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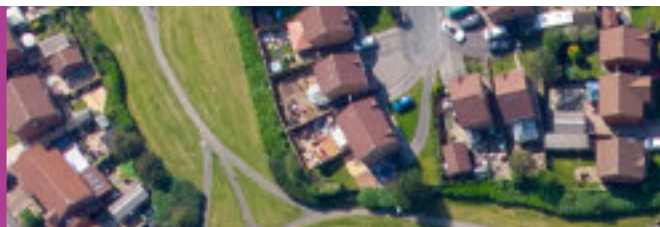
PROSPERING FROM THE ENERGY REVOLUTION

INSIGHTS SUMMARY

Smart local energy systems

Insights from UKRI-funded innovation projects

February 2023



Foreword



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Energy Revolution challenge programme
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For five years, Innovate UK and EPSRC have driven what is believed to be the largest innovation programme in Europe focused on smart local energy systems: Prospering from the Energy Revolution.

The challenge we set ourselves was to work with businesses, communities and academics on a vital issue: the benefits of intelligently joining up energy supply, storage and use at a local and regional level.

We live, work and travel in regions, cities, towns and communities. Yet our energy infrastructure remains very centralised – sending energy one way, from bulk supply points to the networks' edges where we live and work.

Our programme asked: what if we could bring together energy supply, storage and use within places, enabled by the latest technologies? Could we balance supply and demand locally or regionally, create efficiencies, add flexibility and resilience, save carbon and costs, and establish entirely new approaches to interacting with energy?

With £104m of funding from UKRI, the programme funded over 80 projects around the UK, from research, to feasibility studies, to large-scale demonstrators. More than 200 organisations have been involved, and around £170m of private and public money was invested in total..

These world-first projects have explored many different approaches to local and regional energy optimisation. Now, as the programme ends, our priority is to analyse and share what we have learnt from this unprecedented work.

The picture emerging is clear.

- There are potentially enormous gains from widespread adoption of a more place-based approach to energy, alongside national systems. PwC research that we commissioned in 2022 found that reaching carbon reduction targets this way could deliver double the socio-economic benefits, at half the cost, of a national 'one size fits all' approach.
- The UK is committed to net zero by 2050. Without the extra flexibility, resilience and local buy-in from wide rollout of smart and efficient local energy systems, it is very hard to see how our energy networks can be upgraded – whether in time or at an affordable cost – to cope with the demand from electrified heating and transport. Local approaches must be part of the answer to the practicalities of delivering our net zero transition.

- Smart local energy systems can ease costs to consumers, build local prosperity by retaining value in communities, accelerate the journey to net zero, and improve energy security as regions become more self-sufficient.
- But there are still major barriers. Some are regulatory. Some are to do with the balance of national and local policy, resources and planning. And some are about knowledge, skills, capabilities and community engagement. Last but not least, financing of complex local projects remain unproven.

There is no doubt that decentralised energy will be an inherent part of our future energy system, and this represents a huge opportunity. We have a chance to unlock the full potential of joining up these assets locally and regionally, using technology already available.

If you have an interest in the future of energy, I strongly commend the findings of this programme to you. We must all build on the work of these pioneering projects, and urgently develop plans to scale up local energy approaches, alongside national strategies..

This programme has shown that the benefits from smart local energy approaches are too large to waste. Furthermore, their roll-out represents a 'low-regrets' option that will help deliver many of the more challenging aspects of helping people to live prosperous lives in our net zero future. I believe these are opportunities to be grasped with urgency.

Contents

Introduction	4	Policy and regulation	16
Smart local energy systems	6	Policy barriers	16
What?	6	Regulatory barriers	17
Why?	7	Innovation and support	19
How?	8	Skills and capabilities	20
Who?	9	Skills for smart local energy systems	21
Finance and investment	11	Skills gaps	21
Financial value	11	Local authorities	21
Business models and opportunities	12	Training and pipeline	22
Barriers to enabling full value	13	Citizens and communities	23
Investment and funding	14	The role of citizens and communities	23
		Citizen engagement	24
		Communication	26
		Data and digitalisation	28
		Role of data and digital	29
		Innovation	29
		Availability and interoperability	30
		Skills and capabilities	30
		Legal, ethical and justice issues	30
		Key findings and next steps	31



Introduction

The energy system is changing.

As the United Kingdom embarks on its ambitious net zero journey to address the climate crisis, the energy system is becoming cleaner, smarter, more connected, more flexible and more local.

As part of this crucial transition, **smart local energy systems** open up a range of new and innovative opportunities, to help meet our national climate targets while creating serious new value for citizens, communities, businesses, policymakers and organisations across society.

A smart local energy system brings together energy supply, storage, heat, transport and buildings in a local area and connects them in a smart way using data and digital technologies.

Such systems can help local areas to meet their net zero energy ambitions in a holistic way that truly reflects the needs of local people and places, while at once diversifying our energy system to make it more secure and resilient to international shocks.

To meet the targets set out in the Climate Change Committee's Sixth Carbon Budget¹, research from PwC² also finds that a more place-based approach to net zero can bring substantial savings on energy system investment.

This is while providing social and economic value across the board.

Indeed, smart local energy systems can deliver a range of substantial benefits³⁴, including reduced energy bills, regional economic growth, improved health and fuel poverty outcomes, better connected places and new opportunities for net zero jobs and businesses as part of a more inclusive, prosperous, and just energy transition.

Smart local energy systems can play a vital and exciting role in delivering net zero energy across the UK.

The **Prospering from the Energy Revolution** programme thus set out to demonstrate the viability, impact, and future prospects of smart local energy approaches in the United Kingdom⁵.

Funded by UK Research and Innovation and delivered by Innovate UK, more than £104m has been awarded to the programme, with match-funding taking this up to over £170m in total.

This funding supported three demonstrator projects, 10 detailed design projects and a host of other initiatives to explore the feasibility of smart local energy systems, understand the opportunities they present, and demonstrate the considerable value they can offer to the UK's net zero ambitions in practice.

This report summarises the learnings from projects involved in the Prospering from the Energy Revolution programme across five key themes:

- Finance and investment
- Policy and regulation
- Skills and capabilities
- Citizens and communities
- Data and digitalisation

Based on extensive engagement with partners involved in the programme and drawing on insights from the vast range of research produced on the topic, this report unpacks the main processes, learnings, opportunities and barriers to enabling value in these areas.

Finally, it provides a set of key learnings and practical next steps for fully unlocking the value that smart local energy systems have to offer as part of the UK's net zero energy revolution.

Project locations Indicative only

Demonstrators

1. Project LEO
2. Energy Superhub Oxford (ESO)
3. ReFLEX Orkney

Detailed designs

1. Liverpool Multi-Vector Energy Exchange
2. Greater Manchester Local Energy Market
3. GIRONA
4. Zero Carbon Rugeley
5. West Midlands RESO
6. Peterborough Integrated Renewables Infrastructure (PIRI)
7. Milford Haven: Energy Kingdom
8. Project REMeDY
9. REWIRE-NW
10. GreenSCIES 2

Key technology components

1. Open protocol cloud metering for heat networks
2. Domestic Infrastructure & Network Optimisation (DINO)
3. URBAN-X
4. v-powerChain
5. Seasonal Storage
6. BankEnergi
7. Rail-Charge
8. Hypervolt
9. Port Energy Systems Optimisation (PESO)

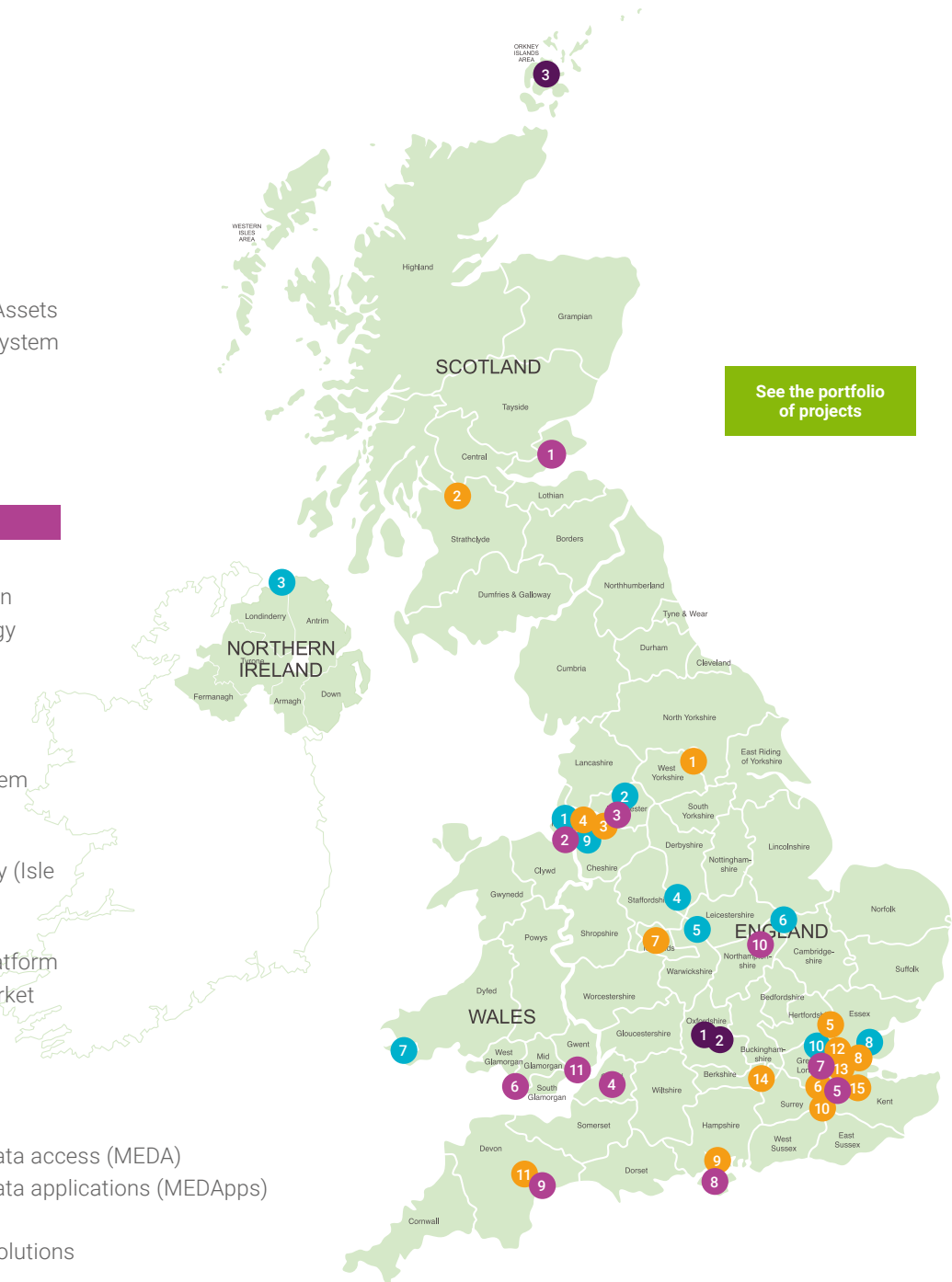
10. Maximising Grid Services from Electric Vehicles (M-GSEV)
11. Heat Networks as Flexible Grid Assets
12. EV Fleet-centred Local Energy System (EFLES)
13. SHOCENSI
14. ADVENT
15. Guru Engage

Concept designs

1. WESLID
2. E-Port Smart Energy Master Plan
3. Greater Manchester Local Energy Market
4. Bristol Energy Smart System Transformation
5. BankEnergi
6. Intelligent Bridgend energy system design
7. GreenSCIES
8. Energy Autonomous Community (Isle of Wight)
9. LEMDEX
10. DLT micro-grid management platform
11. An energy revolution for the market town of Caldicot

There are also:

- 3 projects on modernising energy data access (MEDA)
- 9 projects on modernising energy data applications (MEDApps)
- 18 earlier 'fast start' projects
- 6 projects working on open digital solutions



Smart local energy systems

Smart local energy systems: what?

