EnergyREV

The role of energy networks in smart local energy systems

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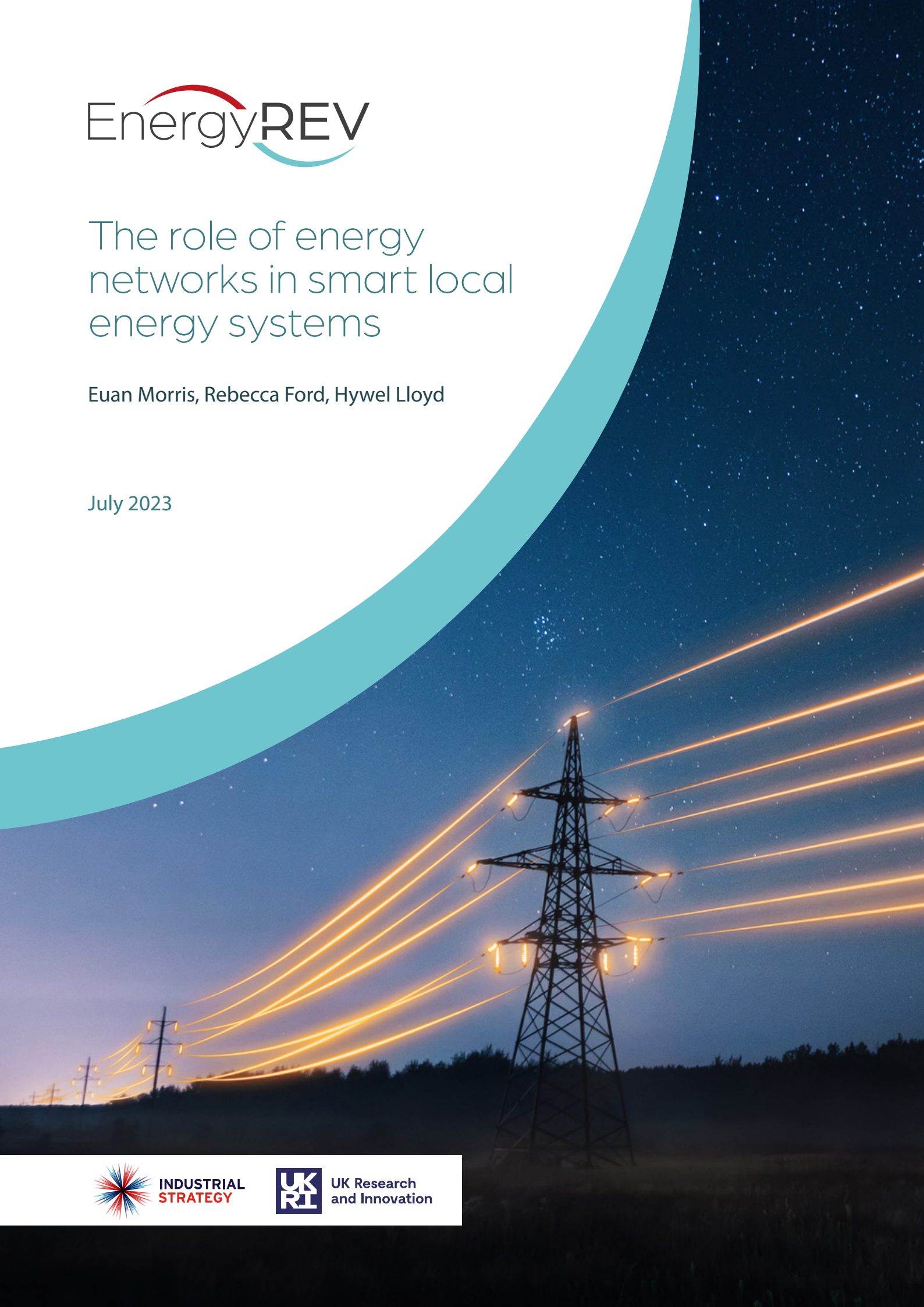

INDUSTRIAL STRATEGY

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Contents

The role of energy networks in SLES

The Distribution Network Operators (DNOs) have a crucial role to play in the development of Smart Local Energy Systems (SLES) to deliver smart-energy places, in turn SLES approaches can aid the transition to the role of Distribution System Operator (DSO). However, despite the mutually beneficial outcomes, there are a number of barriers preventing DNOs from full embracing their role in ensuring the success of SLES.

