase an asset for their community	Company builds an asset and shares benefits with the community	An aggregator coordinates smart appliances to sell flexibility services	"Prosumers" trade energy within a local area or community	Coordinate energy use within an area to minimise dependency on wider grid
Examples	Formal LAEP in local authorities. Hyperlocal LAEP in Eynsham, LEO.	Accelerators and Incubators. Crowdfunding platforms.	Solar Together, Your Home Better	Low Carbon Hub, GM Community Renew-ables, Lune Valley Hydro, Energy Local	District heating, Fan Club, Ripple, Shared assets in multi-occupancy buildings	Equiwatt, Levelise, GridBeyond, Flexitricity.	GM LEM, Urban Chain, Sitigrid, Energy Local?	Community DSO, Campus microgrids, Local Energy Market Alliance
Governance & Stakeholders	Hyperlocal plan is probably done by ad hoc enthusiasts, with wider engagement.	Central convenor sets rules, defines support levels and vets participants.	May self-organise, but benefits from a trusted, savvy central convenor.	Corporate owns asset: CIC, Co-op, etc. Energy sharing needs supplier.	Corporately driven; contractual relation-ship to other parties. ESG will influence.	Probably corporate VPP platform. Open source is possible.	Central market operator & platform. May be corporate, or public/private SPV.	Central micro-grid operator (& owner?). Corporately driven. (May be CIC or co-op.)
Technology & Systems	Formal LAEP needs data, GIS & modelling tools. Hyperlocal is more ad hoc.	May be very simple, but can also provide monitoring, support, acceleration, etc.	May need a procurement platform.	Basic asset O&M, monitoring, settle-ment. May anchor VPP or other platform.	Asset O&M. Needs full back office – settlement, billing, CRM.	Complex tech stack due to interoperability with wide variety of equipment & markets.	Trading is complex, but only need to integrate meters and have a single market.	Real time control of assets & trading, plus backoffice for billing, CRM, etc.
Finance & Benefits	Self-funded, or may be small grants available. Enables other building blocks.	Investors may have social goals, or may seek dividends and transaction fees.	Bilateral between household & supplier. May be transaction fee for convenor.	Likely crowdfunded. Benefits via dividend or energy sharing.	Corporate finance, to gain loyal customers. Community gets trusted partner.	Platform via VC & innovation funding. People earn share of flex revenue.	Platform via VC & innovation funding. Prosumers benefit via energy pricing.	Corporate finance for network plus platform funding. Benefits via energy services.
Regulatory & Markets	No regulatory restrictions, but also limited influence on wider system.	Financial regulation of crowdfunding. Regulatory sandboxes.	Mostly consumer protection & Trading standards. Trust in suppliers is key.	Crowdfunding needs FCA. Energy sharing has complex regulatory reqts.	Consumer protection legislation plus Ofgem licences. (Heat is emerging.)	DSO flex markets are relatively open. BM is complex. Need to stack multiple mkts.	Complex energy regulation; needs a supplier. P415 may open up VLP options.	Complex energy regulation, probably as a "complex site".

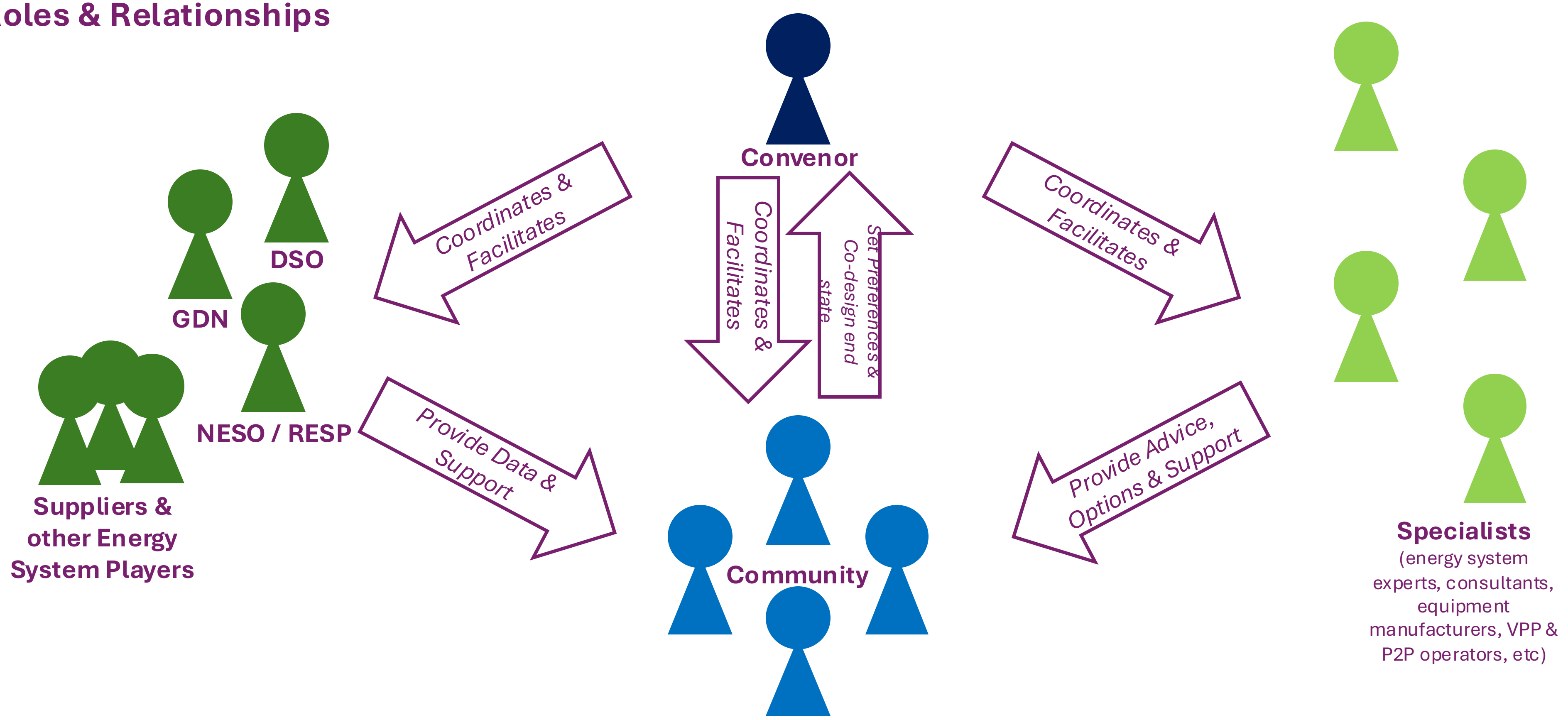
Area likely to have greatest complexity

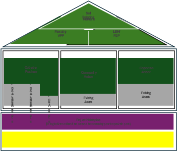


B.1 Local Area Energy Planning

Work together to create a local spatial plan and temporal roadmap for developing energy assets, systems and community engagement within the area. Many Local Authorities (e.g. borough or county councils) are developing LAEP to cover their area, but plans can also be developed for smaller areas, e.g. where people are especially interested or where specific local assets provide a distinct focus. These hyperlocal plans might be prepared with different degrees of rigour, depending on the interest, skills and assets in the area. They can then feed into wider plans being prepared by Local Authorities, Regional Energy Strategic Planners, etc.

Roles & Relationships





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Anchors

Hyperlocal plans are likely to develop around the interests and skills of people in the community. The lynchpin is likely to be someone (a person or organisation) with the enthusiasm and skills to act as **convenor**, coordinating the engagement and planning activities.

Plans may also be anchored in some specific local asset or capabilities, e.g. local hydro scheme, wind turbine, shared loop ground source heat pump array, etc. But an enthusiastic community could equally well develop a local plan without any specific asset in mind.

Scale

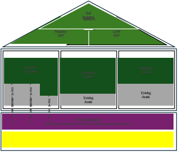
The energy system is converging on a model where a dozen or so Regional Energy Strategic Planners (RESPs) develop plans in collaboration with local authorities, DSOs and other parties in their region. These plans will also be informed by the Strategic Spatial Energy Plan being developed by the National Energy System Operator (NESO).

Hyperlocal plans could be developed around specific assets, communities, geographic areas, distribution substations, etc. Although they don't play a formal role in the energy system's planning, there is a strong drive for energy system planners to engage with local communities, and these plans provide a mechanism to do this.

Maturity & Examples

RESPs and the SSEP are new, so their approach is still emerging. Local Authority LAEPs have been around for 3-5 years, with early examples developed in regions such as Greater Manchester and several Welsh authorities. Energy Systems Catapult and Centre for Sustainable Energy have defined tools and approaches for developing them.

Hyperlocal LAEP have been developed by communities such as Eynsham, on project LEO (Local Energy Oxfordshire). Of course, there has always been scope for local communities to develop their own plans, and many have done so around local hydro schemes, wind turbines, etc. LAEP just start to place these on more formal footing.



B.1 Local Area Energy Planning

Governance

National and regional plans are governed by regulatory structures defined by Ofgem & DESNZ and driven by NESO (National Energy System Operator). Local Authority LAEP are not a statutory requirement, but are typically linked to authorities' Net Zero plans.

Hyperlocal LAEP are more likely to be led by a group of local enthusiasts. They will probably adopt a fairly ad hoc, project-style structure. It will then be down to the people involved to engage their communities, and to use the outcome to influence other actors in the energy system and more widely.

The key role here is the convenor, the party (individual or collect-ive) that coordinates engagement with the wider community and with external parties, facilitates conversations and negotiations, initiates planning and analysis, etc. They may not have formal authority, but rather will need to act in an influencing role. This may be filled voluntarily, by a party within the community. There is also potential for organisations such as DSOs or local authorities to fund a small group of people to fill this role across their region.

Despite this lack of formal authority, LAEPs (or similar planning) are foundations to the success of other activities around smart, local energy. Their potential to influence more widely, through engagement with DSOs, Local Authorities, etc, is substantial.

Stakeholders & Skills

The key stakeholder is the local community (drawn widely – businesses and other organisations as well as people living and working in the area). More formal planning activities place a lot of emphasis on community engagement; if a hyperlocal LAEP can deliver this, then it is well placed to influence more widely and so ensure that wider plans address the community's concerns.

As noted elsewhere, the core role is then the convenor, who helps engage this community and facilitate the conversation with them.

The convenor role is primarily about facilitation, but it needs to be backed with understanding of the energy system and of relevant technologies to ensure the resulting plans are well grounded and credible. This will also need access to data about the area's energy facilities (generation, network capacity, demand, projected growth, etc), and to tools and skills to analyse that data. Formal LAEP often use consultancies for this; grants may enable this for hyperlocal LAEP, or they may get support from equipment manu-facturers and suchlike. Otherwise they will rely on volunteers. The depth of planning will need to be tuned to the availability of skills, data & tools. (Note that plans would ideally be refreshed period-ically, so the team may want to think about how to support this.)

The project is also likely to need to engage with energy system parties in the area, e.g. electricity and gas distribution network / system operators.

B.1 Local Area Energy Planning

Technology & Systems

LAEP could cover just about any energy tech, depending on local conditions, community preferences, etc. One focus will be identifying what techs work best for this area, both for generation and for demand (heating, transport, etc). Likewise for supporting systems, e.g. VPPs or other capabilities.

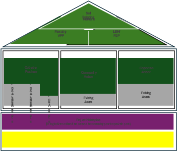
This will be influenced by input from energy system and other experts, e.g. to advise on what is feasible now, what might be on the horizon, etc. This creates some risk that the experts will "capture" the process (especially if they are from a supplier that aims to use the plan as a way to sell its equipment or services); one role for the convenor is to support the community to resist such pressures, while remaining realistic in what can be achieved.

Service Delivery

Main activities are likely to be:

- *Data gathering and analysis*. Building a view of the area's energy consumption and production, the sources of load and generation, the network configuration and capacity, etc. Forecasting how this is likely to change over time.
- *System modelling*. Developing options for how the area's energy infrastructure might be built up, assessing the impact of these options on the community and its environment, modelling the commercial costs and returns, etc.
- *Community engagement*. Working with members of the community to understand objectives and preferences, identify options, co-design solutions, etc.
- *Wider engagement*. Engaging with DSOs and GDNs, policy makers, Local Authorities, etc, to understand the wider context and build the community's plans into their thinking.

The convenor will coordinate these activities, facilitate conversations and workshops, manage contracts with consultancies or other parties to provide specialist expertise, etc.



B.1 Local Area Energy Planning

Finance & Benefits Distribution

May be financed by grant from innovation programme, charitable foundation, energy supplier or system operator, etc. This is likely to be necessary if a significant amount of data analysis, system modelling, etc, is to be undertaken. (A formal LAEP can costs tens of thousands of pounds).

If the focus is primarily on community engagement, then the plan might be developed by enthusiastic volunteers, perhaps with some pro bono support from specialists or "pre-sales" support from equipment manufacturers and service providers.

The plan itself will give no direct financial benefit to the community. However, it will help build their understanding of the energy transition and influence over the way DSOs, suppliers, local authorities, etc, develop the energy system in their area. Engaging in the planning process can also build community and give people a sense of ownership and a stake in the outcome.

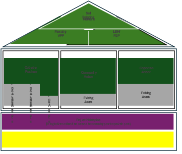
The plan will also provide a foundation for other projects, e.g. to build assets and systems, that will give direct financial benefit. The returns from these projects may in effect fund the initial planning process. They may also fund ongoing maintenance and refresh of the plans.

Regulatory and Markets

Regional plans created by the RESP will have a formal role in the regulatory process for network and system planning. (The exact role is still emerging, as the RESP is very new.) The RESP will be mandated to engage with Local Authorities, so their LAEP will influence this process also.

Hyperlocal LAEP don't have a formal role in this process, but RESP, DSOs, etc, are mandated to engage with customers and community, so local plans can help drive this engagement. They can also give communities space to coordinate their thinking prior to engagement, helping them to engage more effectively.

There are no fundamental regulatory or market barriers to doing this. After cost, the biggest barrier is probably access to data on which to base the plan. Parties such as DSOs and GDNs are increasingly making open data available, but it needs skills to access and analyse, and may need to be supplemented with proprietary data from other parties, geographic information systems, etc. Energy metering data could also help inform the analysis, but accessing it opens up questions about data protection and privacy as well as costs, so these concerns will need to be addressed if the LAEP is planning to this level of detail.



B.1 When to Consider Local Area Energy Planning

When to consider doing this

Community engagement and planning almost always makes sense – it's hard to think of a circumstance where you shouldn't do it. The question is more about how much planning you should do, e.g. how much rigour is needed in the data analysis and system modelling.

For hyperlocal LAEP, I'd focus on the community engagement aspects – helping people understand their options, clarify their preferences, resolve differences in objectives and priorities, etc. This then provides a clear and valuable steer to the project, and to wider planning processes at Local Authority and RESP level which can then cover the more technical aspects.

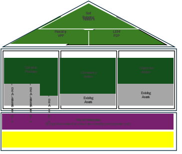
Of course, if people in the community are interested and have the skills to drill deeper into the data and modelling, then go for it. There's a lot that can be done with open data and commonly available tools such as spreadsheets, and doing this deeper analysis will lend weight to your input to the wider plans.

When to avoid it

It's hard to think of circumstances where you shouldn't be doing this at some level. The question, as discussed at the left, is how much to do and how much technical detail to get into.

What scale do you need to make it viable?

Formal LAEP tend to be done by a Local Authority (e.g. a town or county). Hyperlocal LAEP could be a lot smaller – Eynsham's LAEP was done for a village of about 5,000 people. There's no reason why you couldn't develop a plan for a much smaller village or community, although it'd be a lot less formal than one developed for a Local Authority.



B.1 Delivery Checklist for Local Area Energy Planning

Roles & Responsibilities

1) **Convenor**: Assembles participants. Coordinates project. Facilitates discussions. Helps disseminate results.
2) **Network & System Operators (DNO, GDN, RESP)**: Provide data on current systems and networks. Describe planned network development, possible future scenarios, etc. Support community to understand energy system.
3) **Specialists (Energy, Technical, Commercial)**: Identify technical & commercial options. Analyse impact on local environment & energy system. Support community to assess options & trade-offs, build business case, etc
4) **Community**: Define goals and preferences. Co-design options with specialists. Assess trade-offs. Agree target end state.

Activities

- Assemble core team to undertake the planning
- Identify stakeholders in community and plan activities to engage with them, co-design options, gather feedback, etc
- Engage with local energy network and system operators to access their data, development plans, future scenarios, etc
- Gather and analyse data on current state – energy networks, housing, consumption & generation patterns, transport, etc
- Engage with tech developers, equipment manufacturers, VPP & P2P operators, to get info on options, costs, commercials, etc
- Co-design future state options. Identify impact on community, energy system, environment. Assess feasibility, business case.
- Assess trade-offs between options, community preferences, etc, and hence identify preferred options
- Develop pathway(s) to implement preferred options. Probably very high level – enough to demonstrate feasibility, deliverability
- Disseminate findings and use them to influence wider plans

Knowledge & Intellectual Property

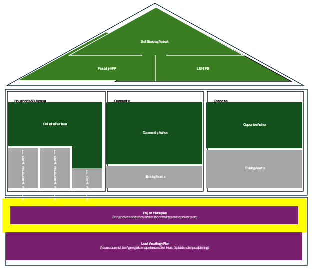
- Needs knowledge of energy system, technology & commercial options, etc. Some of this may be proprietary (e.g. for tech, commercial services), but owners will probably share sufficient to support co-design and business case development.
- Most key data is open, although some may be proprietary

Data

- Local network capacity, headroom, health, etc
- Local generation and demand profiles (current & projected)
- Housing, transport, etc
- Geospatial

Tools & Systems

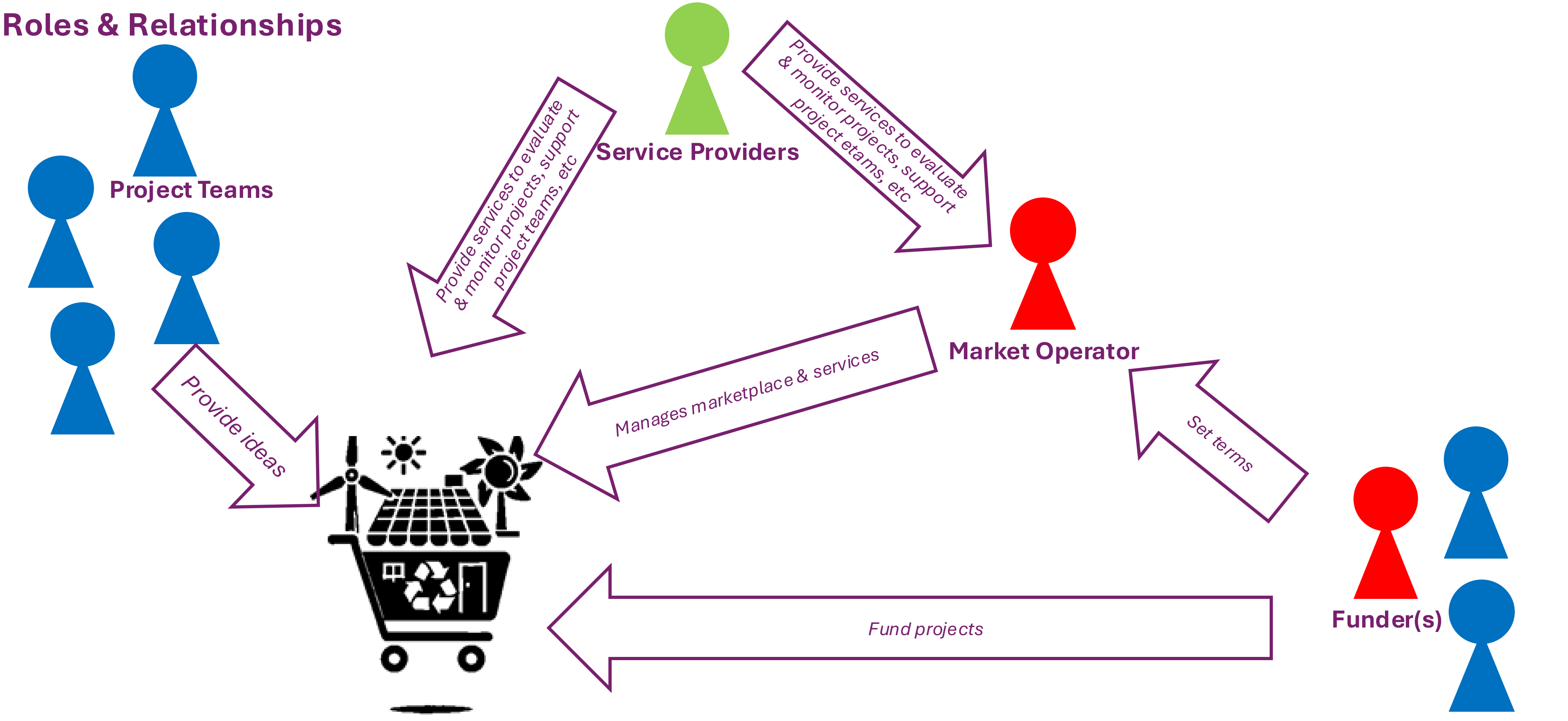
- Basic data analysis tools (spreadsheets, etc)
- Basic maps / geospatial tools. LAEP+ tool.
- Can do deeper analysis with advanced tools for analytics & energy modelling. That's probably overkill for hyperlocal LAEP.