A smart local energy system brings together energy supply, storage, demand and infrastructure and **connects them in a smart way, at a local level such as a town, city or region.**

This allows for a more tailored, dynamic approach to the energy transition, recognising that different places and communities have different needs and ambitions.

The different elements of an integrated local energy system can vary, depending on local needs and opportunities, building stock, network infrastructure and so on.

Usually, this will include some element of renewable generation and storage, transport and electric vehicles, and heat and energy efficiency.

These elements are then brought together physically through cables and wires and digitally through software, artificial intelligence and digital energy platforms.

With local integration, solar panels on houses and factories can help power the community's heating and transport. Battery systems can store renewably generated electricity for later use. Electric cars can return stored power to the local grid when they don't need it. Waste heat from industry can be used to heat homes and schools.

All this can be co-ordinated by smart digital systems – intelligently using all the data available, maintaining the link between the national grid and the local system, and balancing energy supply and demand across the whole community.⁶



Smart: energy supply, demand and storage assets, are connected together using software, artificial intelligence and digital energy platforms.

Local: these systems are set up within a local area, such as a town, city or region. They are managed and delivered usually by local authorities and other local organisations.

Smart local energy systems: why?

Evidence shows that smart local energy systems can offer value financially, socially and economically to policymakers, investors, consumers, society, the economy and the wider energy system⁷⁸.

Energy can be better optimised across local areas, reflecting the need of people and places and the local nature of transport, buildings and heat, while stimulating regional and national economic growth through the development of net zero businesses and industries.

This smarter approach can reduce network reinforcement and system costs, providing savings that can, in turn, be passed on to consumers. Local energy systems can also make significant contribution to the national challenge of **making our energy network infrastructure net zero ready**.

That is not to say that smart local energy systems are the only solution, but that, aligned with national approaches, they can be a powerful tool within the UK's wider net zero energy transition.

Value across the board

1. For UK Government – smart local energy systems can significantly reduce the investment needed to get our energy system net zero ready and support the uptake of electric vehicles, heat pumps and energy efficiency measures. Research from the EnergyREV consortium shows that taking a more smart and local approach to energy can save £1.7 billion in network investment and upgrades by 2040, while PwC estimates¹⁰ that up to £825 billion in wider social value can be enabled with a more place-specific approach for lower investment than a central-only strategy, supporting people with healthier homes and reducing stress on the National Health Service (for example).

2. For local authorities – smart local energy systems can help local authorities meet climate and energy targets in a way that reflects local need, benefits communities and stimulates investment¹¹. Modelling by the Coventry RESO project suggests that a smart local energy system could unlock £721 million in value through optimising electricity generation and use across the region, while evidence from the Prospering from the Energy Revolution portfolio demonstrates how local authorities can raise serious investment for ambitious local energy projects.

3. For businesses – smart local energy systems require a wide range of skills and expertise including installers, data and digital experts, engineers and project managers. They enable new business models, create jobs, and open up economic opportunities. Partners across the Prospering from the Energy Revolution portfolio have already secured over £700 million in additional investment from their participation in the programme, with clear appetite and significant further opportunities on offer.

4. For investors – smart local energy systems can be significant projects requiring substantial levels of investment and offering returns on that investment through generation, supply, storage, and services¹². The Greater Manchester Local Energy Market estimates that their business model would be cash flow positive in as little as five years, generating upwards of £1 million annually in surplus revenue by 2033. With over £58 billion investment estimated required including a large proportion expected from the private sector, the opportunity here for investors across the board is substantial.

5. For energy networks – by reducing the costs of reinforcement, networks can save money and work with local stakeholders to better tailor investment and upgrades. Networks can also benefit from efficiency and flexibility¹³. Project ReMeDY in Southend suggest that implementing their integrated local heat approach in places across the country could unlock up to £1 billion per year in savings to the energy system. Greater Manchester suggest that the embedded flexibility in their project alone could save £40 million per year to the local network – savings which can in turn be passed on to consumers.

6. For citizens and communities – with a more local focus particularly in planning and design, smart local energy systems can be tailored to local need, with services and solutions better serving local people and places¹⁴. Project Girona in Northern Ireland has already delivered savings of up to 60% on household energy bills, with others showing similar savings and a wider tackling of things like fuel poverty. PwC analysis¹⁵ estimates that tackling net zero more locally could create up to £108 billion in savings for consumers for lower investment than a one-size-fits-all approach.

Smart local energy systems: How?

While there is no single type of smart local energy system, we have found from projects in the portfolio that the practical development process and people involved are often similar.

From project engagement and research, smart local energy systems are typically developed in five key stages: **partnership building, design, finance, approval, and delivery**.

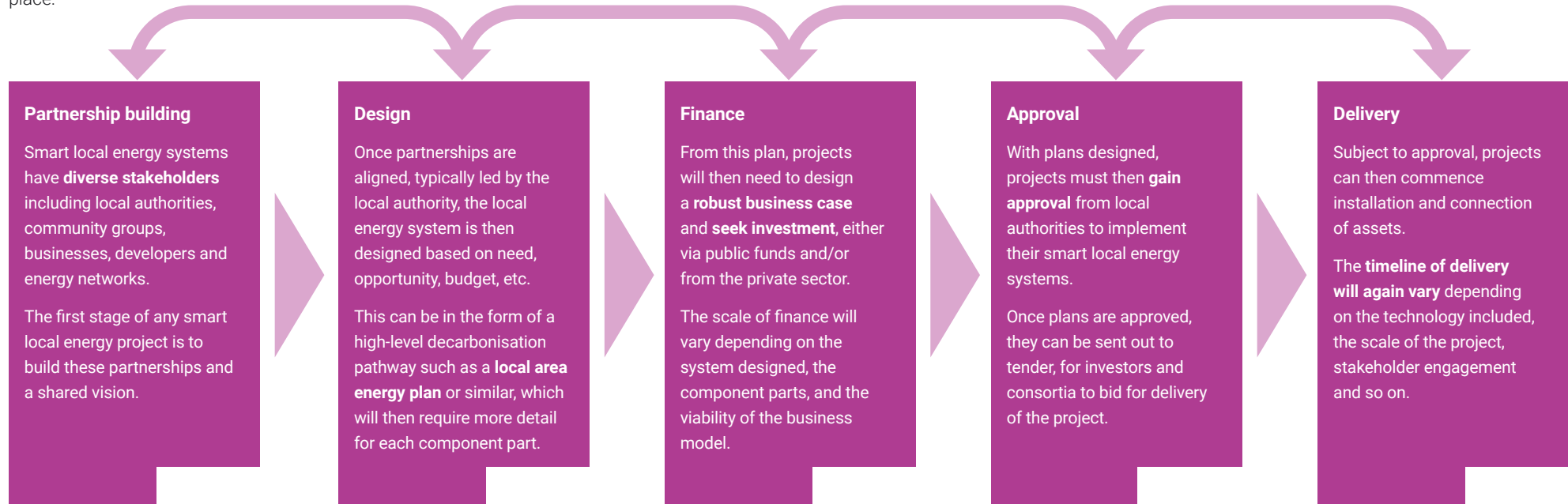
While presented as a linear process below, these stages are very much dynamic and iterative (shown in the curved arrows in the diagram below), and can vary from place to place.

Local area energy planning is a way of using local energy, housing, infrastructure, social and economic data to design plans for local energy systems and needs. Platforms such as the Energy Systems Catapult's **Net Zero Go** tool can support the development of holistic local area energy plans, and help turn these into viable investment propositions.

National support, local delivery

Smart local energy systems can provide value both locally and nationally to the UK economy, net zero goals, and the energy system. They are not an alternative to a high-level energy transition, but rather **one powerful tool for achieving our national goals**.

Enabling smart local energy systems thus requires a foundation of **national policy clarity, support and direction** from UK government and the regulator, to make clear the role of local places within the energy transition, incentivise innovation and investment, and help local stakeholders develop projects to unlock both the local and national value on offer.



Smart local energy systems: Who?

Because they include lots of different components and elements, smart local energy systems involve a number of groups and organisations.