This document provides insights from the Prospering from the Energy Revolution (PfER) programme[1] on the role of the DNO/DSO in the development of SLES, what the benefits are, and identifies some of the changes that could be made both by DNOs themselves and within the wider electricity system to better facilitate these. Finally, a selection of useful tools created during the EnergyREV programme for those involved in SLES are described.

What is a Smart Local Energy System?

Smart

- Integration of monitoring devices providing network visibility.
- Control, automation, and self-regulation allowing for automatic adjustment to environmental changes.
- Embedded learning facilitating improved performance over time through adaptation to system dynamics.
- Enhanced understanding of system leading to more effective decision-making, planning, governance, and user-engagement.

Local

- Local and community stakeholders, involvement from local authorities and both public- and private-sector institutions
- Decisions at a local level allowing the people who are affected by decisions to be involved in making them.
- Full or partial community or local entity ownership of assets keeping some profits within the community the energy system serves.

Energy System

- The provision of multiple energy vectors, including heat and mobility as well as electricity
- From production, through transmission and distribution, to consumption and storage
- Including socio-technical (political, economic, and social aspects) and institutional elements (markets, regulations, contracts, etc.)

1 Insights and evidence were captured during an interactive workshop, hosted by EnergyREV, on 13/12/2022. The workshop was attended by approximately 60 participants, including stakeholders from across the sector, including from PFER demonstration and design projects, distribution network operators, local and national governments, academia, and from both SMEs and larger businesses.

The role of the DSO

In July 2021 the UK Government's Department for Business, Energy, and & Industrial Strategy and Ofgem published their Smart Systems and Flexibility Plan. This highlighted the significant savings that could be possible if the need for network reinforcement required to facilitate the electrification of heat and transport were to be reduced through the use of flexibility. Flexibility is the ability to adjust energy generation and demand, to alleviate network constraints by balancing generation and demand locally, and thus reducing the loading further up the network.

More recently the calls for input from Ofgem on both The Future of Distributed Flexibility and Future of Local Energy Institutions and Governance has reinforced the degree to which this flexibility must be realised at a local level, as well as the increased 'smartness' required to make this a reality. There is a clear direction of travel towards increased local engagement in the future of the energy system, through a combination of the Ofgem-proposed regional system planners (RSPs), and the already widespread use by local authorities of local area energy planning (LAEP).

The need to integrate distributed flexibility and other distributed energy resources, and the requirement for increased visibility of the low voltage (LV) network to facilitate this, will help deliver an increasingly smart distribution system, and one that increasingly and more specifically reflects the variety, opportunity and challenges of each locality. This in turn will provide an increasingly strong case for DNO/DSOs to support the creation and development of SLES.

The DSO can facilitate SLES approaches in a number of ways:

- Engaging with local authorities and community groups, including supporting the creation of LAEPs
- Increasing monitoring and visibility of the LV network, particularly at the customer end
- Investing in data collection and sharing more broadly. DNOs also have a key role to play in upskilling communities.

Despite the benefits to DNOs from capital deferment and the benefits to SLES themselves from DNO engagement, a number of factors, have prevented this symbiotic relationship from developing. These include the distribution of assets and a lack of incentives for both customers and DNOs themselves.

Barriers to DSO and SLES integration

Domestic assets capable of providing flexibility include electric vehicle (EV) chargers and heat pumps. They are configured around user experience (for example, charging an EV as soon as it is plugged in). However, DNOs require access to a set amount of energy flexibility at set times.

There is currently not enough diversity in the distribution of these assets to overcome this issue, and the market does not yet support suppliers and aggregators to mitigate this. In addition, suppliers are more focused on selling flexibility on the wholesale market, and less on interfacing with DNOs to provide grid services.