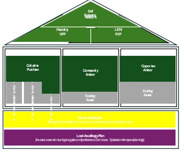


B.2 Project Marketplace

An organisation or digital platform that takes the lead in finding local projects and linking them to community, investors and supply chain. Having a single port of call enables a more coordinated approach to delivery. It also increases economies of scale and reduces risk for investors and suppliers. The marketplace might support other models (e.g. to build capacity for a VPP or LEM), or evolve into one of them, but in the early stages the focus may be more about delivering new renewable capacity and energy efficiency rather than about integrating and optimising the local energy system.

Roles & Relationships





B.2 Project Marketplace

Description

An organisation or digital platform that takes the lead in finding local projects and linking them to community, investors and supply chain. Having a single port of call enables a more coordinated approach to delivery. It also increases economies of scale and reduces risk for investors and suppliers. The marketplace might support other models (e.g. to build capacity for a VPP or LEM), or evolve into one of them, but in the early stages the focus may be more about delivering new renewable capacity and energy efficiency rather than about integrating and optimising the local energy system.

Anchors

The core is the **market operator**, someone to define the scope of the market (what type of projects participate, what support is available, etc), vet projects & suppliers, publish information, manage funding, etc. The operator needs to be trusted and credible with all participants in the market.

The operator may manage a **pot of funds** that can be granted to suitable projects, but a marketplace that simply connects projects to suppliers is also possible. Crowdfunding platforms, that connect projects to funders, also fit the model.

The market may use a **technology platform**, but this isn't essential for small, ad hoc markets. Crowdfunding platforms may be quite sophisticated.

Scale

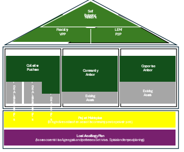
A diverse range of project marketplaces operates in the UK, at scales from a few thousand pounds per annum for a small charity to over £1bn for the DESNZ NZIP programme. Crowdfunding platforms can also be substantial, e.g. Ethex is reported to have raised over £120m for more than 200 projects from approximately 25,000 investors.

The larger markets tend to be national or even international in scope. However, markets can also operate at regional or local scale. E.g. Low Carbon Hub focuses on Oxfordshire and has raised over £10m from 1,700 investors; Northern Powergrid foundation focuses on the communities in Yorkshire and the North East.

Maturity & Examples

Project marketplaces are a well-established model in a wide variety of domains. Parties such as DESNZ and Innovate UK, for example, operate large marketplaces to fund and support innovation projects. Many charitable foundations also operate marketplaces to find suitable projects for their grants.

Crowdfunding platforms are also well established, e.g. Ethex, Energise Africa, Triodos, Crowdcube, Seedrs, Kickstarter.



B.2 Project Marketplace

Governance

The marketplace operator essentially sets the terms for how the market operates, what type of projects it supports, what type of support it provides, etc. Of course, if they are managing funds on behalf of another party, then that party ultimately sets and is accountable for all these terms.

The marketplace operator will then set up the operating processes for vetting projects, allocating and disbursing funding, managing contracts and grant agreements, monitoring projects, supporting project teams, etc, in accordance with these terms. For larger marketplaces, much of this will be built into the technical platform; for smaller marketplaces it may be much more ad hoc.

The marketplace may be set up as a separate corporate body, e.g. most crowdfunding platforms will be set up as public or private companies. (Or as charities, mutual benefit societies or cooperatives, if that fits their underlying purpose.) However, many marketplaces will be run by the operator as part of its day-to-day operations, rather than being set up within a separate company.

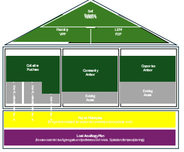
Stakeholders & Skills

The core stakeholder is the marketplace operator. They may bring most of the skills needed to operate the market, or they may subcontract to specialists for skills in areas such as:

- Project and bid evaluation
- Project monitoring
- Providing acceleration or incubation support to project teams
- Technology specialists
- Financing (either as investors for crowdfunding, or for access to follow-on funds after completion of grant-funded projects)

The need for such skills will be determined by the scale of the market and the requirements of the sponsor – if significant public funding is being disbursed there will need to be a high degree of evaluation and assurance, but that can be scaled back for smaller markets. Likewise, the market's sponsor will determine the level of additional support, e.g. via an incubator, that might be provided. On some platforms, these services may be provided as an add-on, with the platform simply providing the means for projects to connect to vetted service providers.

Again, it is key that the market operator is trusted by and credible with all parties. For a large marketplace, the operator may need to be a substantial organisation to provide the depth of support required (even if subcontracting for specialist skills). For a small marketplace, it could be a small, part-time role for a few people.



B.2 Project Marketplace

Technology & Systems

A marketplace could be set up to support almost any type of project and technology, from non-technical community development to highly specialist technology and systems integration. (It will then need to tailor its skills and approach to project evaluation, monitoring, support, etc, accordingly.) The marketplace's sponsor will determine where it sits in this spectrum, depending on what type of activity / technology / innovation / community development they are aiming to promote.

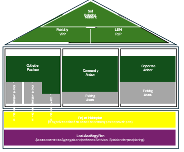
The marketplace itself may use a technical platform to support its activities, e.g. to publish calls for projects and project information, to manage funding, to track project support activities. That's especially likely to be the case for larger marketplaces, or where regulatory requirements to manage and audit processes are stringent (e.g. for financial regulation of crowdfunding). Again, smaller, lightly regulated marketplaces may be managed from a much simpler platform.

Service Delivery

The marketplace operator will manage activities such as:

- Publishing calls for projects
- Capturing, recording and publishing project details
- Evaluating projects / bids for funding
- Allocating funds to projects
- Monitoring project delivery and use of funds
- Evaluating outcomes
- Specialist support for projects (e.g. technical specialists)
- Support for project teams (e.g. incubation / acceleration)
- Facilitating matches between potential partners to assemble collaborative project teams
- Facilitating matches between projects and specialist service providers
- Facilitating access to further financing on project completion
- Managing regulatory compliance and reporting

Again, the extent to which any of these activities is necessary will be determined by the scope and purpose set for the marketplace. In general, larger marketplaces have more at stake, so they tend to set up a wider and more formal range of evaluation, monitoring and support services. (They also tend to have sufficient funds to support these activities.)



B.2 Project Marketplace

Finance & Benefits Distribution

Marketplace might be funded from an innovation or similar programme, in which case its operation will be funded by that programme. The principal benefit will then be in setting up projects that align to the programme's objectives. These are likely to be some combination of economic (e.g. generating growth in a region), environmental (e.g. promoting deployment of LCTs) and social (e.g. developing community cohesion and resilience). The marketplace will probably embed processes to evaluate project outcomes against these objectives.

The marketplace may also be self-funding, e.g. for crowdfunding platforms. In this case it will probably charge some sort of transaction fee to projects and/or investors for setting up and completing a funding round. It may also charge additional fees for services to support the funding process. These fees will cover operation of the platform plus returns to investors in the platform.

More widely, participants in the marketplace gain benefits by getting funds and support for their projects (for project teams), by finding projects that align to their investment goals (for investors), or by finding projects that will buy their services (for support providers and other specialists).

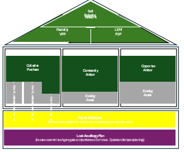
Main costs for the marketplace will be to build and operate the platform and the service delivery processes outlined earlier.

Regulatory and Markets

Crowdfunding platforms are subject to stringent regulation by the Financial Conduct Authority, so need to set up suitable information capture, recording and reporting. Likewise, charitable funding needs to be carefully managed to align to the charity's purpose, and there are tight rules around how the funds of mutual benefit societies and cooperatives may be used.

From an energy system perspective, the regulatory requirements on the marketplace itself are minimal. Any projects it funds will need to comply with energy system codes, regulations and standards, or obtain suitable derogations, but there is no specific requirement on the marketplace itself. (The marketplace may want to check a project's regulatory status as part of the initial evaluation process, and it may provide support for projects to navigate energy system codes, regulations, etc, which can be complex. The marketplace may also aim to capture barriers experienced by the projects it supports, in order to influence policy and regulatory change.)

The one exception to this might be sandboxes operated by the regulators themselves (which are a type of marketplace). These are clearly closely influenced by the regulations they are addressing. If a marketplace is supporting projects that are influenced by specific codes or regulations, it may make sense for it to build links to the relevant sandbox.



B.2 When to Consider Project Marketplace

When to consider doing this

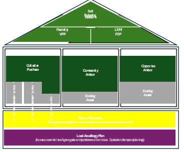
- If people in the community have ideas that they'd like to explore and develop. Even a small amount of funds can make a big difference in the early stages of developing an idea. Availability of funds may also attract people who wouldn't otherwise engage.
- If you want fresh input. People in the community may be able to generate creative ideas that are well matched to local concerns and that could be integrated into the existing project plan.
- To drive engagement and ownership. Enabling people to define and run their own projects, both through funding and through wider support (mentoring, access to trusted experts and service providers, etc), will help build ownership in the wider outcomes.
- To provide wider support. The marketplace doesn't have to be about providing funding – it could be about connecting people with expertise or assets to people who can make good use of them. That support might come from within the community, or it might be provided by the project or its partners.

When to avoid it

- If your project is already very clear in what it is doing. There is no point in raising people's hopes about getting support for their ideas if most ideas are going to be rejected because they don't fit the existing project plan.
- If you can't operate the marketplace effectively. There can be a lot of work required to define criteria for participation in the marketplace, evaluate applications and allocate funding, explain your decisions, monitor and support projects, etc. (The amount of work will depend on how formal the marketplace is, whether and how much funding you are making available, what partners are involved, etc, so you can tune this in the marketplace design. But don't underestimate how much effort will be involved even for a fairly simple, informal marketplace.)
- If you can't follow through. If you are providing seed funding for people to develop initial ideas, for example, then there needs to be a route for them to implement those ideas if they prove viable. (This might be via your project, or it might be by steering them towards funding and support from other sources.)

What scale do you need to make it viable?

The marketplace can be tuned to the funds you have available and the support you can provide. Small charitable foundations can disburse a few grants per annum, amounting to a few thousand pounds. DESNZ' NZIP portfolio funded £1bn worth of projects.



B.2 Delivery Checklist for Project Marketplace

Roles & Responsibilities

1) **Market Operator**: Administers marketplace. Sets up calls for projects. Vets users, projects, funders. Manages processes to evaluate, monitor and support projects. Reports on projects and outcomes.
2) **Funder**: Provides funds to operate marketplace and deliver projects. Sets terms for the type of projects they are interested in.
3) **Service Providers**: Provide services to marketplace (e.g. project evaluation, monitoring, support) and project teams (e.g. specialist expertise, incubation, etc).
4) **Project Teams**: Develop & submit ideas for projects. Undertake projects in accordance with agreed terms if funded.

Activities

- Agree marketplace objectives with funders
- Set up calls for projects that align to these terms
- Engage with potential project teams, support providers, etc, to engage them with the market and support them to submit ideas
- Record project proposals and track their progress through evaluation, funding, execution & delivery
- Engage service providers to evaluate & monitor projects, support project teams, etc
- Provide information to potential funders (e.g. for crowdfunding) and manage their funding and associated regulatory reporting
- Agree terms with successful project teams
- Disburse funds and track use of these funds to ensure they align to agreed terms
- Capture project deliverables and outcomes, and hence report on progress in delivering marketplace objectives

Knowledge & Intellectual Property

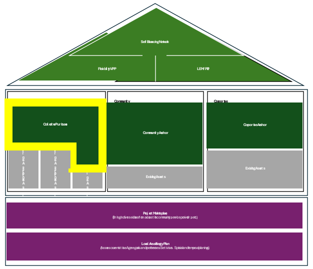
- No special knowledge or IP is required to run a marketplace in general, but the objectives for a specific project call may mean that specific expertise is needed to evaluate and support it
- Crowdfunding marketplaces need a platform, which will be subject to licensing for the software, etc

Data

- Main need is to record project and funding data appropriately
- It's also important to record project outcomes (deliverables and assessments of the impacts of these deliverables) and lessons learned, and to plan for wider dissemination of key lessons.

Tools & Systems

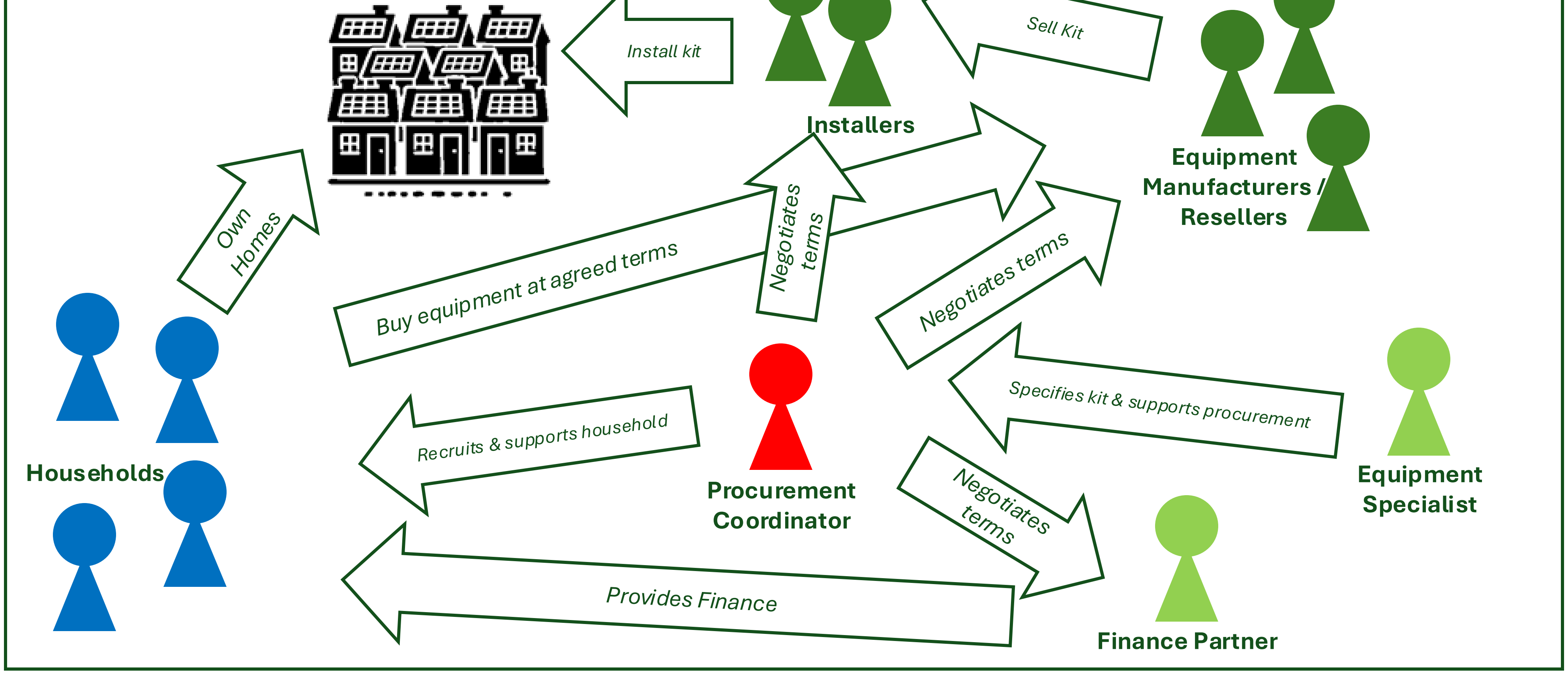
- Small marketplaces with few projects can be managed with simple tools – spreadsheets and document stores. As the volume of projects and funds grows, there is greater need for more rigorous recording and tracking. For crowdfunding, with FCA requirements, a specialist platform is likely to be required.

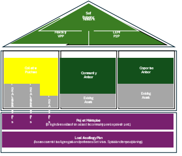


B.3 Collective Purchasing

People join together to negotiate bulk discounts on supply and installation of assets such as solar PV, batteries, etc, typically via a centrally-coordinated tendering process. These assets are fairly standard so bulk buying works well (although installation is site-specific), but the model could be extended to more complex interventions (e.g. retrofit) with thought and a body of suitable suppliers. It could also be extended to assets such as EV chargepoints. You could even envisage collective negotiation of energy tariffs with suppliers, although that'd be a significant change to the UK norm. The model can also include development of financing options to support purchase of major assets.

Roles & Relationships





B.3 Collective Purchasing

Description

People join together to negotiate bulk discounts on supply and installation of assets such as solar PV, batteries, etc, typically via a centrally-coordinated tendering process. These assets are fairly standard so bulk buying works well (although installation is site-specific), but the model could be extended to more complex interventions (e.g. retrofit) with thought and a body of suitable suppliers. It could also be extended to assets such as EV chargepoints. You could even envisage collective negotiation of energy tariffs with suppliers, although that'd be a significant change to the UK norm. The model can also include development of financing options to support purchase of major assets.

Anchors

Needs a **Procurement Coordinator** who is trusted by buyers, credible with suppliers, and savvy enough to specify the equipment and assure its quality. This is often done by a local authority (often contracting out the work of running the scheme) but it could be done by other parties, e.g. a social landlord who is buying kit for their own homes could open the procurement to owner/occupiers in the area (with suitable tweaks to their procurement processes and contracts).

It may help to bring in other partners, e.g. financial institutions to provide financing for the equipment. These could be part of the team running the procurement from the outset, or they could also be procured competitively.

Scale

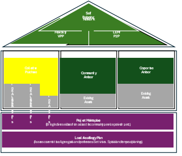
Factors to consider include:

- **Scale economies** – may need 100s of homes to get decent discounts on mature kit like PV. But it's easy to buy, so a regional scheme may work.
- **Maturity** – less mature kit is harder to buy at scale, so small schemes (10s of homes) may be viable. The main benefit may be in support to specify kit and assure quality of the installation.
- **Installers** – are often small & local, so this may limit the scale. Working with a trusted, local installer may make a hyperlocal scheme viable.
- **Overheads** – very large schemes need to be coordinated carefully, so probably need CRM.
- **VPP** – if you plan to link the kit into a VPP, then the scaling issues there will also apply, e.g. you need 1MW to participate in many flex markets.