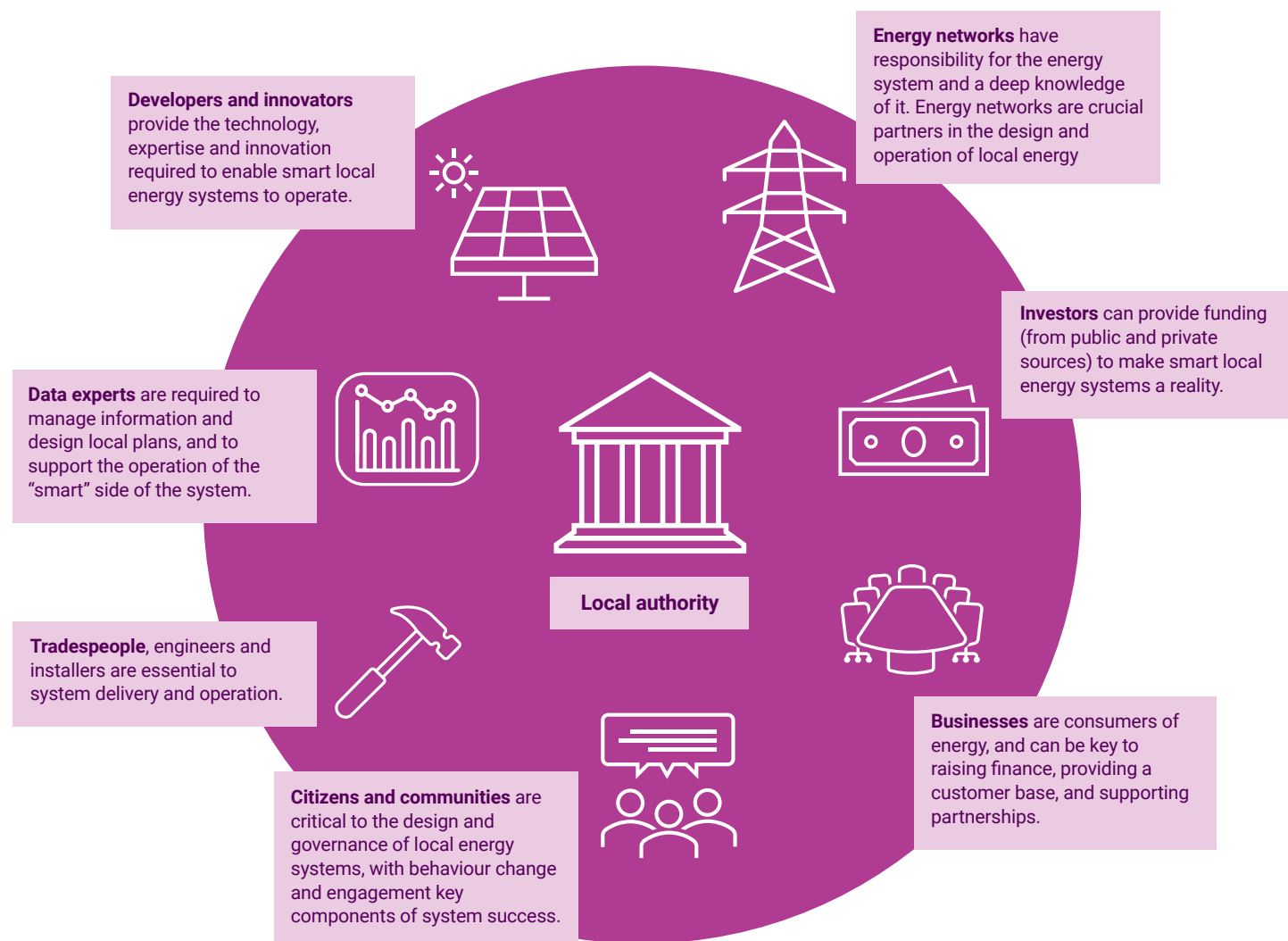
Typically, **local authorities** will be a key smart local energy system partner. Local authorities have responsibilities in spatial, housing and transport planning. They have significant estates and capabilities for raising investment.

They also have power to bring together the people and resources required, making them a natural leading stakeholder in smart local energy systems.

In addition to local authorities, there are some common key players. These include:

- Energy networks
- Developers and innovators
- Citizens and communities
- Data analysts and experts
- Businesses
- Tradespeople
- Investors (private or public)

Figure 1. Partners and roles



CASE STUDY

Project LEO

One of the three demonstrator projects from the Prospering from the Energy Revolution programme, Local Energy Oxfordshire (Project LEO) set out to show how a smart local energy system could work in the local area.

This included joining together solar panels and batteries in social housing and on local buildings such as the Rose Hill primary school and community centre, electric vehicle charging, and clean heating technologies like heat pumps – using smart technologies and digital platforms.

This system then creates value through providing the national grid with flexibility services to help balance the UK's energy needs. In turn, this can give local citizens, communities and businesses optimised local energy at an affordable price.

The project has developed several local plans, and tested technologies and flexibility services in practice as part of its 'minimum viable systems' trials.



Finance and investment

The financial and economic value on offer from smart local energy systems is substantial¹⁶.

By investing in energy at the local level, as part of a wider national strategy, such systems can deliver savings for the UK treasury, energy networks, and consumers – while generating new revenue streams.

This value is typically created through:

- Reducing network reinforcement costs
- Targeting energy solutions locally
- Maximising local generation and consumption
- Addressing fuel poverty
- Creating new business opportunities

In addition to this direct value, smart local energy systems can **create financial value more widely to society**.

This can be by improving health, housing and air quality conditions through things like energy efficiency and insulation as part of smart local energy projects, reducing stress on public and social services¹⁷.

National

Research indicates that a more localised approach to energy can save billions of pounds.

Analysis by the EnergyREV consortium shows that developing more integrated, place-based energy systems across the country could lead to savings of up to **£1.7bn per year by 2040** compared to a one-size-fits all approach.

Recent work by PwC also shows that investment in net zero at the local level would require just **£58bn in investment to unlock energy savings for consumers worth £108bn**, versus £195bn investment for £58bn in savings from a purely national approach.

Regions and places

The value of smart local energy systems has been modelled for specific towns, cities and regions.

The West Midlands **Regional Energy System Operator (RESO)**, a detailed design project in Coventry, shows that an integrated smart local energy system could be **worth £721m over 30 years**.

This would be through maximising local generation and consumption; fuel price savings as the city accelerates its move to electric vehicles; and saving money that would otherwise need to be spent on reinforcing electricity networks.

The **Peterborough Integrated Renewables Infrastructure project (PIRI)** likewise shows that for every £1 spent, the local economy would receive £2.05 back, with a total of £69.93m in economic value to local communities through bill savings, revenue generation and job creation.

Citizens and communities

Projects have shown clear value for people, families and communities.

Project Girona – a smart microgrid of 60 domestic and commercial solar and storage assets in Coleraine, Northern Ireland – delivered £12,000 in energy savings to households involved in the trial between February and October 2021. Girona's smart grid allows people to save on their bills by **maximising local generation, storage and consumption**, with users so far saving on average 40-60% on energy bills per year. The project has also saved over 40 tonnes of CO2 emissions to date.

In the **Energy Superhub Oxford (Project ESO)**, ground-source heat pumps were installed in 60 social housing homes. In those homes, a majority of tenants have reported cost savings, typically of almost 50%. **Project REMeDY** similarly estimates savings to consumers from their integrated, efficient low carbon heat offering.

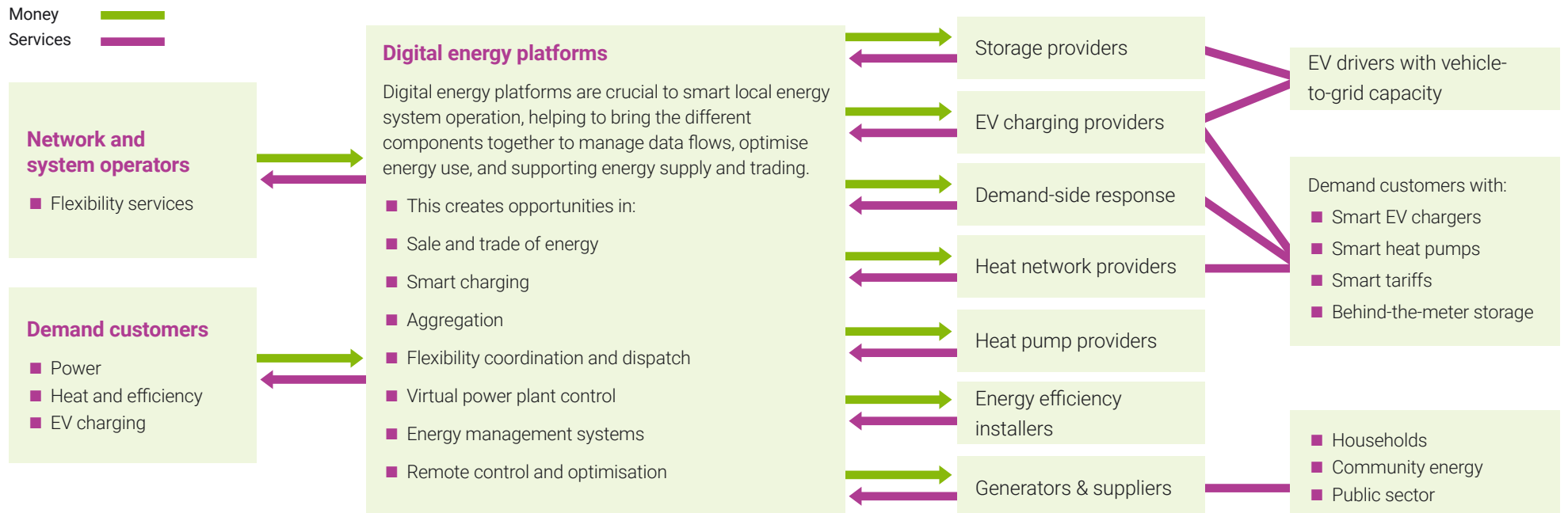
Business models and opportunities

Smart local energy systems can create new financial and economic value for a number of different groups and organisations.

They are also comprised of a number of different parts and innovations, opening up a range of new business models and opportunities¹⁸.

There is no single template for a smart local energy system business model or investment proposition. However, there are some typical potential flows of money and services as identified by projects and research¹⁹ (Figure 2).

Figure 2. Services and money flows in smart local energy systems



Opportunities

Within smart local energy systems, there are opportunities for a diverse range of businesses.

For projects including generation and storage, heat, and transport, there are major opportunities for:

- Battery and storage providers
- Data and software companies
- Clean heat and low carbon technology providers
- Electric vehicle charging providers
- Electricity generators and developers, including households with their own solar, community energy, and publicly-owned assets

Why do it together?

Individual components of smart local energy systems such as renewable generation or battery storage can provide return on investment.

However by bringing smart local energy systems together across generation and storage, heat, energy efficiency, and transport, projects can optimise energy use and sharing to make the energy system more efficient, enabling more opportunities and deliver greater value.

Barriers to enabling full value

For these opportunities, some key barriers to enabling the full financial value that smart local energy systems have to offer still exist.

The **ReFLEX** project in Orkney has noted that the current energy market currently favours large-scale generation, making it difficult for smaller-scale local assets to generate a stable income. **Project LEO** partners say that investors had been deterred by complexities and barriers in the current regulatory framework more broadly²⁰, making the business case of a fully integrated local energy system difficult to develop.

GreenSCIES in London and the **Liverpool Multi-Vector Energy Exchange** also found that the current energy market restricts the ability to unlock the full potential of an integrated place-based approach.

Beyond these more general insights, barriers were identified in **two key areas**: revenue certainty, and flexibility.

Addressing these barriers would provide greater opportunity for all partners to benefit while improving the case for investment in fully integrated smart local energy systems.²¹

Revenue certainty

Large-scale renewable energy generators such as offshore wind farms can apply for a government guarantee of prices they will receive for the power they generate.

This happens through the “Contracts for Difference” scheme.

However, small-scale local generation and storage assets cannot access the same price guarantees making it difficult to model long-term revenues.

This makes it difficult to develop robust business models and investment propositions.

Providing a guarantee such as the Contracts for Difference scheme for small-scale generators and assets would provide more certainty in future revenues.

In turn, this can help to strengthen business models and draw in new investment.

Flexibility

By installing new local storage and generation assets, smart local energy systems can support the energy network by addressing local constraints and providing flexibility to help balance demand and generation across the national energy system in real time²².

This flexibility is key to the smart local energy system business case.

The **Greater Manchester Local Energy Market**, for instance, found that flexibility is crucial to avoiding network reinforcement costs and running the energy network more efficiently, in turn creating savings for consumers.