Other assets, such as distribution-scale battery storage have connection lead times of up to a decade, which creates a significant disincentive to their installation. These problems are exacerbated by a lack of monitoring to provide information about local behaviour and network constraints. This limits the precision of signals that could be sent to smart assets capable of providing flexibility, making it harder for this potential to be utilised.

In contrast with businesses like Amazon which have over 100,000 models of different types of customer behaviour, the electricity supply industry only uses 6, while the rollout of digitalisation has been extremely slow compared to industries such as banking and healthcare. This is a barrier to developing the accurate forecasting and modelling required to facilitate the integration of socialistic assets with unpredictable use-patterns, and hampers the ability to offer value propositions to the customers that own them.

There are a number of ways that DNOs themselves can begin to address these challenges, and embrace the value that SLES approaches can deliver.

What can DNOs do to facilitate SLES?

Data

Data collection and data sharing are both areas that DNOs could focus on now to improve SLES viability. Increasing LV monitoring and standardising the way in which all data, including new LV monitoring, is shared and accessed would be of value. DNOs should default to connecting small-medium scale distributed energy resources and focus monitoring where there are likely to be constraints, instead of the current approach of not installing these resources due to a lack of network visibility. DNOs should also review the suitability of their current data streams, and ensure that the data which is valuable for facilitating flexibility markets is being shared.

For the future, DSOs should work towards standardisation of data sharing, including data catalogues, ontologies, and common data standards. Common APIs for accessing data should be developed, with improved systems for assess registration for all assets.

Whole-systems thinking

DNOs should explore alternative forms of flexibility, including the possibilities for local balancing, as well as flexibility on different scales. In particular collaboration with the Electricity System Operator (ESO) and wholesale markets on whole-system flexibility services should be accelerated.

DNOs should become more involved with understanding heat demand and reduction, working on engagement on behaviour changes, and helping customers understand the options available to them and the impacts these will have on the network.

DSOs should aim to be part of a system with increased openness and fairer market competition that facilitates new forms of value such as peer-to-peer trading. Carbon intensity should be part of all decision-making alongside cost, with the network optimised around minimising this intensity and achieving Net Zero.

Community engagement

DNOs should engage with local authorities and community groups on LAEP, to influence and support the development of SLES as part of decarbonisation efforts. The community should be viewed as partners and DNOs should consult experts in community engagement projects as to how best they can support local community objectives. In addition, the DNOs should get involved with education for communities, particularly focusing on those who are less engaged with the energy system, to wide access and increase participation.

DNOs also need to improve the sharing of system design contracts, and be more transparent about both the potential network impacts of projects, what the blockers are to realise those projects, and the potential value they derive from them.

Community engagement and transparency

DSOs should consider a local convenor role to work between themselves and local authorities and community groups to both enhance cooperation, and to give local people a voice in DSO governance structures. DSOs should be part of democratically-led regional planning across all energy vectors, which looks to widen participation and ensure a just transition. DSOs should consider a 'customers' charter' to help people understand what they can expect from the system and what their own responsibilities are within that system to improve their agency.

Appendix: Useful tools

A range of tools to aid SLES development have been created during the EnergyREV programme.

Interactive Theory of Change

The EnergyREV Theory of Change (ToC) interactive tool highlights the key conditions required for developing SLES which we have found through EnergyREV research. It also illustrates how SLES are expected to deliver desired outcomes like prosperous communities with quality employment, or meeting climate targets.

Those planning, implementing, and supporting SLES projects can use the ToC tool to help think through whether or not their projects meet the conditions, and the degree to which this matters. It includes a range of interactive features, such as the ability to show/hide:

- Summaries of EnergyREV findings relevant to various conditions, with links to the original reports.
- Important policy / governance considerations underlying conditions.
- Suggested metrics that can be used to evaluate progress against creating conditions.
- A high-level summary version.

Access the Theory of Change.

Catalogue of Projects on Energy Data (CoPED)

CoPED aims to unify various information stores and existing portals for the metadata of energy projects under a single extendible umbrella.