Net result is that a scheme could range from 10s to 1000s of homes, depending on the tech and installers you're working with.

Maturity & Examples

- Collective purchasing is well established in other domains, e.g. food cooperatives.
- Employer schemes enabling employees to purchase EVs or other equipment are also a form of collective purchasing.
- Solar Together & similar schemes for PV are well established.
- Your Home Better, supported by GMCA, has explored collective purchase of home batteries alongside PV and retrofit.



B.3 Collective Purchasing

Governance

Parameters and process for the scheme and for who can participate (both as buyer and supplier) will be set by the procurement coordinator. These terms may be governed by public sector procurement regulations or by internal policies, especially if they are buying for their own portfolio as part of the process. If they are contracting execution of the scheme to a separate supplier, then the capabilities of that supplier and its systems may also influence the scheme's terms.

The scheme will also need to define how the relationship between households and the firm(s) supplying equipment, installation, etc, is governed. One option is to have a separate contract between each household and these firms, based on a template defined by the scheme. That contract might also define roles for independent parties to provide quality assurance on behalf of the household. Or it could be solely between the home and the suppliers. It might also be possible for the coordinator to buy equipment and sell it on to the household, but that creates more risk for the coordinator.

Likewise, the contract may need to consider other, related services, e.g. for equipment maintenance. If the kit will be aggregated into a VPP, then the relationship with the VPP operator also needs to be defined. This may entail setting up a separate body (e.g. a co-op) to act on behalf of the aggregation of households to manage their relationship with flex markets.

Stakeholders & Skills

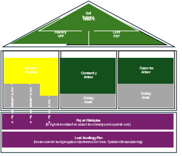
The coordinator is key. They need skills (either internal or sub-contracted) to specify equipment and associated services, set up and run a procurement, evaluate tenders and vet suppliers / installers, define and negotiate contractual terms, etc. They may also provide support such as project management and quality assurance to the homes participating the scheme.

The coordinator will recruit these homes, either through a marketing campaign or by working with an existing community. They will also recruit equipment manufacturers and other suppliers via their normal procurement process.

The coordinator may also partner with other parties to widen the scope of the procurement, e.g.:

- Finance – to help households buy expensive equipment
- VPP – to aggregate equipment for flex markets, p2p trading, etc. (If VPP is procured separately to equipment, the specifications must be clear about APIs and other integration details.)
- Installers – these may be procured separately, brought in by the equipment manufacturers, or they may be part of the project from the outset. The latter might happen if, for instance, the scheme aims to support local installers.

These partners may be brought in from the outset, to help set up the procurement. They could be also be competitively procured. Or the equipment manufacturers may be able to provide their own solutions alongside the equipment.



B.3 Collective Purchasing

Technology & Systems

The best example of equipment purchased in this way is probably solar PV, via schemes such as Solar Together. However, home batteries and similar techs also fit the model well, as they come in well-defined standard configurations. Equipment or services that require more configuration for each individual site, e.g. retrofit or space heating, are also feasible, but will require more thought about how site surveys will be performed, quotes for installation handled, etc. (These are also questions for PV and batteries, but they come in more standardised configurations.)

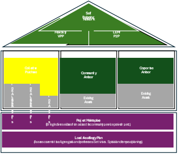
If it is envisaged that the equipment will integrate into a VPP or similar system, then specifications for APIs, access to meter data, contractual arrangements, etc, need to be defined. Interoperability standards in this area are still weak, so careful upfront attention to the specs will be needed. (It will help to have a VPP partner as part of the project from the outset if planning to do this.)

A system may also be needed to run the scheme, especially if it is purchasing on behalf of large numbers of homes. It will support the marketing campaign to recruit buyers, manage their admin-istration as they express interest, receive quotes, sign contracts, etc. It may also handle any transaction fees, e.g. if the coordinator has contracted a party to run the scheme. (Households are likely to contract and pay direct with equipment suppliers, but any fees associated with the procurement itself need to be managed.)

Service Delivery

The coordinator, or the party they've contracted with to run the scheme, may need to handle activities such as:

- Specifying equipment
- Specifying arrangements for site surveys, installation, etc
- Specifying arrangements for equipment maintenance
- Defining standard contractual terms
- Specifying technical integration (APIs, etc) with VPP
- Specifying commercial terms for integration with VPP
- Vetting equipment suppliers, installers, etc
- Evaluating tenders
- Running marketing campaign to recruit buyers
- Administering buyers through the process to sign with manufacturers
- Supporting buyers to understand equipment, contracts, etc
- Providing support to to buyers to project manage and quality assure installation of their equipment, and its integration with VPP if relevant
- Dispute resolution
- Evaluating outcomes of the scheme



B.3 Collective Purchasing

Finance & Benefits Distribution

The principal financial arrangement will probably be direct between buyer and seller of the equipment – the collective purchase scheme negotiates the terms for this deal but is not a direct party in it. (The coordinator might buy the equipment and then resell it, but that adds risk and complexity.)

If the household needs a loan or similar financing, then this might be provided by the equipment manufacturer, or it might come from a specialist partner on the scheme. The latter may fit well for financial institutions with a social or environmental mission, who could then provide beneficial terms to the household.

Costs to run the scheme may be covered by a grant or similar funding, or they may be covered by charging fees to sellers and/or buyers to participate.

Buyers benefit both through discounts and through the scheme's support for specifying kit, vetting suppliers, quality assuring installations, etc. The trust this builds is key for many buyers. Sellers benefit through reduced overheads, logistical costs, etc, to access a large number of buyers. The same would be true for a VPP operator or similar party participating in the scheme.

Partners operating the scheme (coordinator, lenders, etc) benefit through the support it provides for their mission, e.g. enabling access to LCTs. These may be enhanced by the scheme's terms e.g. giving added discount for fuel poor or other vulnerable groups.

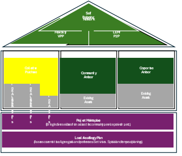
Regulatory and Markets

The scheme will be covered by general consumer protection regulation. The coordinator should also ensure that the standard contract terms it negotiates with equipment suppliers and other parties are clear and fair to the consumer. Likewise, they should ensure that equipment specifications include appropriate standards, maintenance arrangements, etc.

If financing is provided, it will be covered by regulation by the Financial Conduct Authority.

Beyond this, there are no overall energy system regulations covering this type of scheme. However, specific technologies may be covered by energy system codes or standards, e.g. G98/99 codes covering connection of generating equipment (PV, batteries, etc) to the distribution network. Again, these will need to be covered by equipment and installation specifications, contractual terms, etc.

If the equipment is intended to be integrated into a VPP or similar service, then standards defined by the flex and other markets it addresses (e.g. for operational metering, settlement, etc) will also need to be addressed. This is a rapidly emerging and evolving area, so will need specialist input. The HomeFlex code of conduct (https://www.flexassure.org/homeflex) may also apply, although it is still in its infancy.



B.3 When to Consider Collective Purchasing

When to consider doing this

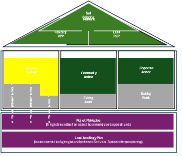
- If there are a significant number of owner / occupiers in the community, especially for those who are able-to-pay or if you have a suitable financial partner lined up
- There is interest in LCTs, but low trust of installers and resellers, so providing access to vetted suppliers adds a lot of value.
- There is low penetration of LCTs in the area, so supporting an initial group of people to deploy them could seed further growth by enabling people to see them in action.
- You have plans for a model such as VPP or P2P trading, but need to create capacity to participate in it.

When to avoid it

- If most people in the community are tenants so don't control the fabric of their buildings. In this case, working with the landlords is essential. Social landlords should be able to purchase in bulk already. If there is a large number of small, private landlords than a collective purchasing scheme for them is conceivable, but I don't know of any examples.
- If there are few able-to-pay households in the community, and you cannot line up a financial partner who is willing to provide suitable financing for people in the community.
- If the building stock is generally in a poor state or otherwise unsuitable for addition of LCTs. It may be possible to set up a scheme to address retrofit and other fabric improvements, but that's likely to be more complex than a simple Solar Together style of scheme.
- If you can't get sufficient interest from a range of installers, resellers or equipment manufacturers. You need sufficient participation to run a meaningful procurement.
- If you don't have access to sufficient expertise to specify equipment, vet installers, monitor installations, etc.

What scale do you need to make it viable?

Solar Together campaigns may involve 5,000+ registrations, leading to ~1,000 installations. You might run a viable scheme with only 100 installations, or fewer for a complex solution such as retrofit, but you lose interest from and negotiating leverage with suppliers as the numbers go down. If you are building a VPP, you probably need 1MW of capacity, which means at least 200 homes and preferably 1000.



B.3 Delivery Checklist for Collective Purchasing

Roles & Responsibilities

1) **Procurement Coordinator**: Sets objectives. Recruits households, manufacturers, installers, etc. Negotiates specs and terms.
2) **Equipment Specialist**: Supports coordinator to specify kit, quality assure manufacturers & installers, support households, etc.
3) **Household**: Buys and operates equipment.
4) **Finance Partner**: Provides cash to support households to buy expensive equipment. May be a partner or competitively procured.
5) **Equipment Manufacturer / Reseller**: Recommends products that meet specification. Negotiates pricing & terms. Provides kit.
6) **Installer**: Installs kit. May be a partner or competitively procured.

Activities

- Set objectives for procurement
- Specify equipment and services to be procured
- Recruit households, equipment manufacturers, installers, etc
- Support households to understand equipment and terms
- Track applications from households and any associated tasks (e.g. surveys to check equipment suitability)
- Run procurement process (e.g. invitation to tender, auction) to set pricing and agree terms
- Coordinate activities for households to sign up with manufacturers and installers (e.g. introductions, surveys, final price agreement, setting up installation plans, agree financing)
- Support households to manage and quality assure equipment installation, configuration, handover, integration with other services (e.g. VPP) and operation
- Resolve disputes / misunderstandings
- Track delivery against original objectives

Knowledge & Intellectual Property

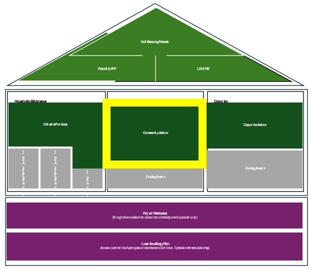
- Needs good understanding of the equipment being procured, so that it can be specified and quality assured effectively.
- If kit is going to be integrated with a VPP, LEM or other system, then will need to agree APIs, etc. These may be proprietary, so may need agreements & NDAs with relevant parties.

Data

- No specific data needed, although individual types of equipment and service may require data (e.g. household meter data, DNO network capacity, etc)

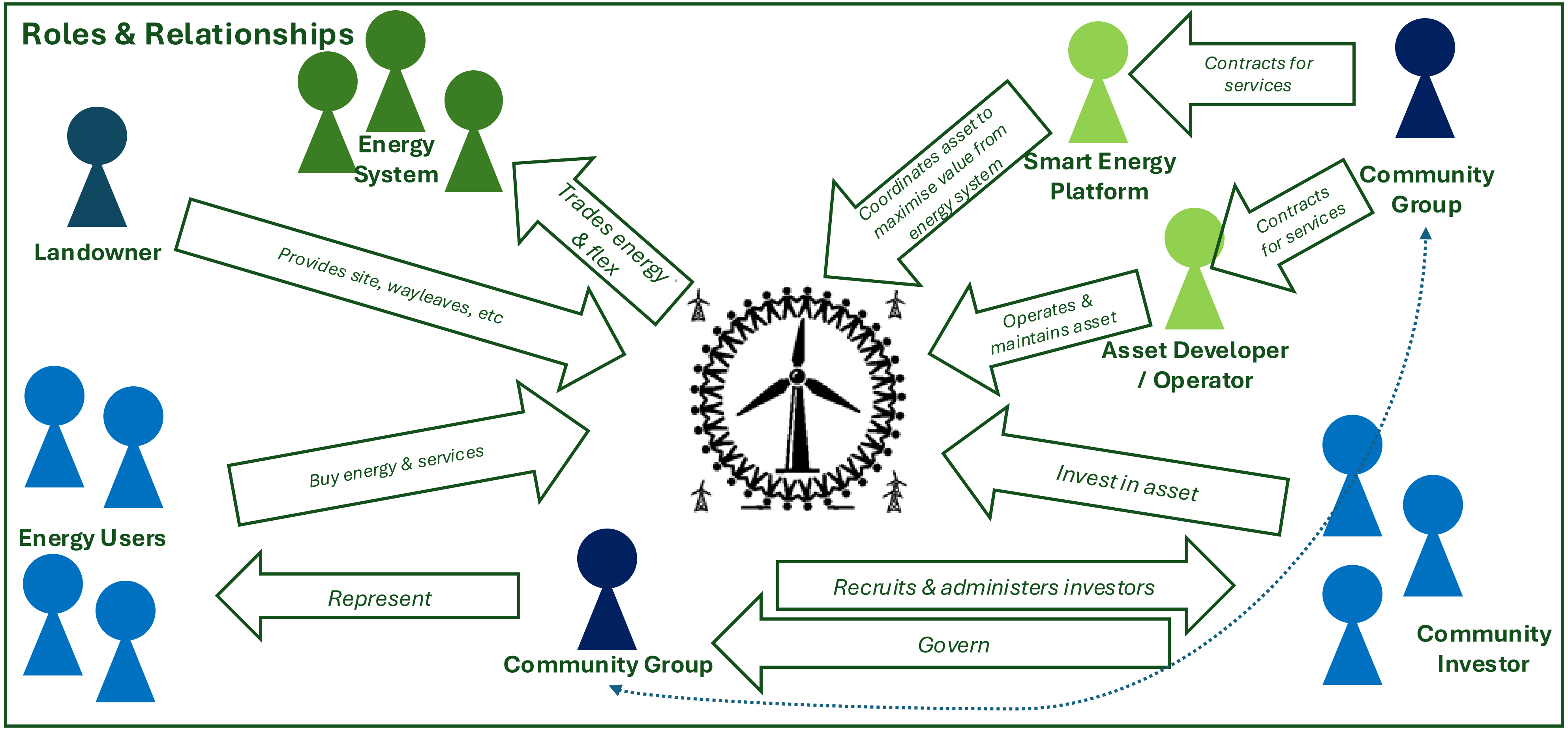
Tools & Systems

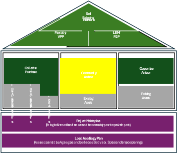
- Probably needs some sort of procurement platform to track the process, record invitations, bids and tenders, etc, especially if buying in large quantities or under public sector rules. If buying in smaller quantities, then may be able to run the process without special tools or systems.



B.4 Community Anchor Asset

Build and operate a common, community-owned asset. This is common for renewable generation (e.g. solar PV on community land or roof of a community building; wind turbine), which may be installed locally or remotely. It's also possible for heat networks (e.g. shared loop ground source array), EV chargepoints, batteries, etc. Ownership may be direct (via crowdfunding) or mediated by a community organisation (school, church, club, etc). Benefits may be shared as revenue from energy sales (e.g. as dividends) or by sharing energy generated by the asset (although that has regulatory issues). The asset might also create scale for other models, e.g. VPP or Self-Balancing Network.





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Anchors

This model is all about enabling a **community-owned asset** of some sort. That's most commonly for generation (solar PV array, wind turbine, hydro scheme), but it could also be for demand (e.g. district heat network or shared loop heat pump array) or energy storage. The asset may provide benefits direct to community members (as dividends or as shared or lower cost energy) or it may help provide scale needed to make another model (e.g. VPP or self-balancing network) viable. This model will centre around financing, operating and maintaining this asset, and distributing its benefits to the community.

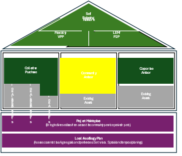
Scale

Assets can scale from a few kW (e.g. solar arrays on schools set up by GM Community Renewables) to many MW (e.g. Ray Valley Solar). The natural scale is driven by site availability, size of community, funding, etc. Larger assets may give better returns due to scale economies, but may be more distant from the community, reducing the sense of ownership & hands-on engagement. Complexity is also a factor – a solar farm can stand alone, selling to national markets or writing a PPA with a suitable offtaker. (Local authorities could use their purchasing power to support schemes in this way.) A shared loop heat pump array has to integrate with the homes it serves, making it harder to support and scale.

Maturity & Examples

Community ownership of solar PV, wind turbines, hydro, etc, is well established. e.g. schemes run by Low Carbon Hub in Oxfordshire, Bristol Energy Community, Lune Valley Hydro, or other groups supported by Community Energy England and similar bodies. This can also grade into corporate schemes: Octopus Fan Club is a corporate scheme, but is Ripple a corporate or community-led model?

More complex models can be anchored in a community asset. Energy Local has long championed models to share the benefits of local generation, and CePro's model at Owen Square in Bristol (shared battery and heat pump array, plus PV on suitable roofs) is interesting. EU models for community energy are also developing rapidly.



B.4 Community Anchor Asset

Governance

Community members will typically own shares in a vehicle (e.g. co-op or CIC) that owns the asset. That vehicle's articles then define decision-making rights and processes, how benefits are shared, what reports must be produced, when shareholder meetings must be held, etc. It's worth getting specialist advice on just what type of vehicle to use, as there are differences in what they are able to do, how they can share benefits, etc.

The vehicle will probably subcontract operation and maintenance of the asset to a specialist, unless members of the community have requisite skills and are willing to volunteer. (The amount and type of work will depend on the asset. Using volunteers to reduce operating costs can be key to making smaller assets viable.) It will also need to consider how to manage finances, pay dividends, etc, and how to administer its membership. For larger assets, or if the community owns multiple assets, it may be necessary to employ staff to handle some of this work. The initial financial models will need to account for all these costs.

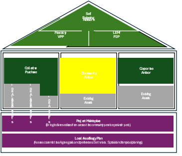
This model overlaps into the fully corporate model of the next building block. Large community organisations like Low Carbon Hub grade into companies with a community-led mission, like Ripple, and then into fully commercial businesses like Octopus. Models where a public body (school, place of worship, club, etc) owns the asset on behalf of the community are also feasible.

Stakeholders & Skills

The key stakeholder is clearly the community, acting through the vehicle it has set up to own and operate the asset. This will need skills (internal or subcontracted) to specify, build, operate and maintain the asset. The initial project to develop a financial model and business case, specify and procure the asset, negotiate PPAs, etc, could be substantial, so project management skills will also be important. The community will also need initial advice on corporate form, and on any regulatory issues associated with the asset and associated business model (e.g. the regulatory issues around sharing energy from the asset with community members are complex).

Once the asset is operational, there will be an ongoing need to manage finances, manage contracts to operate and maintain the asset and buy energy from it, administer membership, manage relationships with the owner of the land on which the asset is built and other parties, etc. Managing relationships (and disputes) within the community will also be important.

If the asset is being used to anchor another model (VPP, local energy market or self-balancing network), then there will need to be partners to manage these models – VPP platform, energy supplier (regulatory issue around energy sharing mean a supplier or similar balancing partner may be essential for P2P models, for example), network operator, etc.



B.4 Community Anchor Asset

Technology & Systems

The core technology is the asset itself. As described earlier, this could be generation, storage, heating system, etc. It could be a single standalone asset, network of assets (e.g. aggregation of PV on roofs across the community) or integrated heat network or microgrid. The choice of asset will depend on factors such as geography (e.g. urban or rural setting, availability of land or roof space, roof orientation, visual amenity issues, access issues, availability of wind or hydro resources, weather patterns), grid and network access, community skills and preferences, willingness to engage in complex regulatory issues and business models, availability of finance, availability of specialists to specify and operate the asset, etc.