Local flexibility remains undervalued in the current energy market, as recognised by the UK Government Department for Business, Energy and Industrial Strategy and Ofgem in the Smart Systems and Flexibility Plan (2021)²³.

Ofgem also has a ‘Full Chain Flexibility’ Strategic Change Programme²⁴ that aims to ensure every asset on the system can access the full value it can provide. These developments have the potential to ensure smart local energy systems can access greater revenues and underpin their business case.



CASE STUDY

Greater Manchester Local Energy Market

As part of their project, the Greater Manchester Local Energy Market developed the **Market Maker** platform.

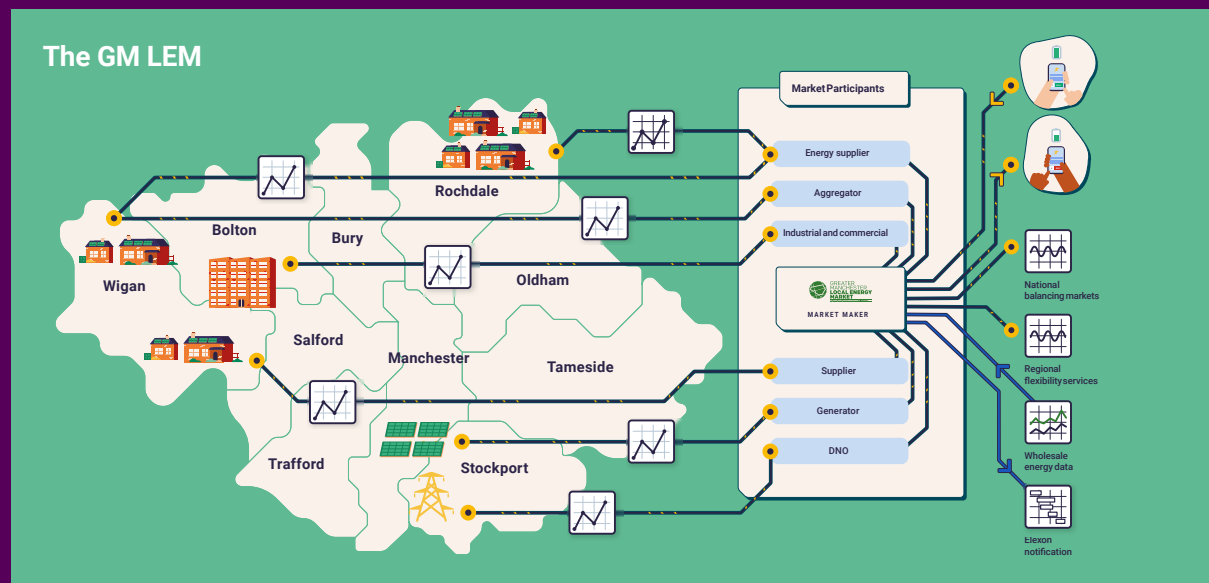
The Market Maker is a form of **local energy market** which connects local generation, storage and smart technologies such as solar and wind, batteries and electric vehicles, together through a digital platform.

The local energy market then provides half-hourly signals to users – who could be anyone from citizens to businesses to large-scale developers – about the cost of local energy, the opportunities for flexibility and reducing demand etc., allowing them to buy and sell and participate in the energy market.

This can create value for users in providing services such as flexibility and supply, and for energy networks in avoiding a considerable amount of network reinforcement and upgrade costs.

The project estimates that bringing the Market Maker platform into operation with the relevant technologies and assets would require **£2.7 million investment over seven years**.

By 2027, they project that they would be cashflow positive, generating **£1 million in surplus revenue by 2033**, leading to almost **£40 million per year in system benefit by 2038** through embedded flexibility and avoided upgrade costs.



Investment and funding

Additional investment in partners involved in the Prospering from the Energy Revolution portfolio, which has so far reached **over £700 million to different project partners**, demonstrates real appetite to invest in smart local energy businesses.

However, a lot of the smart local energy systems projects are still relatively new, and accessing sufficient investment to move from trial to 'business-as-usual' can be challenging.

There is, therefore, a need to open up development finance and investment for smart local energy system project partners, in particular local authorities, to enable a faster development journey to deployment at scale.

As outlined by the Green Finance Institute, this investment can come from a different sources, including: **innovation funding, balance sheet funding, loans and bonds, and private investment**.²⁵

Complexity and risk

While different avenues exist for financing smart local energy systems, projects note two key issues in securing investment.

The first is that smart local energy systems are **complex financial propositions**. They involve lots of different parts and not all are equally profitable – **Zero Carbon Rugeley** finds that energy efficiency measures particularly hurt their investment case²⁶ (yet are still critical for meeting net zero, delivering wider benefits such as warmer homes and achieving a just transition).

The second is that even with robust commercial propositions, there is still **considerable risk** attached since these projects are innovative by definition.

As such, there is a need to **simplify and de-risk smart local energy system business models**. This will require a combination of better up-front support for local authorities to develop strong business cases, better understanding of risk-sharing between public and private partners, and innovative financial mechanisms that deal with some of that risk directly.

Blended finance

Currently being developed by groups like the Cities Commission for Climate Investment (3Ci), blended finance allows for a mixture of short- and long-term loans and equity investment.

This allows local authorities to mobilise both private equity and public funds and loans such as from the UK Infrastructure Bank, to better front the initial capital required for projects (including hard-to-fund parts like energy efficiency) and share some of the risk.

Innovation funding

The Prospering from the Energy Revolution programme received considerable innovation funding.

Innovation funding – usually administered by government or energy bodies like Ofgem – can provide some of the **support needed for smart local energy systems to demonstrate their projects and business models**.

Projects note that innovation funding is essential, but is generally short-term, meaning there isn't always enough time to prove new business models which can take some years to turn cash-flow positive.

There is also a critical **lack of follow-on development capital**, making it difficult for innovation projects to move from demonstration to implementation and deployment.

Balance sheet funding

Local authorities can leverage publicly available funds, either from their **own revenues or from designated government resources** as part of their smart local energy system investment.

At present, most local authorities lack the resources to fully finance their own large-scale smart local energy system projects through their own balance sheets.

In addition, unless the return on investment is virtually iron-clad, local authorities may end up exposing themselves to a lot of debt risk.

More substantial levels of financial support for local authorities would thus be required, and could help to enable the wide range of value on offer.

Loans and bonds

Projects can seek loan funding from bodies such as the **Public Works Loan Board and the UK Infrastructure Bank**.

This allows local authorities to raise money relatively cheaply from government sources. However, the amount on offer today is unlikely to match the amount required to fund smart local energy systems at scale.

Local authorities can also mobilise finance through **bonds**. Bonds function in a similar way to loans, but are a tradeable fixed-rate instrument that yield a regular return.

Around the world, bonds have become an increasingly popular way to finance climate and energy projects for cities and municipalities, although the UK bond market remains comparatively under-developed.

Private investment

Smart local energy systems can seek private investment through **public-private partnerships**. In this case, private equity and venture capital investors would provide capital with a view to gaining some return on that initial investment.

This may also include impact investment.

These arrangements can work in different ways, and include support in resources and skills as well as finance to complete projects.

While flexible, investors from the private sector may seek bigger returns on that investment than would be paid through loans or bonds. There have also been mixed experiences of public-private partnerships in the past.

Policy and regulation

The Committee on Climate Change has highlighted that local action on net zero and in the energy system will be crucial to meeting our climate change targets²⁷. Reflecting this, Ofgem have undertaken a consultation on the future of local energy institutions and governance²⁸.

Policy barriers

Government policy and regulation has a wide-ranging impact on the viability and value of all smart local energy approaches²⁹. As such, national leadership, vision and policy support are required to fully enable such approaches and the value they have to offer.

In this space, projects across the Prospering from the Energy Revolution portfolio highlighted that key policy and regulatory barriers remain.

In particular, the role of local in delivering net zero targets and strategies, and how incentives are joined-up across different policy areas, are crucial for local energy systems to release their potential to create value across a wide range of local and national priorities.

Table 1: High-level policy barriers to smart local energy systems

Policy objective	Overview	Issue	Need
Delivery of net zero targets	The UK government has a strategy for delivering net zero. However, it does not yet have clear action plans to deliver in all areas. For example, measures to deliver the target to install 600,000 heat pumps per year by 2028 have not yet been put in place.	Lack of detail on the local delivery and resource required to meet national net zero targets. This makes it difficult to mobilise and source skills, finance and investment.	Greater clarity on the role of local authorities and other local actors in delivery of key net zero strategies – with financial support mechanisms to enable them to play that role.
Whole systems approach	Smart local energy system components span a number of policy areas and stakeholders, such as UK Government, local authorities, energy networks, investors and industry.	Policy targets and incentives are not always aligned across the energy system making it harder to take a whole system approach to net zero across energy vectors. This makes enabling the full value from integrated, local energy systems challenging.	Better policy alignment across the whole energy system and stakeholders in key policy plans and legislation, such as the Heat and Buildings Strategy.
The role of local in the energy system	Local stakeholders such as local authorities and businesses are central to developing smart local energy as part of a net zero national energy system.	The role local is expected to play in the energy system remains unclear, with current energy policymaking still mostly centralised through UK Government and Ofgem.	Clear direction on the role of local actors in a smart, flexible energy system to ensure local energy assets can deliver their full potential system value.

“Smart local energy systems can achieve a just transition faster and more cost-effectively, but current policy and regulatory barriers prevent the full actualisation of this approach.”

SURVEY RESPONSE FROM COMBINED AUTHORITY STAKEHOLDER

Regulatory barriers

Alongside these overarching policy issues, there are some critical regulatory barriers to realising the full potential of smart local energy systems and business models.

Regulation and industry codes can often be **fragmented and complex**, while the majority of current market and regulatory rules were designed with larger-scale energy providers and services in mind.

This presents challenges to smart local energy systems and business models. From our engagement with projects and wider research, there have been particular challenges in the following areas.

The value of “local” – at present, there are barriers to realising the value that local assets have to offer in energy markets. This includes flexibility, which local energy systems are well-placed to offer to alleviate pressures on the energy system.

Reforms to enable ‘full chain flexibility’ could allow for smart local energy systems to participate in flexibility markets (including the Capacity Market and the Balancing Mechanism), unlocking value for both local energy systems and the energy network.

Licensing and exemptions – the exemptions from the requirement for energy supply and other licences are complex and unclear, creating high entry costs and barriers for small-scale participants. This makes it difficult to develop innovative models linking up generation and demand at a local level.

Simplifying and clarifying licence exemptions to better reflect the increasingly decentralised nature of energy in the UK today, could help enable more innovative and robust smart local energy business models.

Network infrastructure and connections – to create value, assets in smart local energy systems need to connect to the electricity network to provide flexibility, demand-side response and export - to both generate revenue and help balance and operate the electricity system.