CoPED goes beyond a database, as it seeks to connect individuals and institutions in the energy sector to showcase projects, encourage collaboration and offer a forum to engage. Having a central platform provides a collective and strategic voice to support UK energy digitalisation. By creating a shared domain that brings energy stakeholders together, CoPED will facilitate informal networks for knowledge-sharing and exploration of new partnerships, as well as identify gaps in energy data.

Access the Catalogue of Projects on Energy Data CoPED.

Local Area Energy Mapping Tool (LEMAP)

LEMAP brings together spatial and temporal visualisation of local energy flows to support the planning of smart and fair neighbourhoods.

The LEMAP tool has been designed for community-based organisations, local authorities and residents. It brings together public, private and crowd-sourced data on energy demand, energy resources, building attributes, socio-demographics, fuel poverty and electricity networks within the ESRI ArcGIS mapping and analytics software platform.

The tool has been organised around three technical and three engagement elements that include 'baselining' local area energy flows in relation to socio-economic characteristics; 'targeting' suitable properties for low carbon technologies (LCT) such as rooftop solar, heat pumps and EV chargers; and 'forecasting' energy demand profiles at postcode level for different LCT scenarios.

Find out more about LEMAP.

Open Platform for Energy Networks (OPEN)

Open Platform for Energy Networks (OPEN) provides a python toolset for modelling, simulation and optimisation of SLES. The framework combines distributed energy resource modelling for PV generation sources, battery energy storage systems, electric vehicles; energy market modelling; power flow simulation and multi-period optimisation for scheduling flexible energy resources.

Download OPEN from GitHub.

Smart Local Energy System (SLES) Multi-Criteria Assessment tool

The MCA-SLES tool is an assessment tool for SLES projects to assess and monitor progress towards achieving multiple potential benefits against initial aims and aspirations.

It covers six assessment themes:

- Energy system technology
- Digitalisation
- Economics
- Management
- Environmental impact
- Social impact

It enables SLES projects to gain better insights and understanding of a project's current status when measured against objectives and benefits, when and how to achieve these, as well as limitations in relation to the SLES development and deployment over the implementation period.

Access the SLES-MCA.

Causal link skills model for energy transition

This causal link skills model presents three case studies for a SLES transition, highlighting factors that impede or foster growth in skills for SLES.

The demonstration covers:

1. Individual sub-system models
    a. Transition within the energy supply
    b. ICT sub-system
    c. Local government
    d. Transport and mobility
    e. Building and retrofit
    f. Community energy
    g. Skills for citizens
2. Integrated system of systems model

By running these models, the causal dynamics between the factors that foster or impede transition to SLES can be explored.

Access the causal link skills model.

Pattern-IT: A method for mapping stakeholder engagement with complex systems

Pattern-IT is a participatory, card sorting activity that aims to illuminate the relationships between people, technologies and concepts in complex systems. Pattern-IT combines two methods: card sorting and mapping sentences. Depending on the aims and scope of the research or topic, Pattern-IT can be used in an exploratory, descriptive, or interpretative manner. It is a co-created, adaptable and enjoyable method that can be used with individuals or groups, in-person or online, with or without facilitation.

More information about Pattern-IT.

GIS mapping of local energy businesses in the UK

A GIS mapping tool has been developed, which collates UK based SLES related businesses, providing visualisation on the extent to which they are 'smart' and 'local'. A database, comprising 699 legally-constituted companies working in the energy sector in the UK, has been collated. Information from the database has been translated into GIS, enabling data to be visualised on a map.

Companies are considered local based on at least one of the following:

- Relationships with local stakeholders
- Involvement in local decision-making
- (Some) local ownership of assets

Access the GIS map.

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About EnergyREV

EnergyREV was established in 2018 (December) under the UK's Industrial Strategy Challenge Fund Prospering from the Energy Revolution programme. It brings together a team of over 50 people across 22 UK universities to help drive forward research and innovation in Smart Local Energy Systems.

ISBN

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