Solar PV is probably the simplest & most common asset. Wind and hydro are well established, but dependent on access to suitable resources. Heat networks / shared loop arrays are still uncommon in UK, but likely to grow in importance. Likewise for microgrids (best examples of these tend to be in new build homes or community housing developments, with the equipment built in from the outset). All of these entail essentially centralised assets, but models to finance (e.g. via leasing) distributed assets installed in the home are also emerging for PV, batteries, heat pumps, etc. However, these models apply more for the next building block as they tend to be corporately owned.

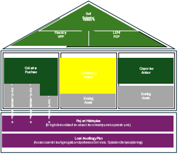
Service Delivery

The community may need to handle activities such as:

- Choosing what asset to focus on. (Driven by commercial, technical and social factors, e.g. to negotiate between various community preferences. So facilitation skills are key.)
- Designing and specifying the asset and its installation
- Negotiating contracts with landowners, equipment manufact-urers, system integrators, installers, O&M providers, offtakers, energy suppliers / traders, VPP operators and aggregators, etc
- Project managing asset build, installation, commissioning
- Operating and maintaining the asset, and any associated platforms for aggregation, VPP, energy trading, etc.
- Managing insurance and warranties on the asset
- Managing finances, both for the asset and to disburse benefits to the community (e.g. as dividends). This may extend to billing and suchlike if an energy-sharing model is adopted.
- Administer membership of the community vehicle
- Corporate administration and reporting for the vehicle
- Manage comms and relationships within the community

Many of these are likely to be contracted out.

NB several of these are more complex for distributed assets, especially those installed in people's homes. But appropriate O&M, insurance, etc, is essential if the assets are to be used by a VPP or similar model.



B.4 Community Anchor Asset

Finance & Benefits Distribution

The asset is likely to be financed through crowdfunding, perhaps supported by grant. If ownership vests in an organisation such as school or club rather than a community-owned vehicle, then it might be financed by that organisation, or via a crowdfunded loan. In all cases, specialist advice on the financial model, the contracts that need to be in place to support it, and its regulatory implications is essential.

Revenue from standalone generation is fairly simple, coming from energy sales to national markets or PPAs. For assets on a building (e.g. school or commercial roof), the way the occupier will pay for the energy they consume needs to be agreed. Similarly for energy storage – it generates revenue by "trading", most likely timeshifting energy from expensive to cheaper times; payment for this must be agreed. It may also generate revenue from flex markets. For heat pumps, the benefit may be in reduced energy costs. These need to be paid for. In all cases, the financial benefits are likely to be distributed as dividends or loan repayments to the community.

It is also possible to set up mechanisms to share energy direct with community members, e.g. via schemes like Energy Local. The financial benefit is then in reduced energy costs. However, this has more complex regulatory implications than paying dividends.

Non-financial benefits may also be significant – ownership and control over energy, community resilience, reduced exposure to fluctuating energy prices.

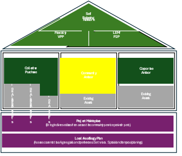
Regulatory and Markets

The community vehicle needs to be set up appropriately. A CIC, Co-op or mutual benefit society may be appropriate depending on the nature of the asset, business model, financing, etc. These all have different benefits, restrictions, reporting requirements, etc, so need specialist advice.

Any crowdfunding needs to be compliant with requirements of the Financial Conduct Authority. Again, this is a specialist area so needs appropriate advice. This will also influence the way dividends are administered and paid.

Energy sharing has complex implications for energy regulation. Energy Local has shown that it's feasible, but it requires good understanding of energy regulations and codes. Settlement pretty well requires all participants to have a common supplier. (That's as much an issue with suppliers' metering and billing systems as with regulations, but the effect is the same.) Code modifications such as P415 are creating new options, but you'll need to work with a specialist to set up an energy sharing or P2P trading model.

That all sounds complex, but many communities have navigated these issues, and well-established models exist for the common technologies such as solar PV. So these issues can all be managed provided suitable advice is obtained. (For more innovative technologies and business models, it may be necessary to talk to Ofgem's Innovation Hub. They are very responsive, but you are now in a very specialist area.)



B.4 When to Consider Community Anchor Asset

When to consider doing this

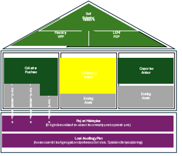
- You can't develop individual assets. (e.g. because people don't own their homes or are in multi-occupancy buildings. If roofs are in poor condition or poorly oriented. If there are planning issues associated with developing household assets.)
- You have a suitable natural resource (river, site for wind turbine or PV array) with an amenable landowner, suitable physical and network access, etc. This is ideally close to the community, e.g. to help build a sense of ownership and engagement, but it's also possible to build assets some distance from the community.
- You have public or community land that could be used (e.g. waste land associated with a park, field, transport corridor, etc)
- You have a community-centred organisation (school, club, place of worship, etc) that has a suitable building or land
- You have a source of funds, via some mix of crowdfunding, grant and financial institution. (Crowdfunding can work with quite small numbers of people, and financial institutions can be vey amenable to asset-backed investments.)

When to avoid it

- No site is available, either because of lack of land or because the available land has difficulties with access, networks, etc
- It's difficult to obtain sufficient consensus across the community – you probably need a segment that is enthusiastic about the asset, and for others to at least not be actively resistant.
- No-one is prepared to be actively involved in setting up the community vehicle to own and operate the model. Again, you need a level of enthusiasm somewhere in the community, and willingness to engage in the complexities of establishing the asset. Advisors can be found to do the specialist work, but they need someone to work with and make the final decisions.

What scale do you need to make it viable?

Assets can range from a few tens of kW to tens of MW. They probably need to be large if standalone but can be much smaller if connected to a suitable building as the cost savings against energy tariffs are large. e.g. GM Community Renewables has placed 30kW PV arrays onto schools. Heat networks require 100s of homes to be viable, but shared loop arrays can be smaller if land for the array is available.



B.4 Delivery Checklist for Community Anchor Asset

Roles & Responsibilities

1) **Community investor**: Agrees objectives & terms. Provides funds. Participates in governance. Receives dividends or interest.
2) **Community group**: Acts on behalf of community members and investors to specify, procure and operate asset. Manages funds.
3) **Energy user**: Buys energy or services from the asset, if that's made available via LEM, P2P or other scheme. May participate in governance of community group.
4) **Asset developer / operator**: Builds and operates the asset.
5) **Smart Energy Platform (VPP, LEM or P2P)**: Coordinates asset operation, settlement, etc, if it's being integrated into a full SLES.

Activities

- Agree objectives
- Identify & survey site for asset. Negotiate with landowners for access, wayleaves, etc.
- Specify asset, operating model, business model (e.g. what markets it will access / revenues it will earn)
- Develop and agree business case
- Set up community group to own and operate the asset, with appropriate governance model
- Recruit investors and engage with wider community
- Negotiate with equipment manufacturers, resellers, installers, EPCs, etc, to agree terms to build and operate the asset
- Manage project to build, commission and hand over asset
- Operate the asset, collect revenues and disburse benefits to investors and community after covering costs
- Govern and manage asset operation, benefits distribution, etc, via community group

Knowledge & Intellectual Property

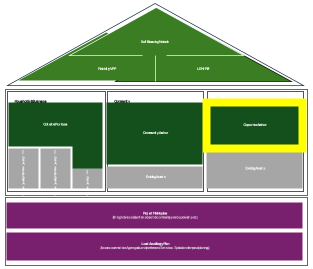
- Needs good understanding of assets, markets, regulations
- Needs good understanding of community governance models
- Needs good understanding of relevant financial regulations
- If integrating into full SLES, will need APIs, etc. These may be proprietary, requiring agreements & NDAs.

Data

- Will probably need data on potential production from the asset, markets and pricing, etc, to build a business case for the asset
- May need data on network capacity, connection queues, etc, to build case, plan project, specify equipment needed, etc

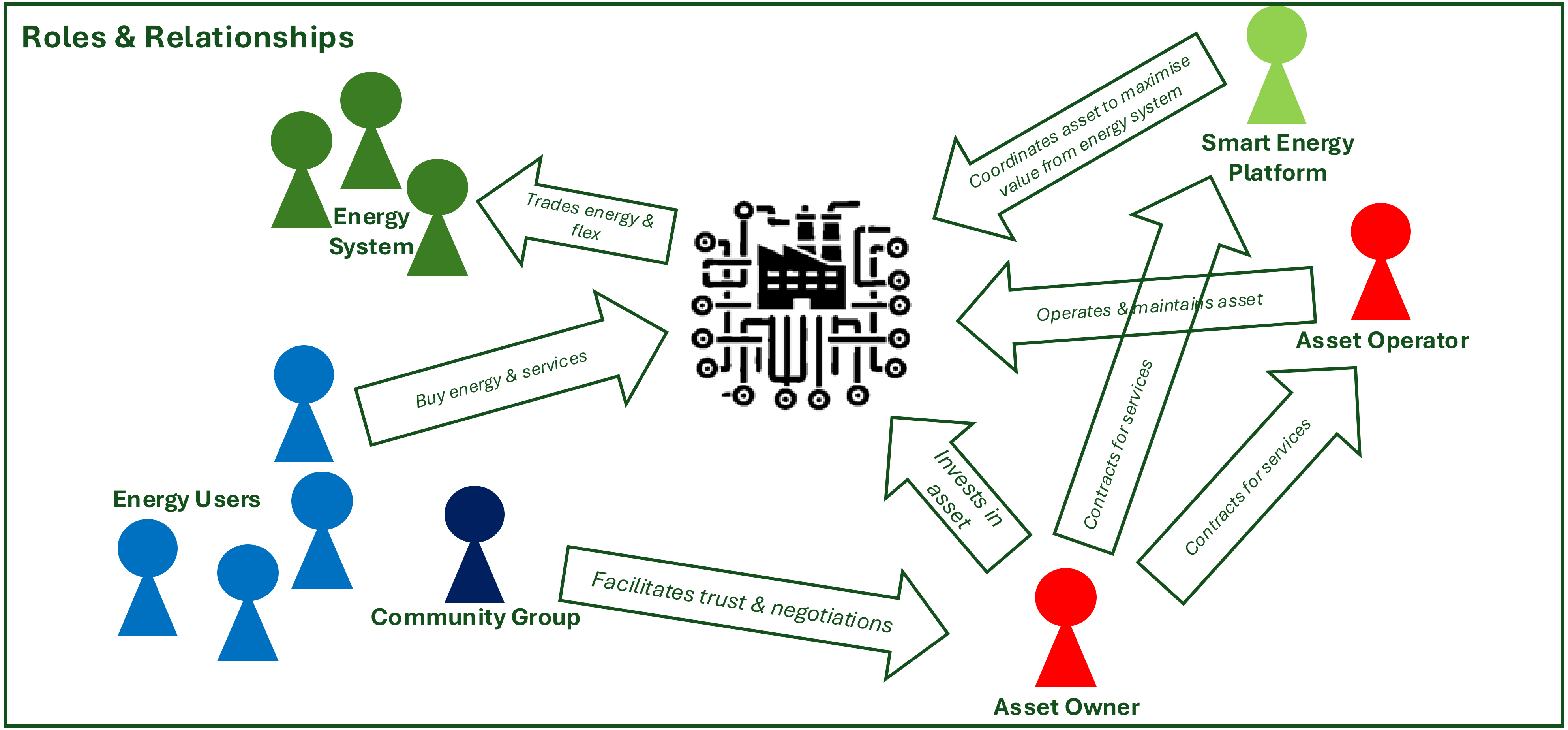
Tools & Systems

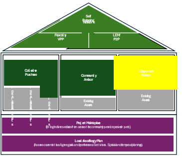
- Assets will need tools for configuration, monitoring, operations, so these need to be covered by the initial spec
- If integrating into full SLES, will need to agree how the asset will integrate and interoperate with the relevant platform(s)



B.5 Corporate Anchor Asset

Build community around a corporately owned and operated asset. This might be renewable generation, a heat network, or even an industrial site that buys excess energy generated by the community. Benefits may flow to the community via corporate ESG (e.g. funding for to community projects, drawn from profits from the asset), or they may come as discounts on energy or heat. Or they may simply be in creating scale to help make other community schemes (e.g. VPP) viable. The model is similar to the community-owned model, but corporate ownership changes the governance and benefits-sharing arrangements, while opening potential to invest in and operate larger assets.





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Anchors

Again, this model is built around an **anchor asset**, e.g. renewable generation, private wire electrical network, heat network. The difference to the previous model is that the asset is owned by a (commercial or public sector) organisation. This gives access to additional finance and hence larger assets. Corporate resources also make it feasible to manage assets that have complex operations. The model also works for smaller assets (e.g. private wire network on a business park or housing estate). The corporate owner now has the final say on decisions, and distribution of benefits is at their discretion. But this model works well for a company with a community-driven ethos or that sees commercial benefits in being closely aligned to its customers.

Scale

Access to corporate finance enables access to larger assets, tens of MW and above. This can be especially important for things like solar and wind farms, which require economies of scale when selling to wholesale markets. Corporate (and public sector) purchasing power can also be an important factor for writing PPAs from such sites. The community can then share in the benefits resulting from this scale.

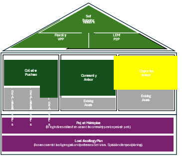
Likewise, complex assets like private wire electrical networks and district heating tend to need a corporate owner to build and operate them effectively. Again, the community can then share in the benefits such a facility creates in terms of lower energy costs, etc.

Maturity & Examples

Corporate models to share benefits from renewable generation are well established, e.g. Ripple, Octopus Fan Club, Thrive. The degree to which they go beyond crowd-funding to provide a direct link and benefits to communities varies, and they grade into community-owned assets.

This is the established model for district heating networks. There are examples of community-owned heat networks (esp in EU), but the bulk are corporately owned.

Private wire (or iDNO-owned) electrical networks are increasingly common in UK, for business parks, housing developments, campuses, etc. There could be scope to build community benefits around such a network, although that's not yet common.



B.5 Corporate Anchor Asset

Governance

The corporate owner ultimately has the final say on most decisions. This is tempered by consumer protection legislation, regulation of energy supply, etc, and the company may choose to participate in voluntary codes like Heat Trust that give further protections. It may also choose to give the community additional oversight and powers through its articles or some sort of charter. However, its relationship to community members will probably be defined primarily through the contracts it writes to provide them with services from the asset. So it's important to ensure that these contracts and clear and fair.

Note that the corporate may be a consortium of partners acting through some sort of special purpose vehicle (SPV). The articles / shareholder agreements for that SPV can then allocate decision making rights in different proportions to the financial ownership (e.g. "golden shares") – this may give route to allocate key decisions to public or community partners while satisfying investors' need for financial returns. The agreements can also create roles for community advisory groups and suchlike, with varying degrees of power over decision making.

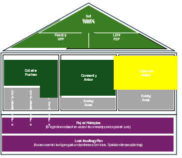
Many corporations also set up charitable foundations or similar, and make provision to give a portion of their profits to them to provide benefits to the community.

Stakeholders & Skills

The corporate asset owner is the the key stakeholder. They bring the skills needed (either internal or via partners / subcontractors) to plan, specify, build, operate and maintain the asset and associated systems and processes. By contrast to a community-owned model, they are more likely to need to attend to concerns such as billing, customer service and support, etc, driven by their commercial relationship with people in the community.

Members of the community interact with the company primarily as customers for its services. This may place obligations on them, e.g. to maintain and insure equipment that connects to the network, as defined in their contract with the company.

Members of the community may also have additional rights, e.g. to get information and be involved in decisions, as defined by the overall governance agreements. They may need skills / advice to discharge this role effectively, e.g. to understand the information and provide informed input on decisions. The effectiveness of any community-driven aspects of the model's governance will be very dependent on the community's willingness and ability to scrutinise the company's operation of the asset and delivery of services from it.



B.5 Corporate Anchor Asset

Technology & Systems

The corporate asset is at the core. It may bring requirements for other technology & systems (e.g. for asset monitoring and maintenance, energy trading, billing, customer relationship management). If it is anchoring a VPP, LEM or self-balancing network, that will bring in further tech and systems. The corporate asset owner will be responsible for integrating and operating these elements, either directly or via partners and subcontractors.

This model may also entail integration with appliances in homes and other buildings in the community. A district heating system, in particular, will need to integrate with buildings' heating systems. (Integrating a private wire electrical network may be as simple as using standard electrical interfaces, but can get very complex if interoperating with smart appliances.) Customer agreements need to be clear about how responsibilities are split between corporate and household (e.g. to connect & maintain equipment).

This model could also lead to the company financing and owning assets in the home, e.g. to finance heat pumps and deliver Heat-as-a-Service. This model is still emerging; it could be a way to reduce the upfront costs of moving to heat pumps. Firms like Wondrwall are also applying it to solar PV and home batteries. Responsibilities for maintaining and insuring the assets then need to be clearly delineated. Issues such as how these obligations are transferred when the house is sold also need to be addressed.

Service Delivery

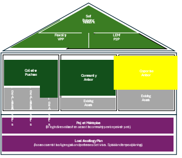
The company that owns and operates the asset will be responsible for all the activities identified for community-owned assets – specifying, designing and building the asset; operating and maintaining it; insuring it; managing energy trading, metering, settlement and billing: community engagement, communications and reporting; etc.

The nature of the asset and of the relationship between the company and members of the community may also mean that it needs to undertake additional activities, for example:

- Integrating the asset with appliances in people's homes
- Billing for energy, heat or other services delivered to homes
- Customer support and relationship management

(All of these activities may be built into the community-owned model to some degree, but the supplier/customer relationship in this model may mean that more attention needs to be paid to them.)

From the community's perspective, this model reduces the need to be involved, e.g. as volunteers, in operating and maintaining the asset and delivering services from it. In essence, they will be paying the company to give them this convenience. That can be a good deal if the company can achieve economies of skills and scale that counteract any added costs.



B.5 Corporate Anchor Asset

Finance & Benefits Distribution

The corporate asset owner provides finance to build and operate the asset. This could be from its own balance sheet or via loans, etc. It may also seek grant funding if the asset is innovative or will deliver social benefits. Note that the corporate could be a single entity, or it could be a consortium, bringing in investors and partners with skills to operate the asset. It could also enable people to invest in the asset via models such as Ripple and Thrive.

As with the community-owned model, revenue may come from selling energy to wholesale markets or via PPA, or by selling energy or services to members of the community. A key attraction of this model for the corporate owner may be in the ability it gives it to build a close relationship with its customers in the community. It may also be a good way to test innovative technologies and services with the community. (That can raise questions if the innovation doesn't succeed: how will the asset be sustained?)

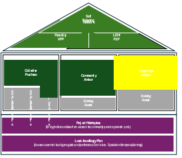
Benefits will be distributed as loan repayments or dividends to investors. This may include a "dividend" to the community, e.g. via donations to local charities and community groups. There may also be discounts on sales of energy and services to community members. The community also benefits through its ability to influence corporate decisions, thus shaping the service levels it provides and its impact on the local economy (e.g. by providing local jobs), environment and facilities.

Regulatory and Markets

Any contract between asset owner and households will be subject to general consumer protection legislation. If the company is also providing energy, it will be subject to energy regulation and codes, although derogations for small scale supply or complex sites may apply. Heat isn't subject to the same regulation, but the direction of travel is towards bringing it under Ofgem's remit. For now, voluntary codes such as Heat Trust may apply. Private wire networks may also be subject to aspects of Ofgem regulation and related industry codes, although this is much less rigorous for them than for the DNOs. In general, if the model involves delivering energy to the household, specialist expertise on the regulatory implications will be needed. One attraction of the corporate anchor model is that the company will have the resources to bring in this expertise. (But note that much of the regulation is aimed at protecting the consumer; if the model is set up to avoid regulation, equivalent protections need to be built into the customer agreements.)