The electricity network is heavily constrained, with queues of up to 15 years for a connection. This can particularly affect local projects that do not have access to the same level of grid expertise as larger projects and tend to find themselves at the back of the queue.

Reforms to the connections process could enable smaller local projects to connect without being stuck in long queues behind major projects. A strategic approach to

network investment³⁰ would ensure the infrastructure is in place to enable local decarbonisation plans to be progressed and to deliver value for citizens and communities.

Lack of attention to demand-side measures – energy efficiency is a key component of smart local energy systems and the UK’s wider net zero energy ambitions. More efficient buildings can help to lower emissions, create healthier homes and reduce bills, while relieving demand on the energy system³¹.

Markets and regulation today, however, are skewed towards supply technologies, with limited incentives and support for energy efficiency and demand-side measures more broadly. In light of the energy crisis, more attention to demand-side measures in markets and regulation would help enable far broader value and more effective smart local energy systems.

Regulating for wider value – current energy regulation is designed mostly to deliver direct value to consumers and protect them from higher bills. This means that the wider value that smart local energy systems can offer socially, economically and environmentally is not necessarily accounted for.

While some energy networks have taken the lead in recent business plans to deliver greater value around environment, biodiversity, local planning and vulnerability³², requirements from the regulator are quite open-ended and ambiguous.

Building social and economic value explicitly into regulation and investment could help to incentivise energy sector actors to work more closely together on set goals and deliver greater benefits for people and places, such as those smart local energy systems can offer.

The role of local

The importance of “local” in net zero and the energy system has been emphasised by the Committee on Climate Change, UK Government and Ofgem.

Local authorities have some remit over up to 80% of net zero-relevant policy areas, with over 300 now declaring a climate emergency.

Yet the role of local authorities, areas and stakeholders in delivering a net zero energy system is not clear.

Energy infrastructure spending and decision-making remains centralised to the UK Government and Ofgem, with limited local involvement.

This means that local authorities and other partners have a critical role in the energy system, but a limited say over infrastructure decision-making and investment.

There is also a lack of clarity on the role local areas are expected to play in the delivery of net zero targets such as heat pumps and electric vehicles³³.

By providing clarity on the role of local authorities (and other local stakeholders) in delivering the UK’s net zero energy targets, and ensuring they can input into energy system governance and spending, local areas can coordinate integrated, place-based energy projects that provide value to both local and national ambitions.

Networks are now expected by Ofgem to better integrate local area energy plans and network planning in their business plans³⁴. Ofgem’s consultation on the future of local energy institutions and governance represents a strong foundation to build from.

A strong national vision

Across these policy and regulatory issues there is one key theme: the **need for strong national government leadership providing a crystal clear vision for the role of local places and stakeholders in the net zero energy transition.**

To fully enable smart local energy systems, local places need clarity from national government on their roles in delivering a net zero energy system – in system planning, decision-making and delivery – and the support, resources, regulatory incentives, statutory obligations and direction required to fulfil these roles effectively.

This will also require strong alignment of priorities and incentives across the energy sector and local stakeholders, to ensure that action is joined up and working towards the same end-goal: a clean, secure, and prosperous net zero energy system that works for people and places everywhere.

This includes reforming markets, policy and regulation to reflect the decarbonising and decentralising nature of the future energy system and reward the creation of wider social and economic value.

Providing this strong national vision and leadership can lay the foundation to realise smart local energy systems at scale, and unlock the massive opportunities on offer to citizens, communities, businesses, industry, the UK economy and net zero overall.

CASE STUDY

Regional energy system operator

The Regional Energy System Operator (RESO) project in Coventry developed plans for a smart local energy system in the area, bringing together heat, transport and power in the wider West Midlands region.

This smart local energy system was supported by a **regional energy system operator** – a partnership of local stakeholders including **West Midlands Combined Authority** and energy networks **Western Power Distribution** and **Cadent**, to deliver network and infrastructure spending plans that better reflect local need.

Through this partnership, local stakeholders like a local authority can **collaboratively inform energy network spending** so that it accounts not just for network upgrades, but for spatial planning, local heat and transport, social and economic opportunity and wider local area energy plans.

It can also be a vehicle for securing additional investment.

Project partners note that a regional energy system operator could be a more formal role in each local or combined authority.

With appropriate governance in place, the regional energy system operator can help ensure the value of local energy is brought to local areas, society, networks and the wider energy system.

Innovation and support

The UK is a world leader in technological innovation, ranking consistently in the top five countries in the world according to the Global Innovation Index³⁵.

So far, smart local energy systems have benefitted from this culture, with innovation funding and support bringing many current projects to life.

The Prospering from the Energy Revolution programme itself was supported by the Department for Business, Energy, and Industrial Strategy's Industrial Strategy Challenge Fund, and supported three demonstrator projects, 10 detailed designs, 16 key technology components, 23 data and digitalisation and 40 other projects, including 301 participants.

It is undoubtedly the largest body of evidence on net zero delivery in the UK.

This **innovation support has been critical to demonstrating the viability of new technologies and business models** for smart local energy systems.

Ofgem has recognised the need for local-level approaches to energy, outlining that innovation at the 'grid edge' is critical to our energy transition, and that recent developments offer an opportunity to support new place-based energy approaches³⁶.

Projects note that two key things would help to unlock the wider benefits that smart local energy systems have to offer, on an even bigger scale: **more dynamic and sustainable innovation support**, and a **clearer pathway to policy and regulatory change**.

Dynamic and sustainable support

Innovation funding has provided a considerable boost to the case for smart local energy systems, allowing projects to demonstrate serious value, gain follow-on investment, and create new tools and partnerships.

However, partners working in the smart local energy space note that innovation funding as it stands can be overly restrictive.

Funding and derogations to trial new technologies and models are often short-term, making it difficult for projects to fully prove their new propositions over longer periods of time.

Longer-term and more flexible innovation support can enable smart local energy systems to demonstrate their true value and potential, crowd-in investment, and begin to transition to business-as-usual.

A pathway to change

Policy and regulatory change is crucial to unlocking the value to that smart local energy innovations have to offer.

Yet the policy and regulatory landscape can be difficult to influence. Projects have noted that consultation processes are complicated and time-consuming, with limited opportunities for dialogue.

Initiatives such as the Ofgem Innovation Link, while valuable, also explicitly state that innovators should not expect rule changes based on their trials.

A more open, accessible relationship between innovators and the regulatory process could help to better support innovators to influence new policy from their learnings and experience.

The value of innovation

The Prospering from the Energy Revolution programme has already created considerable additional value thanks to UK innovation support. The programme started with £104 million funding in 2018.

Since then, over £700m additional private, equity and venture capital investment has been successfully invested into these partner companies.

Project partner Nuvve, which was involved in Local Energy Oxfordshire (Project LEO), combines solutions for supplying power from electric vehicles back to the grid with other services including equipment financing, vehicle-to-grid services, infrastructure and maintenance.. Since the LEO project, Nuvve has received £44.9m in equity investment to further develop this work.

From the Energy Superhub Oxford project (ESO), battery storage developer Invinity has received £20.5m in equity investment that will be used to scale up production of its vanadium flow battery to meet commercial demand and help drive down unit costs.

Skills and capabilities

To bring together smart local energy systems requires a diverse range of skills and capabilities.

From planning and coordination, to tradespeople and installers to fit technologies together, there is a range of expertise across various organisations and levels that goes into making smart local energy systems a reality.

This creates new opportunities for business, government, and industry to develop new skills and jobs in a variety of areas and entry-levels – many of which are transferable, and all of which are crucial to meeting our net zero targets.

Key skills requirements

Research from the EnergyREV consortium³⁷ shows that at a project level, the skills and capabilities needed to operate smart local energy systems can be broken down into key themes.

Adapting these to reflect findings from the projects in the Prospering from the Energy Revolution programme, the themes are presented in the figure on the right.

Key role: Coordinator

Crucial to the success of smart local energy systems is a person with broad knowledge and experience of the energy system and project management skills, capable of bringing together diverse stakeholders and translating their expertise and need.



Managerial and coordination

Smart local energy systems draw on diverse areas and stakeholders. This requires project management with broad expertise, understanding of the energy system, and the ability to effectively coordinate a wide range of people.



Technical and analysis

These systems rely on smart technology and integration. Technical skills needed include developing software and hardware, analysing system performance and optimisation, and building infrastructure and design.



Policy, legal, regulation

Projects must work with complex codes and regulations across energy, buildings, transport, consumer rights, data protection and financial conduct - and the contracts needed to piece these together.



Physical and trades

Systems require assessors to understand building and energy needs; skilled tradespeople to install and maintain equipment; and network engineers to provide connections and integrate with the wider network.



Soft skills

Underpinning all these are soft skills such as relationship-building, stakeholder engagement, convening and communication.

Relationships

Relationships are just as important as skills and capabilities when it comes to bringing smart local energy systems together.

This is because there is a diverse range of stakeholders involved, including energy networks, local authorities, tradespeople, investors, innovators, businesses and communities – each with their own processes and motivations.

Building strong relationships early in the process is crucial to making development and delivery more effective, as noted by projects in the Prospering from the Energy Revolution portfolio.

In particular, Project **Girona** in Northern Ireland note that the relationship between local authorities and the district network operator (DNO) is especially important. This is because the district network operator has deep technical expertise and the capacity to provide connections, making them critical partners in every case.

The Prospering from the Energy Revolution programme has provided a huge source of new knowledge, expertise, tools and partnerships to progress smart local energy systems.

The **Net Zero Go** tool developed by the Energy Systems Catapult provides a hub for local authorities to plan and budget their smart local energy systems.

In the **GreenSCIES** project in London, project partners and London South Bank University have begun the creation of a **Centre for Excellence**, to support development of smart local energy systems across the UK through consultancy and training.

Milford Haven: Energy Kingdom created a virtual room³⁸, to help visualise their smart local energy proposition.

Meanwhile, the **EnergyREV** consortium – the academic arm of the programme – has created a wealth of empirical research detailing key aspects, findings, learnings and requirements for smart local energy systems.

Project partners have also continued to work together on new bids and initiatives³⁹ to advance their smart local energy ambitions and make the case for these systems within the UK's net zero transition.

Skills gaps

Despite this substantial legacy, key gaps and barriers remain in the skills required to make smart local energy systems a reality at scale.

In particular, projects identified gaps in the following areas:

- 1. Fitters and installers** – at present, there is a shortage of skilled tradespeople to retrofit homes and install the component parts of smart local energy systems.
- 2. Project managers** – project managers with the range of expertise needed to fully coordinate different elements of a smart local energy system.
- 3. Data and digital experts** – specifically, those focused on energy systems and how they fit together in the built environment.
- 4. Technical and energy market specialists** – across project partners, there is a need for more technical and market expertise to help understand opportunities, barriers, and design solutions.
- 5. Policy and regulation experts** – with the complexities of the policy and regulation landscape, there is a need for more people with knowledge in this space.

Local authorities

As highlighted, local authorities are central to the planning, design, financing, and delivery of smart local energy systems.