If the model entails any element of crowdfunding, then it will be subject to regulation by Financial Conduct Authority. Likewise if there is any element of financing equipment in people's homes. If this financing also locks the consumer into the company's services, e.g. for Energy-as-a-Service, then you should pay attention to the protections the customer agreement provides for the household to switch suppliers, terminate the agreement, etc.

If the asset anchors a VPP, LEM or similar model, then the market & regulatory aspects of those models must also be considered.



B.5 When to Consider Corporate Anchor Asset

When to consider doing this

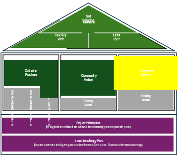
- A company that owns an asset or plans to build one wants to build community buy-in, either to gain a customer base or to make it easier to obtain planning permission
- A company with a strong social mission or ESG commitments is looking to establish links to the community
- You have a site that is suitable for a substantial asset (e.g. it has wind or hydro or geothermal resources) but it is too expensive to develop with community finance alone
- The community cannot access finance
- The community aspires to build a VPP, LEM or similar model so needs access to expertise, technical platforms and operational capability to make the model work

When to avoid it

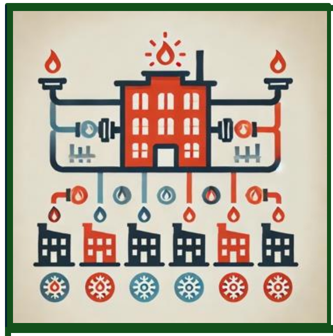
- The community has low trust in potential corporate partners
- The community has the resources (finance, skills, etc) to do it themselves and would prefer to avoid corporate involvement
- You cannot agree on a governance structure and associated articles / agreements that creates sufficient long-term community (or trusted third party) involvement in oversight and decision making
- You cannot agree on individual customer terms, e.g. in standard customer agreements, that make it sufficiently attractive to community members to participate, and that provide them suitable protections

What scale do you need to make it viable?

The considerations are pretty much as for a community-owned asset, but corporate ownership may enable (and require) assets at the larger end of the scale. May also work for more complex assets / business models, as the company can bring expertise and operational depth to execute them. Can also work for smaller assets that are naturally scaled to the size of a given site, e.g. housing development.



B.5 Delivery Checklist for Corporate Anchor Asset



Roles & Responsibilities

1) **Asset Owner / Investor**: Provides site, finance, etc. Specifies asset. Manages build and operations. Delivers services to users.
2) **Asset Operator**: Operates asset on behalf of owner.
3) **Energy User**: Buys energy and services from the asset owner.
4) **Community Group**: Represents users in negotiations about terms, community benefits, etc. Oversees deliver of benefits.
5) **Smart Energy Platform (VPP, LEM or P2P)**: Coordinates asset operation, settlement, etc, if it’s being integrated into a full SLES.

Activities

- Agree objectives. This will entail some sort of negotiation between company and community representatives.
- Agree governance model and set up community group to interact with corporate asset owner on behalf of community.
- Agree terms for contracts between asset owner and people using energy and services from the asset).
- Specify, build & operate asset. (Similar activities to those for a community asset, but likely to be conducted by the company. It may agree some parameters with community, but is likely to reserve much for itself, reflecting the finance it’s providing.)
- Recruit users to buy energy and services from the asset. Sign contracts and set up services.
- Manage service delivery to energy users. Provide support, manage issues and disputes.
- Operate community group to interact with company on behalf of the community, help resolve issues and disputes, oversee community benefits, etc.

Knowledge & Intellectual Property

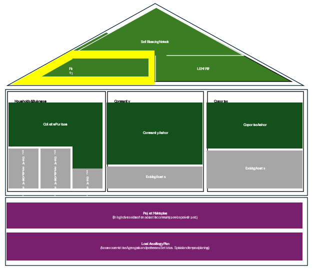
- Assumes company brings necessary knowledge & IP for assets, markets, regulations, integration with SLES, etc
- Needs good understanding of community governance models
- Needs good understanding of commercial terms and options to be able to negotiate effectively with company

Data

- Assumes company manages most data requirements
- Agreement between community group and company should consider what data about asset operation, markets & financials, etc, should be made available to community to give appropriate transparency of asset operations

Tools & Systems

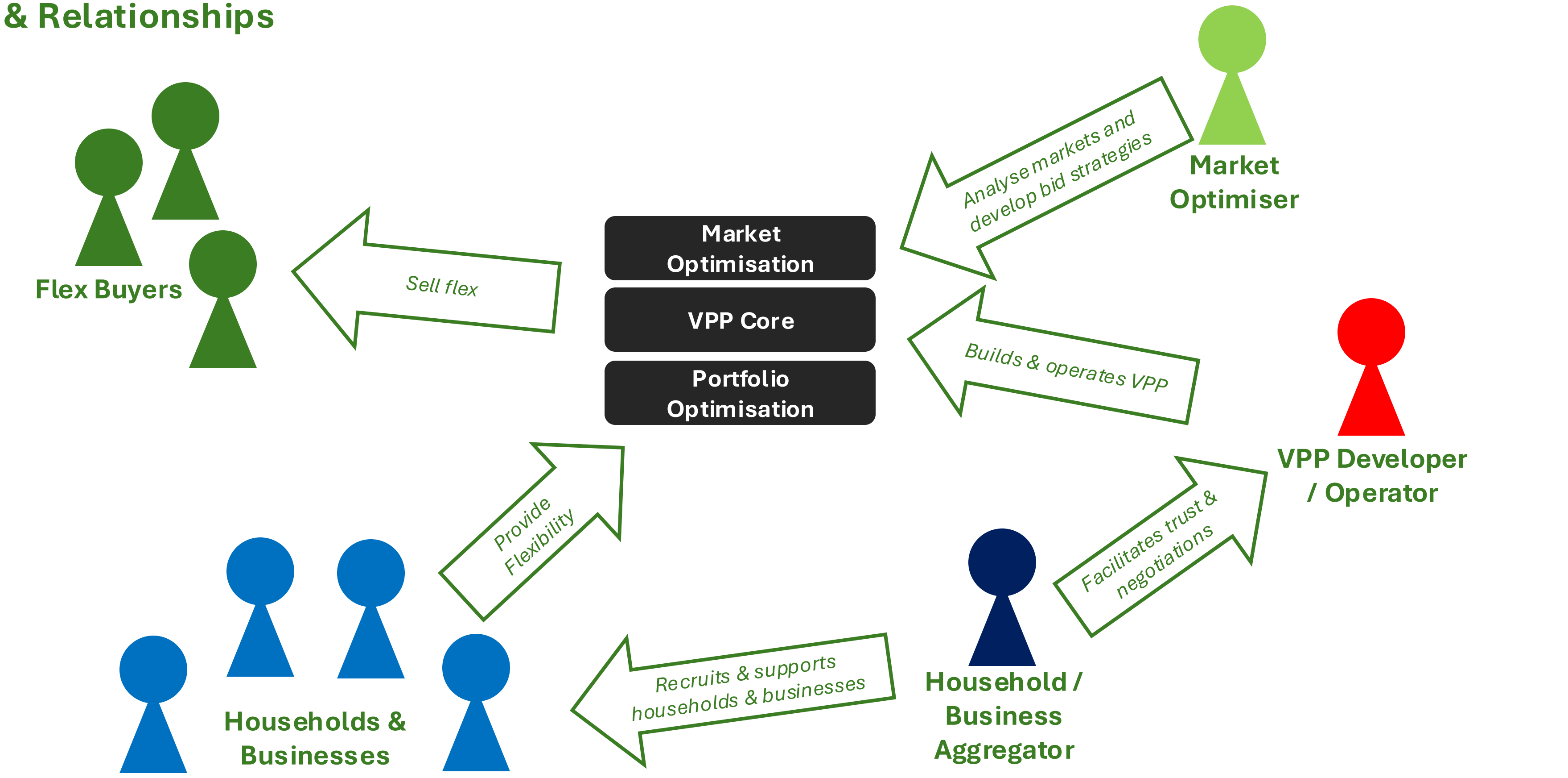
- Assumes company brings necessary tools and systems, either itself or via service providers it engages

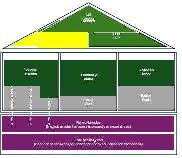


B.6 Flexibility VPP

Coordinate and aggregate people's energy usage to create a Virtual Power Plant (VPP) that can sell flexibility to DSO, for its local flexibility market, and NESO, for ancillary services. Flexibility may come from behavioural response (e.g. people reducing energy use in response to a message) or automation of smart appliances. In either case, it can be sold to the system operator to help manage the system / network. Flex may also enable trading on Balancing Mechanism or wholesale energy markets, but that has more regulatory complexity (e.g. requiring P415 code mod, which has only just gone live). The number of markets also creates technical complexity, e.g. to optimise returns.

Roles & Relationships





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Anchors

This model will probably be built around a **VPP platform** and/or the aggregator which operates the platform. The main challenge, after explaining what flexibility is about and recruiting people to participate, is likely to be integrating assets onto this platform.

For behavioural response, this is relatively simple; it's largely about messaging people then collecting meter data to demonstrate their response. Automation delivers a larger, more consistent response, but needs integration with smart appliances. Standards here are weak, despite DESNZ' work on them, so integration will probably be based on proprietary APIs. This means choice of assets & platform will be tightly linked by their ability to talk to each other.

Scale

Flex markets need a minimum scale to participate. This can be ~10kW for DSOs, but they offer low returns and can be restricted to a limited set of postcodes. National markets pay more, but need 1MW. That means 1000s of homes, dropping to 100s if they have EVs or home batteries. An anchor asset may help build scale.

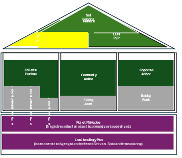
Accessing national markets, especially wholesale markets and BM, also has high overheads, administrative and technical. This means aggregators need significant scale (probably 100s of MW) to sustain building & operating their platforms. That means any local community is likely to need to work with a national aggregator. Most platforms can accommodate this.

Maturity & Examples

This model is well established for industrial and commercial customers, who are served by aggregators like Flexitricity, GridBeyond, Enel X.

Its extension to domestic customers is being actively pursued by firms like Axle, equiwatt, Levelise. However, none of these have achieved financial viability. NESO's Demand Flexibility Service brought more firms into this area over the last few years, with active participation from suppliers like Octopus. But NESO changed the terms in 2024, making it much less attractive.

Players like Carbon Co-op have explored open source platform models. That's an attractive idea but doesn't really avoid the need for scale for the platform to be viable.



B.6 Flexibility VPP

Governance

Again, this is largely a corporate model. The VPP operator / aggregator will drive core decisions about which markets to access, how to participate, commercial terms, etc. However, in many cases it will be passing through terms defined by flex buyers such as NESO and DSOs – as monopsony buyers, they have a lot of power. Community members may contract direct with the aggregator, or they might build a community organisation (e.g. CIC or Co-op) to aggregate their capacity and negotiate on their behalf. (This essentially uses elements of Collective Purchasing for the VPP.) That can help build trust and confidence for community members with limited understanding of flex, and can give a route to share benefits in a way that doesn't dis-advantage those less able to buy expensive appliances (as the community can distribute benefits in line with its social goals). However, it may complicate the contractual structures, as flex buyers' terms about asset availability and participation, for example, then need to get passed down a contractual chain from flex buyer to VPP operator to community org to asset owner.

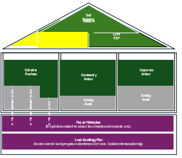
It would be possible to build a wholly community-based model, e.g. if the community organisation were to build and operate its own platform based on open source code. But that would run into questions about achieving sufficient scale to be viable. And it would still be subject to the market power of flex buyers.

Stakeholders & Skills

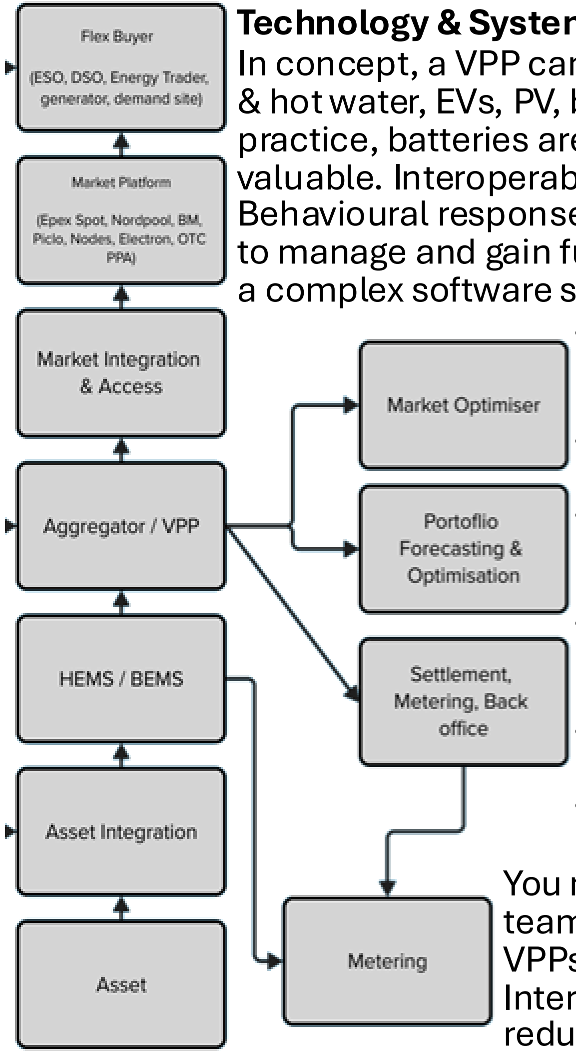
VPP operator is the core stakeholder. Their skills will be driven by the tech stack illustrated in the next page. This is the most tech-nically complex of the models, as it entails complexity at both ends of the stack – recruiting households and integrating their equipment, then optimising sales of flex across multiple markets. By comparison, the LEM/P2P model has less need to integrate equipment (beyond smart meters) and is only dealing with a single market, for energy. The VPP operator therefore needs skills in:

- Community engagement – explaining flex to community members and recruiting them to participate in the VPP
- Equipment integration / OEM relationship management – integrating appliances, batteries, EVs, etc onto the platform
- Portfolio optimisation – forecasting load and flex from the portfolio of appliances, and positioning them to deliver flex when it is most valuable (e.g. by adjusting thermostats to pre-heat space & water at cheap times)
- Platform development and operation – software development and technical operations, with an emphasis on scale and reliability
- Market optimisation – forecasting pricing across multiple flex markets, developing bid strategies to optimise returns from these markets
- Regulatory and market engagement – monitoring and influencing development of flex markets

The VPP operator may partner with other firms on aspects of this, e.g. market optimisation is becoming a distinct niche with several specialists active in it. Likewise, HEMS developers may focus on equipment integration. And community engagement may be devolved to the community organisation described at the left.



B.6 Flexibility VPP



Technology & Systems

In concept, a VPP can include most techs – heating & hot water, EVs, PV, batteries, smart appliances. In practice, batteries are easiest to manage and most valuable. Interoperability is a challenge for all techs. Behavioural response is easier to integrate, but hard to manage and gain full value from. VPPs also need a complex software stack, as illustrated here:

- Asset Integration – connect to equipment in homes/buildings to gather data & send control signals
- HEMS / BEMS – coordinate kit within the home/building
- Portfolio Optimisation – forecast load & flex from the assets, and adjusting settings to maximise flex
- Market Optimisation – forecast prices across multiple flex markets and bid into the markets
- Market Access – integrate to the platforms operated by flex buyers
- Settlement, etc – managing admin and back-office functions

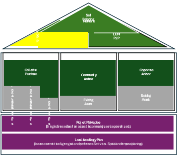
You need large tech & data science teams to run such a stack. Many VPPs partner for some functions. Interoperability standards would reduce complexity, but are nascent.

Service Delivery

Service delivery links closely to the software stack. The VPP operator or its partners will need to undertake activities such as:

- Recruiting households into the VPP
- Supporting them to connect and configure their equipment
- Explaining flexibility and supporting people to set up equipment operating parameters to maximise it
- Developing code to integrate with the APIs for each manufacturer's equipment
- Developing reliable, scalable code to coordinate the portfolio of equipment connected to the VPP
- Developing code to integrate with the APIs for each market platform used by the various flex buyers
- Analysing data from the portfolio of equipment to forecast the flexibility profile it can provide over time
- Analysing flex market data to predict pricing and develop bid strategies to optimise the value the VPP can earn
- Providing customer service and support to households
- Managing settlement and billing for flex services

Most VPPs partner with specialists for some of these functions. E.g. if a community organisation is acting on behalf of the house-holds, it may recruit, support & disburse flex payments to them. (It will also need to manage its own membership administration, etc.) It may also work with installers to connect and configure equipment and set up its operating parameters for the VPP.



B.6 Flexibility VPP

Finance & Benefits Distribution

VPP platform is probably funded by innovation and equity financing, covering costs to build it and access flex markets (e.g. NESO, DSO, BM, wholesale arbitrage under P415). Economics of building and operating such platform mean it is likely to operate at national / international scale. It will probably partition its portfolio by local areas (e.g. postcodes), as that's necessary for DSO markets.

Benefits are typically distributed as a share of the revenue earned on flex markets. Models for distributing benefits include:

- Simple percentage revenue share
- Asset owners pay a fixed fee and receive all flex revenues
- Asset owners receive a fixed, guaranteed payment
- A mix of the above

VPP might also generate implicit benefits, e.g. helping optimise energy use against ToU tariffs to lower energy costs. People will need to pay some sort of fee for such a service. If the operator is a supplier / ESCO, they might also offer Energy-as-a-Service or tariff discounting models (e.g. Octopus Zero Bills). These can also include financing for equipment installed in the home.

If a community organisation represents people participating in the VPP, it may also engender social benefits, e.g. increased resilience & engagement. It also has scope to adjust distribution of financial benefits to favour community projects or disadvantaged groups.

Regulatory and Markets

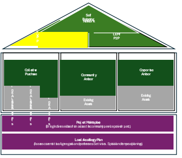
Regulation of VPPs on NESO & DSO flex markets is relatively light, although there are moves to bring aggregators into Ofgem's remit. Voluntary codes such as FlexAssure / HomeFlex give added customer assurance in the absence of regulation.

Trading on wholesale energy markets is more heavily regulated, needing a supply licence. P415 modification to the Balancing & Settlement Code opens this to "virtual lead parties", which is less onerous. This could be a key enabler to VPPs, as it opens up a much larger & more liquid market. (It could also aid P2P models.)

Accessing these markets also entails significant admin overhead. NESO & DSO markets require registration, submission of bids to auctions, etc. Their service terms can also have significant tech requirements, e.g. on speed of response, operational metering, etc. These can preclude domestic participation. DSO markets are less onerous than NESO, but also pay less. NESO's Demand Flexibility Service was attractive (easy to enter, paying well) in 2022/23, but new terms in 2024 make it less attractive.

Trading on these markets also needs strong risk management & optimisation. VPPs must forecast pricing, account for uncertainty in response rates from their portfolios, develop bid strategies across multiple markets with different pricing and penalty functions, etc. This can require a significant data science team.

Standards are also important, e.g. for interoperability. DESNZ has sponsored work here, as has Octopus. Until these are widely adopted, the risk of lock-in to a specific VPP platform is high.



B.6 When to Consider Flexibility VPP

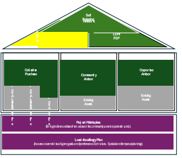
When to consider doing this

- People are considering buying equipment (collective purchase, anchor asset) for other reasons, and need additional revenue to make them attractive (or even viable)
- People have assets (EVs, batteries, heat pumps), so added revenue is attractive
- People have heard of schemes like DFS and want to participate
- People have low trust in energy suppliers, so would prefer to access DFS and other markets via a community group
- A technical partner is interested to work with the community
- The local DSO is looking for flex in the area. (DSOs don't pay a lot, but they are very keen to work with people to help them participate in their flex markets.)
- There is a lot of generation in the area. (DSOs are starting to develop demand turn-up services, which essentially give good discounts to consume local energy at peak times.)
- There are connection queues in the area. (Matching demand to supply can help work around curtailment issues. This links to the self-balancing network model.)

When to avoid it

- If you don't have a VPP platform operator lined up. The amount a household can earn from DSO and DFS isn't likely to be very high, but they are easy enough to access if you have a decent partner to manage the technical & market issues. So you should probably be considering them if you can line up a partner.
- If most people in the area are already participating in DFS via their energy supplier. This may make it challenging for a separate VPP to add full value.
- People have a low level of interest, trust or engagement in the energy system. Flex is complex to understand, so it probably isn't the place to start the journey.
- Note that homes will need smart meters and to be half hourly settled to participate in some flex markets. (e.g. Balancing Mechanism and wholesale trading. These are more complex markets than DSO or DFS, but potentially much higher value.) Very few homes are half hourly settled right now, so this can be a significant barrier unless they are prepared to switch to a suitable supplier. This will change as mandatory HHS eventually rolls out (much delayed, currently set for 2026).

What scale do you need to make it viable?
DFS and DSO flex is viable for small capacity (10kW), but a VPP really needs to access markets such as BM, wholesale, etc, which means 1MW minimum to participate and substantially more to be viable (e.g. to support costs of developing and operating a platform). Can partner with aggregators who have capacity in other areas to create scale, but most of them will only be interested it you have 1MW.



B.6 Delivery Checklist for Flexibility VPP

Roles & Responsibilities

1) **VPP Developer / Operator**: Builds & operates platform to aggregate assets and sell flex to markets identified by Market Optimiser.
2) **Household / Business Aggregator**: Recruits & supports parties to participate in VPP. Negotiates terms with VPP operator. (May be a community group, or this could all be performed by the VPP operator itself.)
3) **Market Optimiser**: Analyses market data and identifies best strategy to sell flex across multiple markets. (May be part of VPP operator, or may be a separate specialist.)
4) **Flex Buyers**: NESO, DSO, energy traders, etc, that buy flex. (Markets are fragmented, hence need for optimiser.)
5) **Household / Business**: Provides flex to integrate into the VPP. May be behavioural, or via automated control of smart kit.

Activities

- Set up VPP platform. This will entail choosing the platform / operator / partners, commercial negotiations, technical configuration, establishing governance and reporting structures, etc.
- Set up community group to recruit and support households.
- Recruit households & businesses to participate. Often requires education, as flex isn't well-understood / intuitive.
- Integrate smart appliances with VPP platform, either direct or via HEMS / BEMS or manufacturers' cloud platforms. Standards are weak, but promising options are emerging (e.g. Mercury).
- Gather data and use it to predict availability of flex from appliances & optimise this across the portfolio.
- Bid available flex into flex markets. May be simple initially, with a focus on a single, simple market such as DSO or DFS. Likely to grow complex as optimise value across multiple markets.
- Manage settlement processes. Covering both flow of meter data to flex buyer, and of cash from them to VPP operator and hence to households and businesses participating in the VPP.

Knowledge & Intellectual Property

- Needs good knowledge of flex markets, appliance capabilities & interoperability, ways to maximise behavioural response. Much of this is probably embedded in proprietary algorithms & APIs.
- Needs VPP platform. May be open source, but likely to be proprietary. Either way, it will need to be licensed.

Data

- Algorithms to optimise market pricing are dependent on historical data, etc. Some is open, but much is proprietary.
- Algorithms to forecast household flex and optimise portfolio response require historical household data. This takes time to acquire. May need to start with fairly generic models.

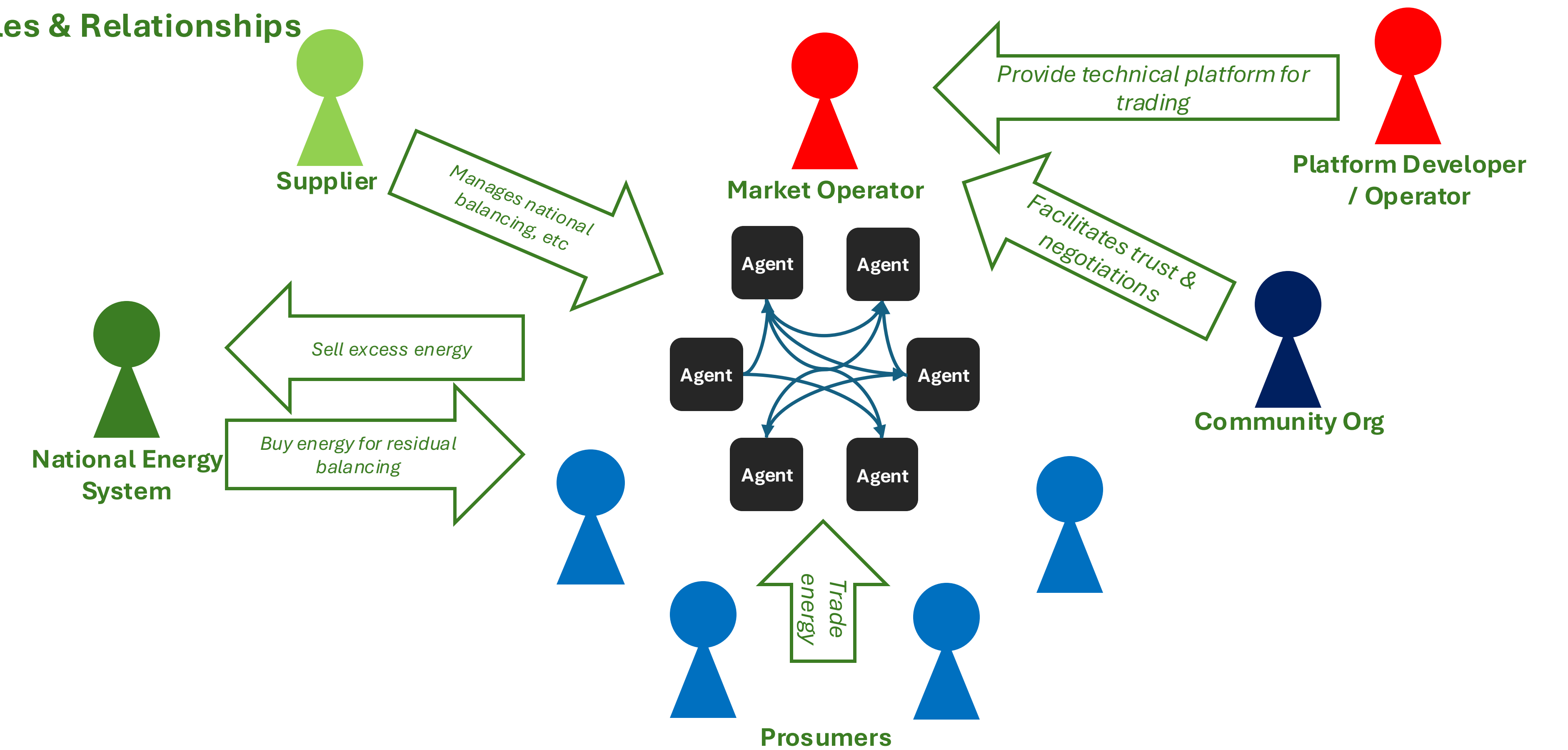
Tools & Systems

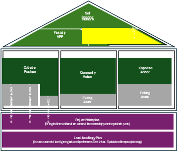
- Core VPP platform to coordinate assets reliably at scale
- Analytics platforms for market and portfolio optimisation
- Tools to connect & integrate appliances in homes / businesses
- Gamification and comms tools for behavioural response

B.7 Local Energy Market / Peer-to-Peer Community

Trade energy between members of the community, enabling them to agree on tariffs that benefit both producer and consumer. Conceptually, this creates less need to share profits with an intermediary; in practice there still needs to be someone to manage imbalance, credit risk, etc. And trading, whether via a central marketplace or peer-to-peer, requires a technical platform that is built, maintained and operated by someone. So the benefit is often in people's ability to set prices specific to their individual circumstances. The market may also enable flex, e.g. via dynamic pricing of energy trades. Anchors (large generators and loads; network operator) may also participate in the market.

Roles & Relationships





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Description

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Anchors

Again, the model is built around a **market platform**. The commodity and trading patterns differ c.f. the VPP model (it's now energy rather than flex, and people buy as well as sell), but the core is still trading. In concept, P2P creates a different topology for this trading, c.f. centralised energy & flex, but people may not experience it that differently – they simply see the trades.

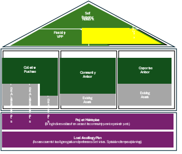
Current regulatory model means there must be an **energy supplier** at the market's core, e.g. to manage residual balancing, network charges, credit risk, etc. Innovation projects have explored placing these responsibilities elsewhere, e.g. via licensed market operator or multi-supplier models, but these aren't yet allowed.

Scale

The key trade-off is between trust (which favours trading with people you know) and liquidity (requiring a large market to give a good price). Wholesale markets maximize liquidity but require access via a "trusted" suppler. LEM & P2P emphasize trading in smaller areas, assuming either that people will pay a premium to have control over the provenance of their energy or that trans-action costs can be reduced by removing suppliers. The first is true for some people and the second may be true with a good tech platform. GM LEM suggested there is a sweet spot at the scale of a city or large town, but this isn't really proven. The key to doing this at local level is probably to find a group of people that will pay a decent premium for energy of known provenance.

Maturity & Examples

There is a lot of interest in P2P and LEMs, and they have been much explored in innovation projects. Examples in the UK include firms like UrbanChain and Sitigrid, and projects like GM LEM. There are also many international examples, as many people find P2P appealing. Energy Local also has elements of this, and it now has a reasonable degree of adoption across UK. But the requirement to have a supplier involved has limited adoption of these models – they create complexities for the supplier and give them little in return beyond current wholesale markets. So there probably needs to be change to the current "supplier hub" regulatory model for this type of trading to really take off.



B.7 Local Energy Market / Peer-to-peer Community

Governance

Again, the market operator will probably drive key decisions and commercial terms, making this a fairly corporate model. Even in a P2P market, trades are likely to be mediated by a central agreement with the market operator – it's not really tractable to write a lot of bespoke individual contracts. (Distributed ledgers may enable large numbers of contracts, but they're likely to be clones of a core agreement, perhaps with a few variable parameters for price, etc.) As with the VPP model, developing and operating a market platform requires scale. Open source may ease this to a degree, but the economics still pull you towards placing a corporate platform operator at the core of the market. This may be exacerbated by the need to involve a supplier also.

This can be moderated by building appropriate corporate gov-ernance. As with VPP, a community organisation could mediate the relationship between individuals and the market to improve their negotiating power and ability to exercise oversight. Projects like GM LEM have explored operating the market via an SPV that includes local authority participation, to ensure there is public say in key decisions. (Shareholder agreements can be set up to allocate decision rights differently to dividends, allowing investors to get the financial returns they need while giving the LA power on key decisions.) Local authorities can also use purchasing power as significant energy consumers to exert influence on the market.

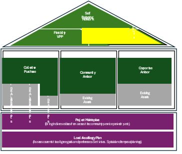
Stakeholders & Skills

As with the VPP, the key stakeholder is the market operator, and they need skills to build and operate the technical stack. The stack is less complicated in many ways, as there is only a single market for energy, rather than multiple flex markets operated by various flex buyers. This reduces need for market integration & optimisation layers. Likewise, the platform won't necessarily need to integrate with equipment in the home beyond accessing meter data, reducing the complexity of asset integration dramatically.

This reduced technical complexity is countered by the increased regulatory complexity of integrating with the supplier hub model. Responsibilities for balancing, handling network and policy costs, managing credit, etc, need to be accounted for, either by obtaining a supply licence and managing them within the market, or by partnering with a supplier. This also complicates recruitment to the market, as it requires people to switch supplier.

There may also be added complexity in the user experience. In flex markets, people essentially just accept the price offered by buyers or negotiated through their auctions. For P2P trading, there is much more scope for people to define their own pricing parameters (probably for an agent to then execute).

Overall, then, the core skills are about building an operating a tech platform and creating an effective user experience onto it. There is less need for data science and optimisation skills then in the VPP model, but greater need to manage regulatory engagement.



B.7 Local Energy Market / Peer-to-peer Community

Technology & Systems

The core is the market platform. Conceptually this could be centralised (e.g. a central LEM as envisaged for GM LEM) or distributed (e.g. P2P trading network built on a distributed ledger such as blockchain). In practice, there may be little difference to most people – they see a user interface that lets them place trades, or more likely, set parameters under which an agent trades on their behalf. The underlying matching and trading mechanics can be abstracted away. And even if trading is done by a network of P2P agents, they are likely to be based on a common code base, so the model is centralised at this level. Likewise, market admin and ops will probably be conducted by a central market operator.

The main function of the platform is to capture, match and record trades. It will also handle backoffice functions for settlement & billing, user admin and support, etc. As discussed earlier, it may also support functions such as managing residual balancing, or this may be deferred to a separate supplier platform.

The platform will need to integrate with meters, or at least access meter data, to handle settlement. As noted earlier, it doesn't need to integrate with the underlying appliances, so the market can operate independently of the type of equipment in homes, etc. Meter interoperability is better defined than general appliance interoperability, so the integration needs are much less onerous than for VPP or self-balancing network (although still not trivial).

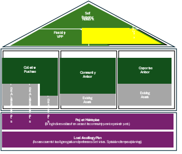
Service Delivery

The market platform captures, matches & records energy trades. It then settles these trades against meter data, and bills people for the energy they've produced/consumed. The principal complexity is that there is potentially a large volume of trades, each at their own individual price. So the market needs a platform that can handle this matching, trading and billing reliably at scale.

The main functions of the market operator are then to:

- Build, maintain and operate the platform
- Manage flows of meter data
- Manage settlement and billing processes
- Recruit households, businesses, asset operators, etc, to participate in the market
- Administer and support these market participants
- Integrate with systems from supplier(s) or other partners that are providing functions such as residual balancing, credit management, network charging, etc

It may partner on some of these functions, e.g. working with a community organisation to recruit and support members of the community to participate in the market (as with the VPP model).



B.7 Local Energy Market / Peer-to-peer Community

Finance & Benefits Distribution

As for VPP, the platform is probably funded by innovation & equity financing, covering costs to build. Again, the economics mean the platform is likely to operate at regional or national scale, partitioning itself into local markets as they form. If the platform also handles functions such as balancing, it will also need financing to cover associated risks. These costs will be recovered through a mix of platform access and transaction fees.

Market participants benefit implicitly, through value within their trades, which may let them to buy/sell energy at a better price than they could get from a supplier. But local markets are inherently smaller and less liquid than national ones, so this benefit may not be significant unless intermediation costs are high (which isn't the case in UK). It may be possible to exploit regulatory niches around network charges & policy costs, but these are unlikely to scale. (Market developments like nodal pricing might change this, but they are uncertain and will take time to materialise.)

The main benefit may therefore be in controlling the provenance of energy. People can see and choose where their energy comes from, giving them a sense of control and engagement, letting them steer money towards local causes, building local community and resilience, etc.

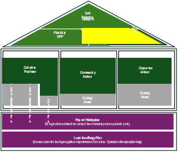
(The platform might also operate a VPP, giving direct revenues from access to flex markets. That then overlaps with the VPP model.)

Regulatory and Markets

Many people find the concept of a local, P2P market appealing, but it is very different to the supplier-hub model that is central to UK regulation and market structures. As noted earlier, suppliers undertake a lot of functions beyond basic energy trading, e.g. to manage balancing, network charging, credit, etc. A P2P model needs either to find an alternative way to implement those functions, or it needs to integrate a supplier to undertake them.

Projects like GM LEM and P2P specialists like UrbanChain have done a lot of thinking about this, but the model is still emerging. Regulatory changes such as the P415 code mod will help. In the meantime, the key requirement is to find a supplier that is both trusted by the community and is willing to support the model, and to find a platform operator that can work with that supplier.

Discussion of P2P and LEM also overlaps heavily with thinking around distributed ledgers, with their decentralised nature holding many attractions to people who distrust large institutions. Again, the reality is complex – even a fully decentralised trading and ledgering platform can have underlying reliance on central code repositories and administrative & operational functions. If setting up such a market, you should make sure you have assessed the impacts of licensing this software and contracting with the party providing the operations. (And note that even if the software is open source, you will still be dependent on someone to maintain and license it. For some open source code this will be a community, but it is more likely to be a commercial organisation.)



B.7 When to Consider Local Energy Market / Peer-to-peer Community

When to consider doing this

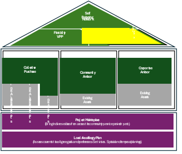
- You have a platform operator interested to support the market, and they have a supplier lined up to work with them. (Or they are engaging with regulatory changes such as P415, that may let them act as a VLP to support market balancing.)
- People in the community value the social benefits of a local market – community cohesion and resilience; ability to steer benefits towards local causes & vulnerable members of the community; ability to buy energy of known, local provenance; etc. They are willing to tolerate the innovative nature of a local market (e.g. in terms of the regulatory changes needed, the continuing evolution of p2p platforms, etc) in order to access these benefits.
- There is excess generation within the community (via a community anchor asset or via rooftop PV or similar) or a willingness to invest in such generation, and a desire / need to gain additional revenue by selling this excess energy locally.

When to avoid it

- You don't have a platform lined up, and don't have the technical and energy system expertise to select one with confidence
- You don't have a trusted supplier lined up to support the market. (Note that people need to be prepared to switch to this supplier, so unwillingness to switch is also a barrier. As P415 rolls out, they may be able to remain with their existing supplier and simply sign up to a common VLP.)
- There isn't any significant amount of generation available locally
- People in the community aren't interested / savvy enough to be involved with the market, which will probably entail effort to switch suppliers, set up a trading app / agent, etc. (Some people may simply value convenience and low cost so far above control and insight into the provenance of their energy that they have no interest in a local market / p2p.)
- People have a low tolerance for market uncertainty and risk – they just want / need to pay a clear, firm price for their energy. (The market will probably set a cap to the price via its link to a supplier, who can offer a fixed tariff, but the trading inherently creates uncertainty to pricing. If people don't want to engage with this, then there is little reason for them to participate.)

What scale do you need to make it viable?

Unlike flex markets, which set a minimum capacity, there is no firm minimum limit. But the market needs to be sizable to have sufficient liquidity and to cover platform costs. The latter means choosing a commercial operator that supports multiple local markets. GM LEM suggested individual markets can be viable at regional scale; smaller markets are feasible if people value provenance sufficiently highly.



B.7 Delivery Checklist for Local Energy Market / Peer-to-peer Community

Roles & Responsibilities

1) **Market Operator**: Oversees market operations; provides transparency on trading & other activities; provides trust and assurance to market participants; sets trading costs & transaction fees; vets market participants.
2) **Platform Developer / Operator**: Provides platform for market trading and supporting functions (backoffice, etc)
3) **Supplier**: Undertakes licensed functions for balancing, network charging, etc, on behalf of market operator & participants.
4) **Prosumer**: Trades energy on the market.
5) **Community Group**: Represents prosumers in market governance, negotiations on trading conditions and fees, etc. Helps build consumer trust in the market.