Many have shown an appetite to deliver their own smart local energy systems, to meet their local energy and economic needs.

Yet many **local authorities at present lack the resource and the in-house skills and capabilities to develop smart local energy projects.**

This is typically around the need to develop (1) better **data and analysis capacity** to produce robust local area energy plans, (2) **deeper energy system expertise, finance and investment access**, and (3) **energy project management skills.**

Supporting local authorities to expand their staff expertise and capability in these areas would enable more of them to deliver smart local energy projects and unlock the value they have to offer.

Local area energy planning has been a significant development in the smart local energy space.

Different tools exist for local area energy planning, with no single, fixed methodology.

However, the process is often similar. This figure is based on Prospering from the Energy Revolution work by the Energy Systems Catapult.

1. Preparation

Establishing need, scope, purpose, partnerships and roles.

3. Representing local area

Collecting and analysing data on local energy needs, infrastructure, etc.

4. Modelling

Modelling and costing of different scenarios and options.

5. Scenario refinement

Refining models and reviewing pathways with stakeholders.

6. Actions and priorities

Establishing priority projects and preparing for implementation.

7. Create the plan

Drafting, reviewing, finalising and signing-off the local area energy plan.

2. Stakeholder engagement: an ongoing, iterative process throughout the development of the plan.

Training and pipeline

Given the value that smart local energy systems can offer as part of the UK's net zero energy transition, and the opportunities for skills and job creation, there is a clear need for more dedicated addressing of these skills gaps.

This means thinking more practically about the training required to enable smart local energy systems at scale, and the pipeline for these skills to reach the workforce – how they will be resourced, who will be responsible, and what incentives will be available for workers and industry.

In order to develop these smart local energy skills, projects recommend three things:

1. **Training for smart local energy system roles**
2. **Clarity in the skills pipeline**
3. **Policy certainty**

From this greater clarity, certainty and targeted approach, investment in skills and wider projects can be stimulated, helping to demonstrate the viability and value of smart local energy systems.

Green Homes Grant

The Green Homes Grant provided grants for homes and businesses to do energy efficiency upgrades such as loft insulation and heat pump installation. After a turbulent start, the initiative was ended early. Problems included a shortage of skills and supply to meet demand.

Because the Green Homes Grant ended early, tradespeople were left without the longer-term incentives necessary to upskill for delivery.

The Green Homes Grant did have some success in the local delivery element. Provisions for **local delivery, especially around heat, and longer-term assurances can help to mobilise the skills** required in practice for net zero and smart local energy systems.

Training and support for smart local energy roles

Engagement with projects shows that key project members with the right skills can be difficult to find.

In particular, **project managers with whole systems energy expertise and energy data experts** to bring systems together are in short supply.

Supporting local authorities to develop skills in-house, and potentially providing technical assistance through regional bodies such as the Net Zero Hubs, can aid the development of skills which are both **highly valuable and transferrable**.

Clarity in the skills pipeline

The scale of need, resource for training, incentives, and responsibility for getting the workforce net zero-ready remains unclear.

The **Green Jobs Delivery Group**¹⁰ has made strong inroads here, drawing together key skills and industry stakeholders to identify need and ambition.

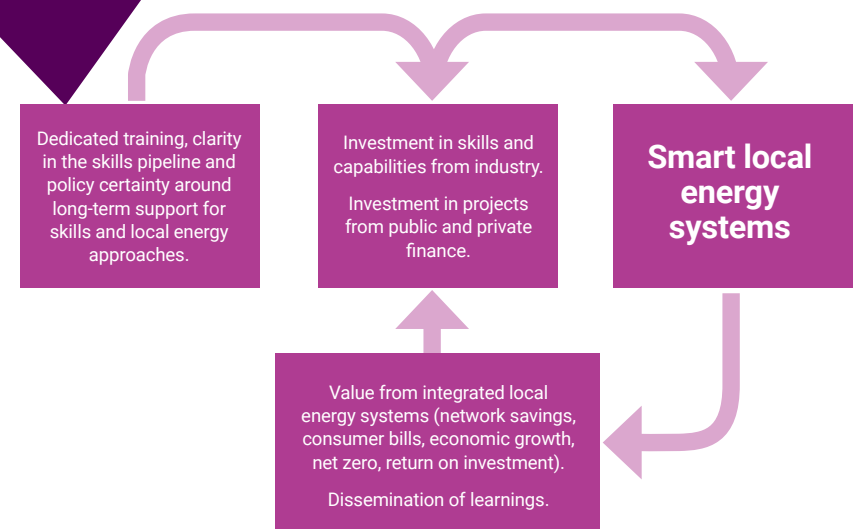
However, this is yet to be met with **detail on delivery and resource**. Evidence shows that a clear pipeline (including training, resourcing, incentives and upskilling) would help to fully unlock the skills required.

Policy certainty

Overall, there remains a lack of detail on the delivery of key net zero targets, such as 600,000 heat pumps per year by 2028, and the role of local actors in that.

Without this certainty, industry may be less likely to mobilise skills and training – especially given recent adverse experiences with things like the **Green Homes Grant** as noted by partners in Zero Carbon Rugeley.

Long-term certainty and clarity on the delivery of targets can enable industry to mobilise the skills required for smart local energy systems.



Citizens and communities

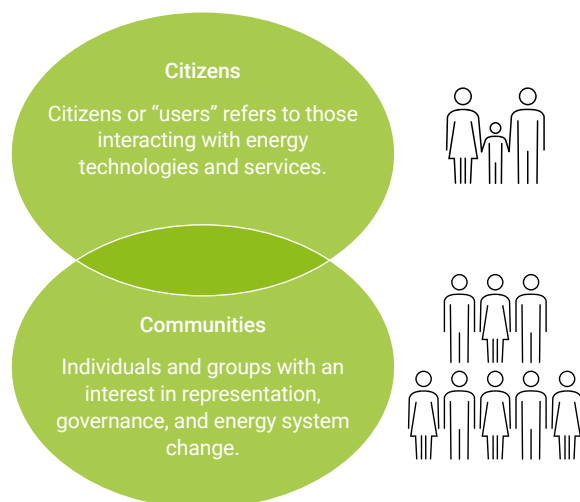
Citizens and communities are at the heart of smart local energy systems.

They are the people who live and work in the places that smart local energy systems aim to support and who will ultimately use the services they deliver.

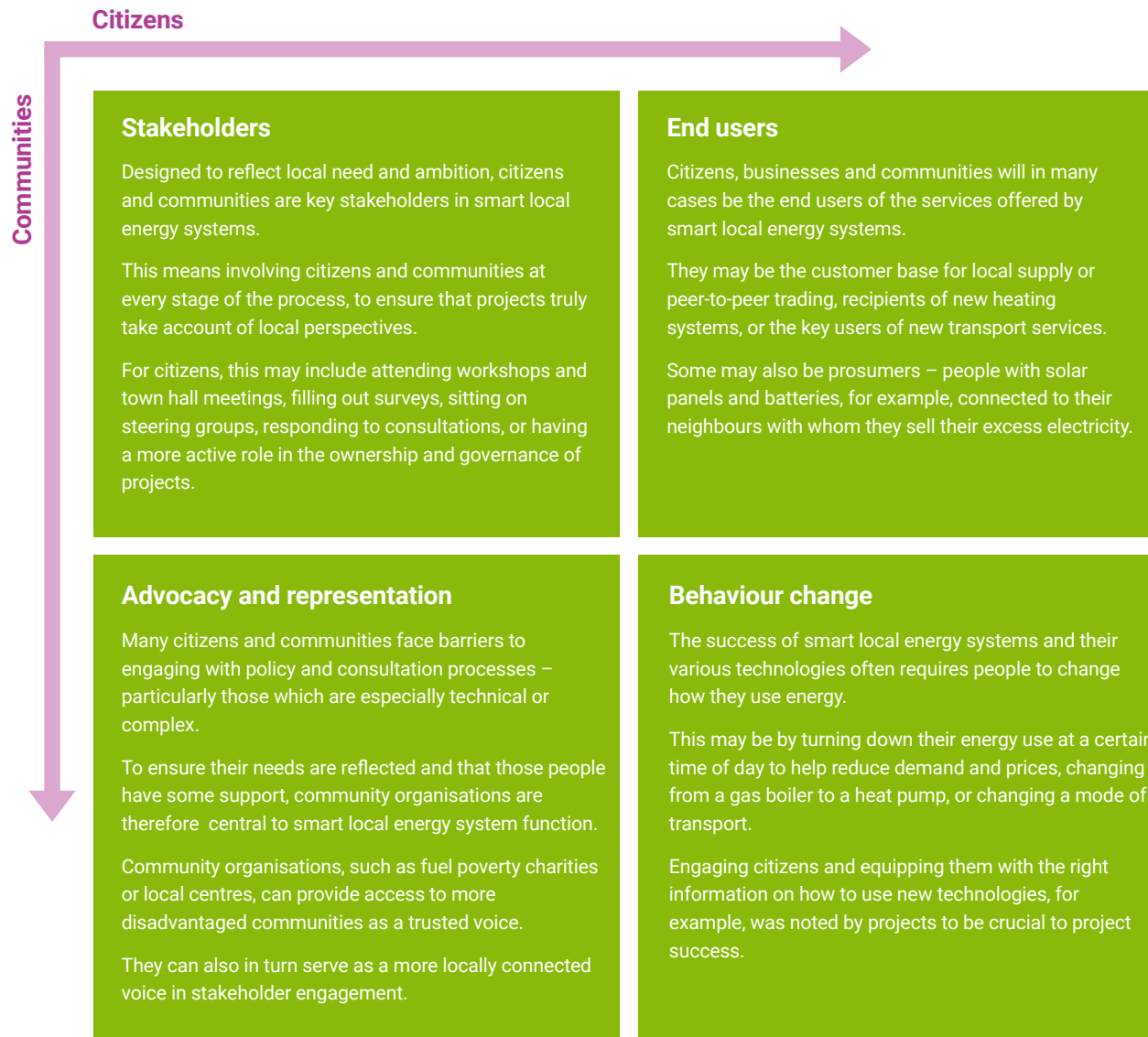
They also stand to benefit greatly: projects have noted considerable potential bill savings for smart local energy system users, while more localised clean energy can help make the energy system overall more secure and resilient.

To make smart local energy systems work effectively, citizens and communities are key stakeholders to engage. Many will be expected to adapt behaviours or allow tradespeople into their homes and local areas to conduct work. Buy-in from citizens is essential for a fair and just net zero transition⁴¹.

Considering the role of citizens and communities is critical to enabling full value from smart local energy systems.



The role of citizens and communities



Skills and capabilities

In addition to the skills and capabilities highlighted in the previous section, evidence shows that skills and expertise in citizen engagement are specific and essential.

Especially in projects which involve people from disadvantaged and vulnerable groups, meaningful,

purposeful, and skilled engagement is fundamental to making sure that people are included, avoiding harm in the process.