Activities

- Set up trading platform. As for VPP, entails choosing platform / operator / supplier, commercial negotiation, technical configuration, establishing governance and reporting structures, etc.
- Set up community group to recruit and represent households.
- Recruit households & businesses to participate. Support them to switch to the supplier supporting the market, get smart meters installed if they don't already have them, set up trading preferences / strategies (e.g. via app or agent), etc.
- Set up facilities to gather meter data to support settlement. This is simpler than for VPP, which may need to integrate with a wide range of kit, but still non-trivial and potentially costly if it can't be done via the supplier's existing processes and systems.
- Manage settlement and billing. This probably entails integrating trading data (or at least resulting balances) into the supplier's billing system so that prosumers' costs/revenues are integrated into their bills. (Separate settlement is also feasible, in which case cash flows, credit balances, etc, need to be managed.)

Knowledge & Intellectual Property

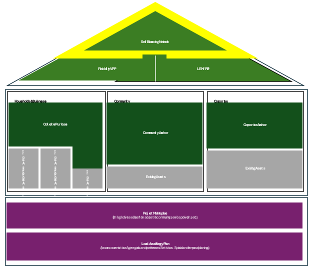
- Needs good knowledge of regulations for energy supply, e.g. scope for licence exemptions. Also need to track & influence relevant code mods, e.g. P415 to allow VLPs to trade energy.
- Needs trading platform. May be open source, but likely to be proprietary. Either way, it will need to be licensed.

Data

- Trading is done by users, so market operator doesn't need to forecast demand, pricing, etc. But if it wants to make this info available to users, it needs relevant data and analytics.
- Key requirement is to be able to record and process potentially large volume of trades accurately for settlement.

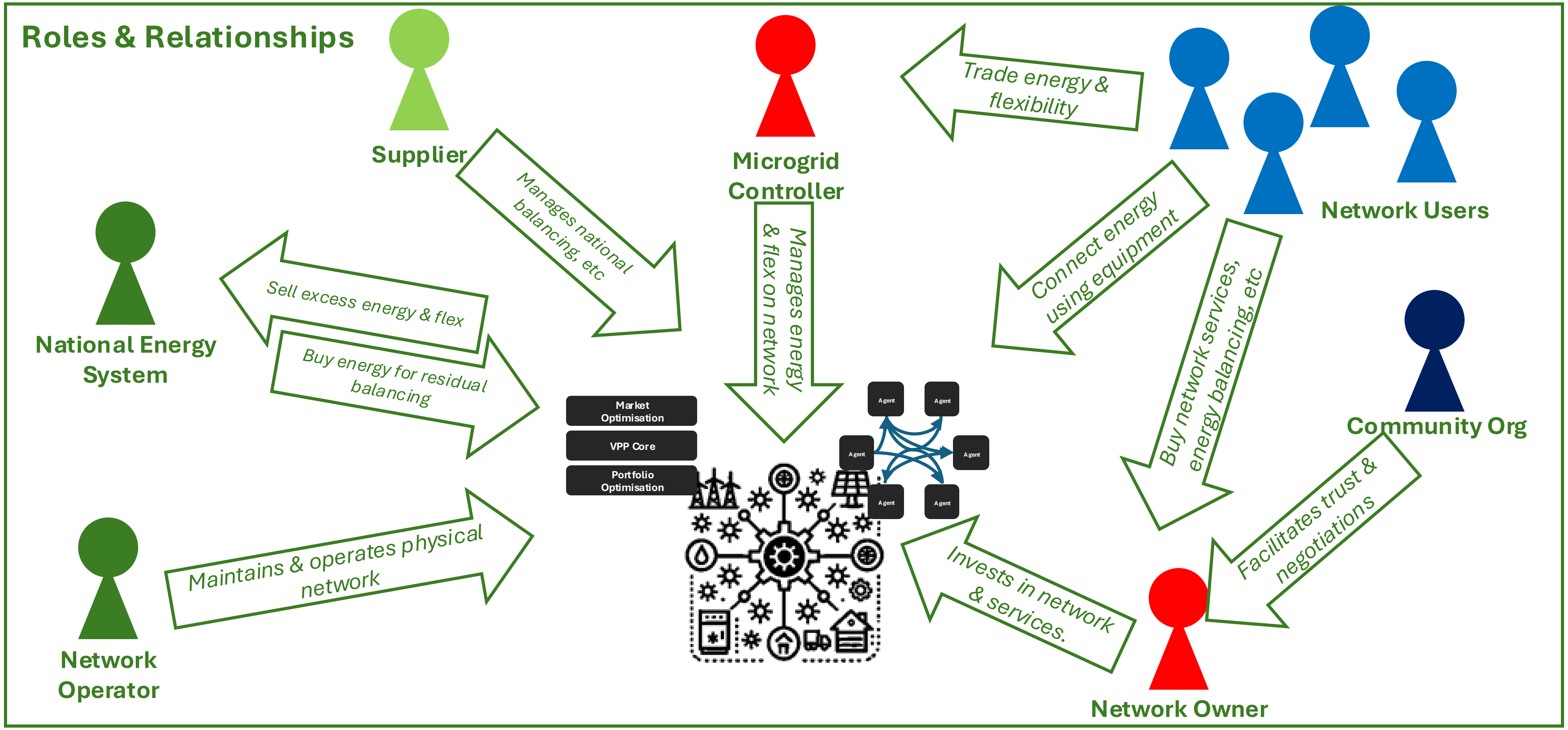
Tools & Systems

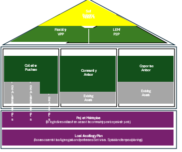
- Core platform to handle trading reliably at scale
- Backoffice systems to capture and settle trades, manage CRM, etc. These need to interoperate with supplier systems if trades are to be integrated with people's bills, and to support management of residual balancing with wider energy system.



B.8 Self Balancing Network

A virtual balancing system optimises generation and demand within a network segment (e.g. microgrid) to balance locally as far as possible. The system manages both flexibility (as with VPP) and energy (as with LEM/P2P) by coordinating equipment to maintain balance within the network. A key focus may be to avoid network constraints on sharing energy with the wider grid. This may also enable commercial models such as Energy- or Heat-as-a-Service, allowing the system to flex equipment without disadvantaging its owners. People benefit from cost savings due to this flex, plus convenience, reduced pricing risk, etc. Service charges may also cover financing for the equipment.





B.8 Self-Balancing Network

GrahamOakes
Community & Municipal Energy

Description

A virtual balancing system optimises generation and demand within a network segment (e.g. microgrid) to balance locally as far as possible. The system manages both flexibility (as with VPP) and energy (as with LEM/P2P) by coordinating equipment to maintain balance within the network. A key focus may be to avoid network constraints on sharing energy with the wider grid. This may also enable commercial models such as Energy- or Heat-as-a-Service, allowing the system to flex equipment without disadvantaging its owners. People benefit from cost savings due to this flex, plus convenience, reduced pricing risk, etc. Service charges may also cover financing for the equipment.

Anchors

This model is anchored around a **network segment**, e.g. a microgrid on a business park or housing development, a set of feeders behind a substation, etc. It essentially combines VPP & LEM/P2P to manage both energy and flex within the segment so as to balance locally as much as possible, minimising reliance on the wider grid. The goal may not be to balance at all times, but rather to balance sufficiently to avoid peak energy prices, network constraints, etc. Balancing might be made easier by having a controllable anchor load or generation, reducing the need to integrate with large numbers of smaller assets. A key element is having a microgrid controller capable of monitoring the network and dispatching assets to maintain this balance.

Scale

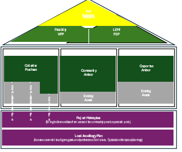
Probably best for a private-wire microgrid (campus, housing estate, business park). That could range from tens of homes to a large airport. Larger networks give more liquidity, but useful balancing can probably be achieved even at the low end. So the key parameter is probably the social unit (community, landlord, etc) rather than the number of properties.

A larger unit could be built by managing across the public network, but that creates regulatory complexity and requires DNO / iDNO involvement. A federation or fractal hierarchy of networks is also feasible.

May trade off scale with depth of control: this model may limit its scale c.f. a VPP or LEM due to its deeper level of control.

Maturity & Examples

Self-balancing is well established on islanded systems (e.g. Scottish isles). It's less common on networks connected to the wider grid as it's easier to manage balance with the greater liquidity of the national system, and the regulatory and market models are built around such national balancing. However, growing penetration of distributed generation has made a degree of self-balancing attractive on campuses, business parks, etc. Growth in connection queues also makes self-balancing more attractive, as it reduces need for a network connection. Projects such as Community DSO are exploring application of the model to wider communities. The Local Energy Market Alliance advocates this style of model also.



B.8 Self-Balancing Network

Governance

On a private wire network, decisions will be driven by the network owner (facility operator, landlord, etc). That could be a community, e.g. on community-led housing development, but it's more likely to be a corporate entity.

On the public network, the operator of the microgrid controller will exert most control. For an iDNO network, that could be the iDNO or it could be the entity (probably commercial) that has commissioned them to build and operate it. For a public, DNO-owned network, this will probably be a separate entity due to restrictions on the type of assets that a DNO can operate. However, the microgrid controller will need to work closely with the DNO. This controller could be a commercial or community body, or an SPV combining the two.

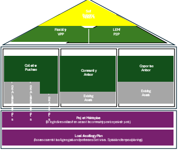
Within the network, trading of energy and flex could be centrally-driven (LEM) or distributed (P2P), with the associated governance. However, there is likely to be an overlay of central decision-making for the controller to dispatch assets to maintain balance. This is especially true if the goal is to be as independent as possible of the wider grid. This all requires suitable contracts to be in place between the controller and other parties on the network.

If the network is connected to the wider grid and using it to support balancing when necessary, then it will also be subject to its codes, standards and regulations.

Stakeholders & Skills

The key stakeholder is the microgrid controller. They need the skills (internal or subcontracted) to build and operate the network and associated control systems and markets. This combines many of the skills of the VPP and LEM/P2P models, although some elements (e.g. VPP flex market optimisation) will only be required if the microgrid is trading any excess energy and flexibility with the wider system. (That's certainly feasible, and may well be required to make operating the microgrid commercially viable.)

The controller probably needs to work with a supplier to manage the balance with the wider system. This is similar to the LEM/P2P model, with the controller acting on behalf of all parties on the microgrid to manage this residual balancing. The regulations around this need to be managed carefully, e.g. with the controller acting as a license-exempt supplier to the other parties. It is conceivable that models will emerge around P415 or similar that allow these other parties to contract with alternative suppliers.



B.8 Self-Balancing Network

Technology & Systems

The network needs a balance of generation & demand – if there is a large mismatch, then the degree of balancing that can be achieved is small. (If generation dominates, excess can be exported to the grid. If demand dominates, you can import, but it's questionable to call this self-balancing.) Having storage available on the network will make it a lot easier to balance.

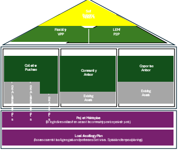
You also need a reasonable degree of flexibility spread across the generation, demand and storage. And some of this flexibility must be dispatchable by the controller, which requires technical and commercial interoperability. (Choice of equipment on the network may be driven by this need for interoperability – if the network owner is also landlord for the buildings on the network, then they can choose equipment that integrates cleanly with the network controller. This could simplify integration considerably.)

The core technology is the microgrid control system (or equivalent network control system). As noted earlier, this entails elements of VPP (to manage flex from assets on the network) and LEM / P2P market (to trade energy between parties on the network). That could all be built into a single controller, giving a large degree of centralised control, or a central microgrid controller could operate alongside a LEM or P2P market, managing any residual balancing issues once the market has achieved as much balance as possible via its trading activities.

Service Delivery

The network / microgrid controller is the core entity, providing most of the services outlined in the VPP and LEM/P2P models in order to achieve balance within the network. (Some aspects of these models may be de-emphasised – a VPP's flex market optimisation is only needed if selling excess flex to wider flex markets, for example, and billing may be simplified c.f. P2P models if the controller is selling energy- or heat-as-a-service to the parties on the network.)

If the network is private wire, then the controller will also manage (internally or via subcontract) build, maintenance and operation of the physical network. If it is operating over a public (DNO) or iDNO network, then this will be handled by the network owner / operator. Suitable service level agreements then need to be in place between the DNO / iDNO and the controller, either explicitly or implicitly via the relevant grid codes. (The extent to which standard codes will apply versus bespoke agreements being needed probably depends on the degree of self-balancing. If the network is aiming to avoid network constraints by achieving a high degree of self balance, then it may need to work closely with the DNO to show that it is compliant with relevant standards, codes, etc – this is still pretty much in the realm of innovation rather than business as usual, except for large, well-defined facilities such as airports and other industrial facilities, which are often managed by the non-regulated arms of the DNOs or similar bodies.)



B.8 Self-Balancing Network

Finance & Benefits Distribution

If a private wire network, it's likely to be financed as part of construction of the estate, campus or business park, i.e. from capital investment by the property owner/developer. Public network will be financed by DNO, with costs recovered via network charges. iDNO network could be either.

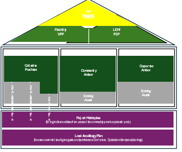
Microgrid control system is probably built & operated by specialist tech developer and licensed to the microgrid operator (e.g. estate owner, SPV set up to run the microgrid). Costs to run the network, balance it, etc, are born by this operator and recovered via charges to network users. These may be conventional fixed service plus variable energy costs, or they may be fixed energy-as-a-service fees. The control the microgrid operator has over flex gives them leverage to manage underlying costs and risks, so this could be an attractive model for both operator and network users, but it's still an emerging model. There is also scope to combine this with rent, equipment finance, etc, to create service bundles for the users.

Users benefit from some mix of convenience, reduced costs, greater cost certainty, higher service levels, etc. The extent to which benefits are shared between the operator and users is down to the contracts they negotiate. Involving a community group in governance and operation of the microgrid may improve the share available to network users. It can also allow greater emphasis on social benefits (e.g. reduced charges to fuel poor).

Regulatory and Markets

As the network is managing energy balance, it needs to engage with similar issues as the LEM/P2P model. So either it needs to involve a supplier, or it needs to operate under exemptions for licence-exempt supply or complex sites or similar. The scale of a typical microgrid probably means the latter is feasible.

The network also needs to engage with issues of network ownership and licensing, i.e. for DNOs and iDNOs. Private wire networks may avoid many of the complexities of such licensing, and so avoid some of the obligations they entail (e.g. for consumer protection, vulnerable consumers, etc), but this means that suitable protections need to be built into service agreements between network users and the operator. Again, there is potentially a valuable role for a community organisation to work on behalf of the collective group of users in this regard.



B.8 When to Consider Self-Balancing Network

When to consider doing this

- You have an islanded network, e.g. remote community not connected to the grid
- You have a well-defined network segment, e.g. private wire microgrid on an estate or communal development, and the owner is willing to explore this model, e.g. to work around constraints and curtailments due to connection queues, or to sell energy- or heat-as-a-service.
- You have a community that would like to build independence and resilience and the local DNO is willing to explore this model (probably as an innovation project).
- There is a sufficient mix of generation (PV, wind, hydro), demand (EVs, heat pumps) and storage on the network to enable a reasonable degree of self-balancing. (And people are pragmatic about the degree of self-balance they are aiming for. 100% self balancing is feasible but is likely to be expensive.)
- You have access to advice on the regulatory issues of complex sites, exempt supply, etc. And all parties are prepared to accept the consequences of operating under these models (e.g. in who is responsible for dealing with network outages)

When to avoid it

- Your community isn't associated with a reasonably clearly defined network segment
- There isn't sufficient generation or storage on the segment to be able to provide a reasonable level of self-balancing
- You don't have, and can't easily access, expertise needed to set up the model. A range of expertise is required – to understand regulatory and market issues, to build and operate the physical network, to build and operate the microgrid control systems and integrate them with equipment on the network.
- a
- People aren't willing to accept the consequences of operating under these models, e.g. in the level of reliance they are placing on the microgrid controller to maintain and operate the network, deal with outages, etc.
- You don't have a clear point of ownership & governance for the network. You will need clear ownership (by a single party, or a set of parties with clear agreement of responsibilities) of balancing, network maintenance and operations, etc.

What scale do you need to make it viable?

Trades off scale with depth of control – requires deeper control of assets than VPP or LEM, so may work best for a smaller, well-defined network on an estate, etc. If generation & demand is distributed, then may need several hundred homes to achieve a decent level of balance. If there is anchor generation or storage, might work with a smaller network (e.g. Owen Square in Bristol has about 100 homes).

B.8 Delivery Checklist for Self-Balancing Network

Roles & Responsibilities

1) **Network Owner**: Invests in and owns the physical network. (DNO, iDNO, or property developer with private wire network)
2) **Network Operator**: Operates and maintains the physical network.
3) **Microgrid Controller**: Operates system to coordinate assets to balance the network (this probably combines VPP and LEM/P2P trading). Sells residual flex to energy system (direct or via a partner market optimiser). Manages residual balance between n etwork and wider energy system (via a **supplier** or with own supply licence / licence exemptions.) Charges network users for services.
4) **Network User**: Use equipment (generation, demand, storage) connected to the network. Pay for network services (possibly EaaS).
5) **Community Group**: Represents network users in collective negotiations with Microgrid Controller.

Activities

- Define scope of the network – what network segments & sub-stations; which properties are connected to it; etc.
- Assess amount of generation, demand, storage on or planned for the network. Hence model degree to which self-balancing is feasible. Develop business model and case for self-balancing. Develop plans to integrate additional kit if needed for balancing.
- Define & set up governance structures if there is to be any degree of community involvement in governance. (If not, define what consumer protections will be in place. NB this may be determined by existing agreements, e.g. tenancies.)
- Set up network management platform (NMP). As for VPP & LEM, this entails selection, negotiation, tech set up, etc.
- Integrate equipment from households/businesses with NMP, and sign appropriate commercial terms. Make arrangements for people opting out of the self-balancing scheme.
- Set up settlement, billing and other backoffice systems & processes (e.g. CRM and customer support), either by the microgrid controller or via partner supplier or other parties.

Knowledge & Intellectual Property

- Needs good knowledge of network operations, equipment capabilities & interoperability, regulations for energy supply / applicable exemptions, energy & flex markets
- Needs network management platform. That's likely to be proprietary, so will need to be licensed.

Data

- Historical data on generation, demand, etc, to help establish business case, manage risk on EaaS models, tune forecasting & balancing algorithms, etc. External market data to support trading on national wholesale and flex markets.
- Ongoing data management for billing and to refine algorithms

Tools & Systems

- Network management platform
- Backoffice systems for settlement, billing, CRM, etc
- Analytics platforms to refine algorithms, trading strategies, etc
- User apps to monitor usage, control EaaS/HaaS settings, etc

Appendix C

Technical and Financial Notes

C.1 Local Area Energy Plan
C.2 Project Marketplace
C.3 Collective Purchasing
C.4 Community Anchor Asset
C.5 Corporate Anchor Asset
C.6 Flexibility VPP (Virtual Power Plant)
C.7 Local Energy Market / Peer-to-Peer Community
C.8 Self Balancing Network

C.1 Local Area Energy Planning

Technology & Systems

Administering the Scheme

- Basic tools to plan and schedule meetings and events, record the results from these sessions and integrate the findings into a final plan and report.