Projects find that involving specialists in citizen engagement and communication as part of their core project partners can help to enable this.

When engagement happens

Engagement with citizens and communities is an ongoing process, rather than a single intervention in the development of a project.

The level of engagement may vary – that is, some projects will have more user-focus than others – but in most cases, engagement has tended to be early and continuous.

What is citizen engagement?

Because citizens and communities are central to smart local energy systems, engaging those groups is crucial to success.

Projects across the Prospering from the Energy Revolution programme emphasise that meaningful engagement on an ongoing basis is essential to making sure that services work effectively, people are supported to help design and interact with new technologies and systems, and people are not harmed in the process.

Broadly defined, this means interviewing key stakeholders, hosting surveys and workshops with citizen and community representatives, and conducting focus groups.

These are not the only methods, however. Some projects have developed this further, facilitating a **citizens' jury** in the Greater Manchester Local Energy Market, for instance, and developing a **"critical friend"** steering group of local stakeholders in the case of GreenSCIES⁴².

Who should be engaged?

The citizens and communities to be engaged will vary from one smart local energy system to the next.

Across the projects, EnergyREV research by Soutar and Devine-Wright (2022)⁴³ shows that a number of different groups have been involved, including:

Citizens/users

- Local residents, tenants and homeowners
- Public fleet drivers and managers
- Housing developers
- Business and social landlords
- Local authorities
- Commercial users and industry

Communities

- Community groups
- Community energy groups
- Local development groups
- Sustainability groups
- Culture/heritage groups
- Schools and education institutions
- Sustainability groups
- Mobility groups

Citizens' Jury

As part of the Greater Manchester Local Energy Market project, community energy partner Carbon Co-op conducted a citizens' jury of local people.

The session brought together twelve demographically representative people over six days to deliberate on who should own and operate the Greater Manchester local energy market, and what role Greater Manchester Combined Authority should play going forward.

At the end of the session, participants were then asked to give recommendations from a set of potential models and structures for the system.

This allowed citizens to learn about place-based energy approaches more generally, and to help shape the design to local need.

Citizens' juries and assemblies have become increasingly popular tools in energy and net zero decision-making.



Communication

Fundamental to engaging citizens and communities is communication.

Smart local energy systems can be complex, including a range of innovative technologies that are brought together in different ways.

This can pose challenges to engaging effectively with people, since many will lack the technical understanding necessary to meaningfully participate in engagement processes.

Barriers to participation are especially pronounced for lower income, disadvantaged and vulnerable groups, who tend to be less well-versed in new technologies and the energy system in general, and less confident to ask questions⁴⁴.

To secure buy-in and ensure a more just, inclusive transition overall, it is crucial that project communication is accessible and empathetic, particularly with those in often excluded groups.

Trusted intermediaries

Trusted intermediaries such as community energy organisations and energy advocacy groups have been used by many net zero projects to help better translate needs and changes to people⁴⁵, especially more vulnerable or typically excluded groups and communities.

With deep knowledge of their communities and people who live there, those intermediaries have a critical role to play, and are a valuable partner for ensuring not only that information is communicated, but that local voices are heard.

Principles for ethical delivery

As part of their core outputs, Project LEO developed an initial set of eight principles of ethical delivery for their “smart fair neighbourhoods” trial.⁴⁶

These are:

- 1. Clarity of scope:** stakeholders are clear about the scope of the project and what it can and can't deliver
- 2. Collaborative design:** working with community partners to make sure the trial meets people's needs
- 3. Inclusive participation:** making it possible for a wide range of stakeholders to have their say
- 4. Do no harm:** protect all participants and ensure nobody is made worse-off
- 5. Rewarding experience:** make sure each touch point is rewarding and positive, and that benefits are distributed fairly
- 6. Informed consent:** making sure all involved citizens and communities have relevant and honest information about cost, benefit and risk presented in an accessible way
- 7. Respect:** treating all participants and communities involved or affected by the smart local energy system without bias, prejudice or derision
- 8. Continuous improvement:** seeking to maintain engagements and contact on an ongoing basis

Ethical and consumer protection

As part of smart local energy systems, people will often be encouraged to use new technologies and services.

This might include electric vehicles or heat pumps, for example, or involve being part of more innovative business models like peer-to-peer energy trading that have some risk attached.

This means that people could be exposed to some potential issues. Technologies may not work as planned, leading to times without heating, for instance, or paying more money due to incorrectly sized equipment

To counter this, there is a need for smart local energy projects to pay attention to **consumer protection**.

Particularly as most are currently innovation trials, projects need to have in place robust no-detriment and anti-harm mechanisms.

For example, In the case of the **ReFLEX** project in Orkney, partners spent a lot of time making sure that people using the new electric vehicle leasing service were supported and protected contractually within those leases. That meant being on call in case of technical faults, and providing cars with longer battery life to cover longer journeys.

This is especially true for vulnerable groups such as those on low incomes, with disabilities, and from immigrant and minority communities.

These protections can ensure that people involved in smart local energy systems can benefit from their participation, are not left without services or a reduced quality of life compared to what they had before, and are not harmed in any way by their decision to participate in the trial or project.



Data and digitalisation

Table 2: data and digital elements of smart local energy systems

Stage	Overview	Examples
Planning and design	Data used to inform the initial design of smart local energy systems	Social and economic, energy network, building stock, infrastructure, geospatial, transport, heat.
	Artificial intelligence and modelling to support better system design	Platforms to support modelling and prediction of energy need, uptake of technologies, geospatial mapping, local area energy planning
Operation	Data used in the operation, optimisation, and day-to-day running of smart local energy systems	Smart metering and data, smart technologies e.g. heat pumps and electric vehicles, price signals, generation and local assets
	Software and artificial intelligence to manage energy flows, pricing, system optimisation, etc	Digital energy platforms, virtual power plants, smart energy management, flexibility coordination and dispatch, smart charging
Monitoring and evaluation	Data to understand the impact of smart local energy systems	Social impact (wellbeing, fuel poverty etc), user feedback, health, air quality, regional impact (growth, jobs etc), bill savings, data generated by the system itself

Central to the value on offer from smart local energy systems is the ability to better optimise energy flows; target energy technologies and services to local need; and draw together different pieces to unlock savings for homes and businesses.

All of this value is enabled by **data and digitalisation**.

Representing the “smart” side of smart local energy systems, data and digitalisation are critical to how such systems function and deliver benefits.

They are also crucial to the UK energy system more broadly, as it becomes smarter and more diverse.

These are the parts that do the complex work behind the scenes to make sure smart local energy systems work as efficiently and effectively as possible.

Data is key to

- Planning and designing smart local energy systems
- Understanding system operation
- Enabling real-time monitoring and balancing
- Monitoring the operation and impacts of projects on bills, behaviours changes, social impacts and emissions reductions

Digital elements are then integral to how systems operate. These include software, artificial intelligence and information and communication technologies that

- Improve the design and planning of local energy systems
- Support energy trading
- Optimise energy use
- Provide price signals and market information
- Balance supply and demand in real time

Innovations in data and digitalisation

Reflecting this pivotal role, innovation in data and digitalisation has been a major focus of the Prospering from the Energy Revolution programme.

The initial programme funded 11 concept designs, including development of critical smart local energy system digital technologies.

Innovators and developers have been central in the detailed design and demonstrator projects, providing the technology and data solutions to support system planning, optimisation, and operation in Project LEO, Energy Superhub Oxford and ReFLEX in Orkney.

In addition to this, the programme supported the Energy Revolution Integration Service⁴⁷ led by the Energy Systems Catapult, pulling together data from across project partners to support dissemination and learning from the portfolio.

Considerable progress has also been made in developing **data use and practice principles**. The Energy Data and Energy Digitalisation Taskforces respectively have produced a wealth of analysis and guidance on making the most of energy data and developing smart local energy digitalisation principles⁴⁸.

Energy data best practice guidance

In their 2019 report, the Energy Digitalisation Taskforce developed guidance to support best practice in energy data use and sharing.

This has since been adopted and promoted by Ofgem, with good progress made in working towards more open and expansive energy data for societal benefit.

Funding and innovation

Modernising Energy Data Applications (MEDApps)

The Prospering from the Energy Revolution programme supported considerable work to explore the role and innovation of data and digitalisation in smart local energy systems and wider net zero.

This included the Modernising Energy Data Applications programme (MEDApps), supporting the development of data platforms for better local energy use and planning.

The Modernising Energy Data Access (MEDA) competition similarly funded the development of tools and processes to unlock data services for the energy sector, while the Open Data Solutions competition funded six projects to working on new open software, hardware and data solutions to help accelerate the UK's net zero energy transition.

Mind Foundry

Funded by the MEDApps programme, **Mind Foundry** are building an energy-focused geospatial system that will enable the user to visualise overlays of data that varies over time and from place-to-place.

From this, users can model and predict trends and correlations, complete low quality or incomplete datasets, and model the effects of changes on the system such as varying supply, demand or infrastructure.

It will further allow for the simulation and testing of different local energy and net zero strategies, for example, alternative charging point placement.

Urbantide

Another MEDApps project, **Urbantide** are aiming to combine UK-wide smart meter system metadata with multiple cross-sector data sources to identify households in fuel poverty in a completely novel way.

This can help to target energy efficiency measures to those most in-need, more effectively and completely than traditional methods allow.

Moixa

Moixa is a tech innovation company which was involved in the SmartHubs project in West Sussex.

Using artificial intelligence and machine learning, Moixa developed their "GridShare" technology, which connects storage devices such as batteries and optimises power flows across the grid.

Since the programme, Moixa have secured £4.6m in investment to develop its GridShare smart energy management software.

Barriers and challenges

For this central value and importance, there are some key remaining challenges in the data and digital space – overcoming which would help to level up the smart local energy system opportunity.

Digital spine

Energy system data and digital assets are often held in a number of different places, different formats, and with different levels of availability.

To overcome this and make the energy system work smarter, The Energy Digitalisation Taskforce recommend a digital spine.

A digital spine is a network of organisations from across the energy system, sharing standardised, critical data about the energy system such as power flows and price signals via a standard interface.

The organisation (or “node owner”) can share raw data or aggregated versions where information is deemed sensitive.

The Department of Business, Energy and Industrial Strategy commissioned a trial in October 2022 to explore its feasibility.

Availability and interoperability

Supporting evidence from the Energy Data and Digitalisation Taskforces, projects note that the data they need for smart local energy system design is not always readily available.

In particular, **the lack of information about household energy use and demand** such as that provided by smart meters is not typically accessible due to data privacy rules⁴⁹.

This can make it difficult to accurately model some of the assumptions behind smart local energy systems.

Projects such as **RESO** have shown that accessing this data for planning and operation can create significant cost savings and unlock significant value for local regions and communities⁵⁰.

Data can also come from a **number of different sources**, such as energy networks, local authorities, national datasets and others across many assets and platforms.

However, these datasets do not always match up at a spatial level or in quality, and nor are they always accessible.