Service Delivery

- A lot of data can be obtained from public sources such as the DSOs' open data portals. This may need to be integrated with analysis tools (although a spreadsheet is probably enough for many purposes) and GIS systems (which may be available through the local authority, e.g. the LAEP+ tool).
- Advanced analysis may require modelling tools specific to the energy system or assets you are considering (e.g. to analyse solar PV outputs). These can probably be provided by equipment manufacturers or similar parties.

On-site / In-home

- N/A

Finance

Costs

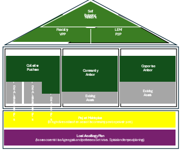
- Greater Manchester's LAEPs, done via the GM LEM project, cost about £50-100k per local authority. They were early adopters so costs were high, but they also benefited from economies of scale in doing multiple LAEPs at the same time. A lot of the cost was in collecting, cleaning and modelling data – even where data was openly available, there were considerable differences of opinion as to how trustworthy it was and how to interpret it.
- Eynsham's hyperlocal LAEP was much less technocratic, so did not incur those data & modelling costs. The bulk of the cost was in working with community groups and holding public meetings, much of which was undertaken on a pro bono basis. So budget for communications & facilitation costs proportionate to the size of the community, plus expert input on energy system opportunities. Then allow time to develop the findings into a well-structured plan / report.
- If you have specific assets in mind, then you may need budget for initial technical / feasibility studies (as for a community anchor asset). Equipment manufacturers may provide some of this free of charge, but it can be worthwhile paying for independent advice. There may also be grant funding available for this sort of study.

Revenues

- There's unlikely to be any direct revenue resulting from a LAEP. It's a foundation for other work.

Additional Benefits

- Buy in: A well-facilitated process will help build buy-in across the community, which is both essential to implementing future SLES plans and to valuable to building community cohesion and resilience.
- Influence: Being able to demonstrate that you've built a solid plan with community buy-in will strengthen your influence with DSO, RESP, etc, and so increase the likelihood that wider plans will align with the local plan.
- Focus: Surfacing and negotiating options and trade-offs will let you reduce uncertainty and divergences at an early stage, letting you focus on delivering the most important outputs and benefits down the line.



C.2 Project Marketplace

Technology & Systems

Administering the Scheme

- Operators of large innovation portfolios may use bespoke systems to track and manage their grants / projects, but smaller portfolios can probably be managed with ad hoc tools like spreadsheets. It's worth thinking this through in advance, to identify just what stages your projects will go through and what budget categories you want to manage – you can then design a clean, usable spreadsheet to track status and progress. (It's not uncommon to start off with something ad hoc and find that it gets unusable as time goes on.)
- Crowdfunding platforms are a specialist domain, due to the regulatory requirements and consequent need to manage compliance, maintain records, etc. If you are considering this, it's worth looking at one of the public platforms.

Service Delivery

- You will need to monitor and track project status and funding. As above, a lot can be done with spreadsheets, provided you keep them in sync with your accounting systems. It might also be possible to build appropriate tracking into the project management capabilities of many accounts packages (and their associated plug-ins), but that's a more specialist activity and probably only necessary to large portfolios that are disbursing significant funding.

On-site / In-home

- Not relevant to the marketplace (although it may be relevant to individual projects).

Finance

Costs

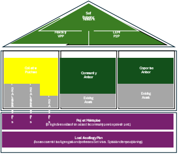
- Project funds: The main cost will probably be the funds that the marketplace's sponsors want to put into projects.
- Evaluation: Reviewing and assessing applications, recording & disseminating results and feedback. Consider the time and skills needed – large applications may need several days of effort across multiple reviewers.
- Monitoring: Tracking project status and use of funds. Dealing with change. This could be as much as 5-10% of project budget,
- Acceleration: Providing added support to project teams. This is optional. For portfolios like NZIP, it can amount to £30k per project.

Revenues

- The marketplace itself is unlikely to generate any revenue. The projects it supports may do so, and there might be scope to capture a portion of these to sustain the marketplace. That would require a separate business model.
- Again, crowdfunding is a different matter – the marketplace / platform is likely to charge fees to projects (e.g. as a % of funds raised – 3-5% seems to be typical) and/or funders in order to cover its costs and generate a return to its investors.

Additional Benefits

- Projects set up to further the aims of sponsor – these may be environmental or social as well as economic.
- Building buy-in within the community by surfacing ideas that they can take ownership of and that align to their needs / desires / interests.
- Generating creative ideas by opening access to diverse perspectives.



C.3 Collective Purchasing

Technology & Systems

Administering the Scheme

- Systems to manage marketing and recruitment of households. Probably well suited to a cloud CRM platform, for example. These could also extend to managing ongoing communication and support with participants, track progress of installations, etc.
- Procurement platform

Service Delivery

- May need specialist tools to specify or configure equipment, survey homes, etc. E.g. to configure solar PV to roof size and orientation.
- Otherwise it will largely be down to equipment manufacturers and / or installers to provide any systems they need to manage their process.

On-site / In-home

- Best suited to standardised equipment where a single specification can be applied to a large number of purchases and where installation is relatively straightforward. Costs to specify equipment, survey homes, etc, will go up with more complex, bespoke or otherwise non-standard equipment.

Finance

Costs

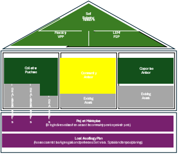
- Marketing costs to attract and recruit households to participate. These could be small in a well-defined, close-knit community or amount to tens or hundreds of pounds per participant for a scheme reaching more widely.
- Specialist support to specify equipment and services. May be minimal for simple, standard equipment or require more time and expertise for equipment that is more innovative or complex or has significant integration aspects.
- Surveying homes and other sites, if needed to configure equipment or provide quotes for installation, etc. (May be chargeable to the homeowner, or recovered as part of the subsequent cost of equipment and installation.)
- Running procurements for equipment, installers, financing
- Administering introductions between homes, installers, equipment manufacturers, etc, and tracking and quality assuring the installation and commissioning process
- Providing support to households along the journey

Revenues

- Participants in Solar Together are reported to gain discounts of 10-25% on the equipment they purchase.
- Organiser has scope to include a charge into the cost of equipment and installation to cover their costs. They also have scope to sell additional services for project management and suchlike if some households need them.

Additional Benefits

- Wider adoption of LCTs
- Household confidence and trust in equipment and installer
- Access to trusted finance at decent rates
- Standard equipment specs, making it easier to integrate into subsequent building blocks (VPP, LEM, etc)



C.4 Community Anchor Asset

Technology & Systems

Administering the Scheme

- Community administration: Systems to track membership, manage communications, distribute dividends/interest, etc. These could be fairly ad hoc for a small community, but it might be worth looking for a specialist member admin system for a larger community. The group will also need all the facilities needed to manage a small company, e.g. for financial accounts and reporting.

Service Delivery

- Asset: The core technology will, of course, be the asset itself
- Asset monitoring & metering: Systems to monitor the asset's operations and state of health, collect asset metering data, etc. These are likely to be provided by the manufacturer, but in some cases it may be worth supplementing this with specialist monitoring and maintenance applications. This may be worth considering during the initial feasibility and design stages.
- Asset management: Systems to control and manage the asset. Again likely to be provided by the manufacturer, but may be supplemented.
- Settlement metering: Meters for settlement and billing may be separate to the asset's metering. This data will be collected by suppliers / offtakers, but it may be worth capturing it independently to check billing accuracy, etc.
- Integration to smart systems building blocks: If the asset is being used to anchor or otherwise support one of the smart systems building blocks, then systems to integrate it to the VPP, trading platform, etc, may be needed. This maybe built into the asset's standard software and APIs, or it may require additional software and/or hardware.

On-site / In-home

- N/A

Finance

Costs

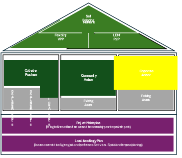
- Administering members/investors in the asset. Could be ~£12/member p.a. to cover communications, distributing dividends/interest, annual meeting, etc. Will also be initial legal and administrative costs to set up the scheme (£5-20k).
- Feasibility studies, site surveys, equipment design. Could be £5-50k (ChatGPT).
- Capital costs of equipment. E.g. ChatGPT gives costs of:
  - Solar PV: £700-1,200 per kW
  - Wind turbine: £1,200-2,000 per kW
  - Hydro: £2,500-5,000 per kW
  - Battery: £400-700 per kWh
- Land and connection costs: Site dependent. May not be needed if adding PV to roof of an existing site. Could be £10k-100k+ to connect a remote site.
- Financing costs. If via community shareholders, then probably covered by above admin costs. If a separate loan or other finance, then these are extra.
- Ongoing insurance and maintenance of equipment. This is dependent on the type of equipment, site, etc, but typically ~1-5% of the capital cost.

Revenues

- Sale of energy from asset: Dependent on the PPA you negotiate, which in turn depends on type of asset, site, etc. Average wholesale energy price over last 7 years has been ~8p/kWh, so that's a reasonable baseline. Adding a battery may let you sell at peak times for a better price, but also adds costs. Connecting to a LEM/P2P may also enable a slightly better price. If the asset is on a site with significant load (e.g. school) it might save 20-30p/kWh against existing tariffs.
- Sale of flexibility from asset. Relevant to some assets (e.g. batteries, CHP, anaerobic digesters). See notes in Flex VPP building block.

Additional Benefits

- Ownership and engagement in the energy system
- If connected to a LEM / P2P / Energy Local scheme, can help people reduce their energy costs. Scope to offer additional discounts to vulnerable or fuel poor
- Community cohesion and resilience built through working together and common ownership



C.5 Corporate Anchor Asset

Technology & Systems

Administering the Scheme

- Most administration, user support, etc, will probably be managed through the corporate's systems. (If it's being set up from scratch to manage the asset, e.g. a bespoke company to service a new development or an SPV building a large asset, then it will need all the relevant corporate admin, CRM, etc, systems.)
- If a community group is set up to act on the community's behalf for negotiations, communications, oversight, etc, then it will need administrative systems similar to those outlined for the community anchor asset.

Service Delivery

- The asset will need monitoring, management, data collection, integration, etc, as for the community anchor asset.

On-site / In-home

- May not be relevant for many assets. However, services like Heat-as-a-Service may require tight integration with appliances in the home. This will need to be thought through in the initial feasibility and design stages, and appropriate agreements set up with households.

Finance

Costs

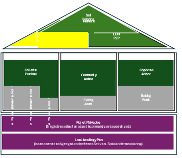
- Costs to build and operate the asset (feasibility, capital, connection, financing, insurance, maintenance) are fundamentally the same as for a community asset, but the corporation (company, public body, SPV or whatever) may be able to bring expertise and resources to bear that reduce them (through economies of scale, access to finance, use of internal expertise) c.f. what a community would pay.
- If setting up a community group to interface with the corporate on behalf of the community, then there will also be costs to establish and operate that group. This could be relatively informal and ad hoc, or there may be similar costs to create and administer a formal group, as with the community asset.

Revenues

- Could use similar models to the community asset (i.e. sale of energy or flex), but it's also possible that the corporate will bundle outputs from the asset into higher value services, exploiting synergies with other corporate resources and expertise. This is likely to be largely within the corporate's control, subject to any transparency and oversight agreed with the community.

Additional Benefits

- Corporate resources and scale may enable additional services beyond what a community could support, e.g. for district heating & heat-as-a-service.
- Additional benefits may be delivered through corporate ESG initiatives linked to the asset and its operation, e.g. to meet further social or environmental goals, support community projects, etc.



C.6 Flexibility VPP

Technology & Systems

Administering the Scheme

- Aggregators will handle user support, asset integration, distributing flex revenues, etc. So most administration can be outsourced to them. The key administrative systems are then the procurement systems though which an aggregator might be procured (if not a partner from the outset).
- If you want to distribute benefits in a bespoke way, or to build collective negotiating power with the aggregator, then setting up a community org (e.g. co-op or CIC) to act on behalf of the collective users might be useful. This will need systems for member admin, record keeping, accounting, member communications, etc, as appropriate to any small business.

Service Delivery

- Market access and optimisation: Connects to DSO & NESO market platforms (e.g. Piclo, Electron, NESO auction & dispatch platforms). Defines and makes bids to markets. Handles settlement. Flexitricity is generally open to doing this for domestic portfolios. Other aggregators might also be interested. Specialist optimisers like Habitat, Arenko, EDF tend to focus on larger assets. Innovative suppliers like Octopus & Ovo/Kaluza will also do it.
- VPP core: Monitor and manage portfolios of small assets. Several players have emerged to specialise in this, e.g. equiwatt, Levelise, emerging players that are specialising in IoT for home energy mgt. Innovative suppliers will also do it.
- Asset integration: Collect data from smart appliances and send control signals to them. This is very dependent on equipment APIs, which are controlled by the OEMs. It may also be mediated through cloud platforms operated by the OEMs.
- Metering: Collect meter data for settlement. Requires integration to DCC (Data Communications Company) and user consent.

On-site / In-home

- Can operate behavioural response without in-home systems beyond a mobile phone. However, revenues will be low. To increase revenue, you need to integrate with larger, smarter assets in the home – EV chargepoints, batteries, heat pumps, etc. All of these have different APIs and operating characteristics.

Finance

Costs

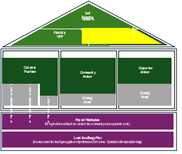
- Optimisers have different business models, but typically take between 10% (for large portfolios, e.g. >10MW) and 33% (for small portfolios, e.g. 1MW) of flex revenues. Most optimisers aren't interested at less than 1MW, so you'll also need a separate aggregator for most domestic and small business portfolios. Expect them to take another 10%.
- Doing it yourself needs a substantial team. You need tech expertise to integrate assets & maintain a VPP platform, data scientists to optimise across markets, and a regulatory team to manage constant market & policy change. That's why community orgs like Carbon Co-op, Low Carbon Hub have made little headway.

Revenues

- Grid scale batteries currently earn ~£80/kW p.a. That gives a view of the maximum a smaller asset could earn. Assets that are only plugged in part-time (e.g. EVs), are used for other purposes (e.g. batteries to timeshift PV) or which can't export (e.g. heat pumps, hot water tanks) will earn a lot less. £40/kW p.a. would be good; £20 might be more realistic.
- Earning this amount needs access to and optimisation across all markets – NESO & DSO services, BM, wholesale trading (via P415). That needs an aggregator and an optimiser who know their stuff.
- A home without any specific asset has perhaps 0.3kW of flex (from DFS data). That can rise to 5+kW with a battery or V2G-enabled EV. So that gives revenue of between £6-100 p.a. depending on what's in the home.

Additional Benefits

- Flex revenues can be an important supplement to other benefits from LCTs. They may be small, but they could make the difference that makes investing in an asset worthwhile.
- Flex also has an important user-engagement benefit. It enables people to be active participants in the energy system, not just passive recipients. Some people value this very highly.



C.7 Local Energy Market / Peer-to-peer Community

Technology & Systems

Administering the Scheme

- Probably very similar to Flex VPP

Service Delivery

- Trading platform: The core is a platform that can match people's offers & bids to buy and sell energy respectively. These offers and bids are probably made by an agent that trades on the user's behalf, based on parameters they set via an app or website. That agent probably needs to integrate with meters on their equipment to track supply and demand and hence determine what energy they need / can offer to the market.
- Settlement: Many of the complexities of LEM / P2P are in balancing and settlement, as few people will be able to meet their needs entirely from the local market so they need to integrate with the wider system via a supplier. That means the market platform needs to integrate with the supplier's settlement and billing systems. (Ideally it would integrate with multiple suppliers' settlement add billing systems so that people could have a choice of supplier. But the regulatory structure currently means that most local marketplaces require everyone to switch to a single supplier. P415 may change this.)

On-site / In-home

- As above, trading agents probably need to integrate with the home's generation and either key appliances or with the home's smart meter.
- Settlement needs to integrate with (or at least be able to access data from) the home's energy meter. This will need to be a smart meter.

Finance

Costs

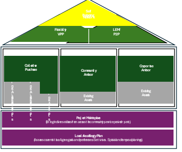
- Although a LEM/P2P platform may not need the depth of market analytics and asset integration of a Flex VPP, it will need to be able to match trades at scale, to integrate with meter data, and to settle (via supplier systems) reliably. This all needs a substantial technical team to build, maintain & operate. Open source code may reduce some of the build & maintenance costs, but this is still a specialist area. It's probably best to partner with a platform that can spread costs over multiple markets. The main cost will then be fees to this partner. (Platforms tend to charge a mix of fixed monthly fee plus per-trade fees. The latter may be fixed, typically a few pence, or a % of the trade value, e.g. 1-5%.)
- There will also be costs to operate billing and customer support processes.

Revenues

- Over the last 7 years, the average cost of energy on wholesale markets has been about £0.08/kWh. The balance of what people pay is in network charges, policy costs, etc. LEM / P2P schemes may exploit regulatory loopholes to avoid some of these costs, but that's unlikely to be sustainable in the long term.
- So the scope for LEM / P2P to create value beyond what people can get from a SEG tariff is limited. The best opportunity is probably to match producers to consumers who value the provenance of their energy – buying from people they know, in their local community. They may be prepared to pay a premium for this. E.g. early adopters of green electricity tariffs were prepared to pay a couple of pence per kWh. They same may be true for local, community energy.
- So revenue models probably need to be built around this ~2p/kWh.

Additional Benefits

- Similar to Flex VPP, revenues from LEM / P2P trading may be an important supplement to other benefits from LCTs like solar PV, creating enough value to make an otherwise marginal investment viable.
- Likewise, there's an important user-engagement benefit. LEM / P2P trading enables people to be active participants in the energy system, not just passive recipients. Some people value this very highly.
- Potential to sell at reduced price to certain groups, e.g. vulnerable or fuel poor.



C.8 Self-Balancing Network

Technology & Systems

Administering the Scheme
- Similar to Flex VPP and LEM / P2P

Service Delivery
- Network controller: As noted elsewhere, this needs to combine aspects of Flex VPP and LEM / P2P. It may operate at lower sale than a national VPP or regional LEM / P2P scheme, but that is likely to be offset by the need to coordinate assets in order to balance the network in real time, requiring tight, real time integration with key assets. Alternatively, the requirement to balance in real time could be relaxed, but that might mean forgoing some of the benefits of avoiding peak network charges.
- Settlement: As with LEM / P2P, the network operator will probably be charging for their services via people's energy (or energy as a service) bills, so it will need appropriate billing systems. This may be simplified c.f. LEM / P2P if the operator uses regulatory derogations (e.g. for complex site and unlicensed supply) to act as the supplier for the houses / sites on the network – the need to integrate with supplier systems and national balancing will be much reduced. (But note that people also lose some of the regulatory protections that licensed suppliers provide.)

On-site / In-home
- Device integration: As above, key equipment on the network (major loads, generation and storage) will need to be integrated with the network controller if it is to maintain rigorous balance.
- Meter integration: The operator's platform will need to integrate with home's / site's meter or data collection agency to manage settlement and billing.

Finance

Costs
- As for Flex VPP and LEM / P2P, the main cost will be in maintaining and supporting the network control platform and operating the associated billing, customer support and related processes.

Revenues
- Energy revenues are likely to be as for LEM / P2P – local trading may make it possible to access a premium or perhaps 2p/kWh for energy of known, local provenance.
- The network may also be able to sell flexibility to the wider system, as per Flex VPP.
- In addition, local balancing will reduce the peak capacity needed to connect to the wider network. This may reduce connection charges for a new-build network (approx. £200k/MW on average in UK, but highly dependent on location) and ongoing DUoS and TNUoS charges. Again, these are highly location dependent, but DUoS might be 10p/kWh at peak (red band) times and TNUoS might be £50/kW p.a. For a private wire community of 200 homes, that might amount to £15k p.a. of benefit, i.e. £75 per home.

Additional Benefits
- As for Flex VPP and LEM / P2P