This presents challenges for accurately modelling whole energy systems and wider needs and benefits.

Recent efforts have been made to overcome this. The Energy Digitalisation Taskforce commissioned by Innovate UK and the Department for Business, Energy and Industrial Strategy in early 2022 outline the need for a “**digital spine**” of interoperable energy data to support better data access and use in the energy system.

Ofgem have also adopted and encouraged the Energy Data Best Practice Guidance⁵¹ as put forward by the Energy Digitalisation Taskforce, with networks increasingly opening their data for better sharing and planning.

Skills and capabilities

Data and digitalisation is an exciting, growing sector of the UK workforce.

Yet projects note that the skills needed to support smart local energy systems in this space remain lacking, particularly in local authorities.

There is a clear need for more targeted development of the skills required to plan, analyse, monitor and optimise smart local energy systems, and to do this consistently across different places.

Developing these skills will require some national direction (i.e. creating appropriate training pathways for energy data specialists), ensuring people can learn these skills and put them into practice in every region and local authority).

Legal, ethical and justice

How our data is used, who has access to it, where it is stored and who owns it all have ethical impacts.

Data gathered without the proper safeguards in place can be open to theft and exploitation, and weaken trust with consumers.

Furthermore, if only certain people have their data included in the design of a project or service (for instance, only higher-income groups who are more engaged with smart meters and technologies), then inequalities may be accidentally made worse in the process.

Ensuring transparency, accountability and fairness in the use of data in smart local energy systems is paramount to maximising the value that such systems have to offer.

Progress has been made again here by the Energy Digitalisation Taskforce, who outline the critical need for consumer protection, effective digital governance, and strong security measures.

Key learnings and next steps

Based on extensive engagement with project partners and wider research, this report has set out insights from five major smart local energy system themes from across the Prospering from the Energy Revolution programme.

It has highlighted the value on offer from smart local energy systems, the opportunities that smart local energy systems present for the energy system, society, economy and net zero, and barriers to unlocking them.

Across these insight areas, there are some key, shared learnings. Clarity on policy direction, for instance, can help to enable both finance and local skills to get projects up and running. Better supporting local energy systems in policy and regulation can enable new financial offerings, digital innovation and services for citizens and communities.

These shared learnings present key steps in eight priority areas to help fully unlock smart local energy systems for the future.

1. **The role of local in the energy transition**
2. **Support for local authorities**
3. **Valuing local in the energy system**
4. **Investment and infrastructure**
5. **Dynamic and sustainable innovation**
6. **Dedicated skills pipeline**
7. **Citizen safeguarding and fairness**
8. **Improved data access and sharing**

1. The role of local in the energy transition

Evidence shows that making the role of local places and stakeholders for delivering net zero energy clearer in policy and regulation would help to fully enable the value that smart local energy systems have to offer.

This would allow local stakeholders to contribute more to the UK's net zero energy transition and better mobilise the finance, skills and plans required to develop their own smart local energy solutions.

For UK Government, this means: outlining a strong and clear national vision for the role of local in planning and delivering net zero energy, particularly for local authorities, backed-up with financial support, technical knowledge and assistance, statutory remit, and detail on their role for specific net zero policies such as electric vehicles and heat pumps.

For the regulator, this means: ensuring local partnerships between energy networks and local authorities are being supported, as per final RIIO-ED2 determinations⁵², and providing a clear remit for local stakeholders in energy network planning.

For local authorities, this means: continuing to work with local citizens, communities and stakeholders to ensure delivery and discussions reflect their needs and priorities, particularly for vulnerable groups and people, and working with UK Government and other stakeholders to develop the best way for local areas to participate in the energy transition.

For energy networks, this means: continuing work with local authorities and other stakeholders, to share expertise (and data and resources), develop local plans and support more effective use of the network.

2. Support for local authorities

In addition to their role in the energy transition, projects emphasise that more support for local authorities to develop plans, skills and resource can aid the delivery of smart local energy systems.

This would involve clarifying statutory powers over the energy system, as well as supporting local authorities to finance wider local energy planning and delivery

For UK Government, this means: devolving some areas of energy including financial resource and planning, providing technical assistance and upskilling support (potentially at regional level through Net Zero Hubs), and leveraging institutions such as the UK Infrastructure Bank to help local authorities raise finance and crowd-in investment.

For the regulator, this means: building on the consultation on the future of local energy institutions and governance to establish the role local authorities will play in energy infrastructure planning.

For local authorities, this means: continuing to work with UK Government and other local authorities to identify need and viable pathways to unlocking the value from smart local energy systems, working with the finance community to develop new ways of raising money, and showing ambitious leadership in developing relevant skills and supply chains.

For energy networks, this means: extending and developing work with local authorities and other stakeholders such as community energy groups, to share expertise, develop local plans and support more effective use of the network.

3. Valuing “local” in the energy system

As recognised by the Department for Business and Industrial Strategy and Ofgem in the Smart Systems and Flexibility Plan (2021) and emphasised across projects, evidence shows that the value that smart local energy systems have to offer the wider energy system is not recognised in current energy markets.

Better recognising this value would provide greater revenue certainty and enable more robust business models to be developed.

For UK Government, this means: providing policy support and regulatory and market incentives for local energy approaches within the wider net zero energy transition.

For the regulator, this means: more consistently valuing flexibility delivered by local assets and users and reshaping markets to better value demand reduction, to deliver more holistic value to people and the system overall.

For local authorities, this means: working with UK Government, the regulator, energy networks and smart local energy system developers to shape the policies and regulations necessary to fully enable this value, and to deliver that value locally with more tailored solutions to support vulnerable groups and a wider just transition.

For energy networks, this means: providing expertise and knowledge to support the shaping of a more locally dynamic energy system and regulatory framework, and working closely with local partners to better target and deliver local projects and value.

4. Investment and infrastructure

Smart local energy systems can help avoid the need for substantial amounts of expensive future network reinforcement upgrades and deliver net zero at an overall lower cost to bill-payers, treasury and the energy system.

Yet major investments in infrastructure, particularly to deal with connection issues, are still required. Enabling local energy approaches within this can help unlock that saving and wider value for citizens and communities.

For UK Government, this means: supporting Ofgem to deliver faster investments in energy infrastructure, and considering how local stakeholders can have more influence within infrastructure planning and spending processes.

For the regulator, this means: accelerating investment in network upgrades ahead of need to alleviate connection delays with priority for local projects, and developing their requirements on networks to explicitly incentivise more holistic social and economic value.

For local authorities, this means: working closely with networks and government (and local communities) to help overcome barriers to realising local value and shaping investment decisions based on local need.

For energy networks, this means: showing even greater leadership on delivering holistic social and economic value as outlined in their business plans, and taking a more strategic approach to investment by working with local partners to invest ahead of need to deal with connection issues and support local projects in the connections process.

5. Dynamic and sustainable innovation

While innovation support has been valuable and critical to projects, the innovation landscape at present is disjointed and trials often only last for a short period of time.

Allowing for more dynamic, longer-term support and trials would help smart local energy systems develop more robust business and evidence cases and transition to business-as-usual, supporting the raising of finance and unlocking of wider value.

For UK Government, this means: providing more joined-up, flexible innovation support and increasing public spending review timelines to enable projects to run for longer periods of time, building on the extensive work already led by Innovate UK.

For the regulator, this means: allowing for longer-term and more flexible derogations, so that innovation trials can test their propositions for longer, and creating a more accessible and viable pathway for innovation projects to influence regulatory change and transition to business as usual. This should be accompanied by targets for Ofgem to meet around the innovation to business-as-usual pipeline.

For local authorities, this means: supporting trials in their areas and sharing knowledge, learnings and assets where appropriate, and collaborating with business to help develop more effective business models and source investment.

For energy networks, this means: using their extensive innovation experience to help shape more appropriate derogations and conditions, continuing to support local energy innovation projects, and driving stronger engagement and more diverse collaborations.

6. Dedicated skills pipeline

Projects consistently state that greater training and resourcing of staff for the design and delivery of smart local energy systems is crucial to future success.

This includes training specifically for smart local energy system roles, such as project managers and data specialists with diverse energy expertise; providing better resource for local authorities to develop capabilities; and providing long-term market certainty/incentives for tradespeople.

For UK Government, this means: providing detail on how and when skills will be required, including long-term detail on the incentives for industry in delivering things like the target for heat pump installations, and supporting local authorities to train energy and net zero project coordinators.

For the regulator, this means: providing greater detail on the role of local energy in the future of the energy system, including around local supply and flexibility, and supporting networks to meet skills commitments as part of their business plans.

For local authorities, this means: developing the in-house resources for project management, energy planning, citizen engagement etc, and working with local industry to support skills and supply chain development.

For energy networks, this means: continuing the development of workforces and the greater sharing of expertise, with a particular focus on increasing collaborations with local authorities to support their technical development.

7. Citizen safeguarding and fairness

Citizens are core to smart local energy systems, with engagement being especially important to their success.

While the potential benefits for citizens are considerable, participation in new technologies and systems can create risks if people are not central to and protected in project planning.

There is significant social value in smart local energy systems, when vulnerable groups are protected, and the benefits of new systems are designed to reach lower income and underserved communities.

For UK Government, this means: ensuring consumer protection legislation such as the Consumer Protection Act (2015) is fit-for-purpose and adequately enforced, and prioritising a just energy transition in net zero policy initiatives so that underserved communities can directly benefit.

For the regulator, this means: reviewing Ofgem's Consumer Vulnerability Strategy 2025⁵⁹ to ensure that innovations not only reach those in vulnerable situations for a just transition, but that people are protected in the innovation process.

For local authorities, this means: working with local community partners and other smart local energy stakeholders to ensure engagement is inclusive, meaningful, and that people are being adequately supported within smart local energy systems.

For energy networks, this means: using their Priority Service Registers and connections with local partner organisations to provide a basic standard of service and effective, rapid emergency response for those in especially vulnerable situations (e.g. with medical equipment).

8. Improved data access and sharing

Data is becoming increasingly open in the UK energy system, especially from energy networks.

Yet the platforms and skills to make best use of this data are still lacking, with data from households still in short supply.

Developing data sharing and access that is straightforward, building on work done to encourage best practise, can help to fully enable smart local energy approaches and deliver considerable value to the wider energy system.

For UK Government, this means: developing energy-specific data skills and capabilities and continuing to support the rollout for recommendations from the Energy Digitalisation Taskforce, such as Digital Spine and more open data access.

For the regulator, this means: continuing to encourage networks to make their data available and accessible and developing platforms and tools to help their stakeholders use it, including non-data expert stakeholders, while continuing to protect consumers.

For local authorities, this means: identifying key data needs with networks and other data holders and developing in-house capabilities to use growing amounts of data for local energy planning and analysis.

For energy networks, this means: working together to make data more accessible and interoperable, and developing tools to support smart local energy system planning and analysis.

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34 Smart local energy systems: Insights from UKRI-funded innovation projects

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