BRIEFING

EnergyREV

Common types of local energy system projects in the UK

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Key findings

This policy briefing identifies four common types of local energy system project implemented in the UK over the past decade. Each type is distinguished by geographic, scale, technological and institutional characteristics:

1. Projects led by 3rd or public sector organisations emphasising energy demand-side technologies and sectors such as housing;
2. Projects led by private firms focused on electricity supply integration and management;
3. Projects led by private firms with multiple energy vectors integrating across demand, network, and supply-side technologies;
4. Projects led by power network operators focused on network improvements.

These four types are indicative of a wide range of project rationales and scopes, ranging from public policy objectives in housing to electricity-network management, integrating variable renewables, and multi-sector multi-vector energy-system integration. These are common types of local energy system projects only; the wider community and local energy landscape in the UK is still more diverse.

Key messages

The key message for policymakers and funders is that one-size-fits-all support mechanisms will not work as projects range widely in rationale, scope, technologies, and partner composition. As examples, some project types may require revenue support whereas others may require partnerships or regulatory reform to capture new value streams. The key message for system modellers analysing benefits, costs, and integration challenges for local energy system projects is that project heterogeneity can be captured efficiently using a small number of common types. A next step for further supporting modelling is to better understand how and why project types vary spatially.

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Supporting evidence

A longer technical report accompanying this policy briefing provides full details of the background context, literature, data, methods, and findings.

Acronyms

BEIS	Dept. for Business, Energy and Industrial Strategy,
CSE	Centre for Sustainable Energy
DNO	Distribution network operator
PFER	Prospering from the Energy Revolution
SLES	Smart local energy systems
UKERC	UK Energy Research Centre
WWEA	World Wind Energy Association

What is local energy? What are local energy system projects?

In general terms, local energy projects are energy-related activities, initiatives or investments responding to place-based needs or opportunities. Local benefits may accrue to people, organisations or infrastructures. There are many different terms and definitions (Box 1). Over the past 10 years, the UK landscape has shifted from community energy to local energy (Devine-Wright 2019).

Community energy describes collective citizen-led action motivated by a range of social, economic and environmental goals (Devine-Wright 2019). Community energy projects in the UK are diverse in form, scope and purpose (Seyfang et al. 2013). Urban energy projects have similarly been developed and led by a variety of community, private, local authority and partnership organisations (Rydin et al. 2013). Until recently, available financial incentives for renewables (e.g., feed-in tariffs) have seen site-specific electricity generation projects become more common, particularly rooftop PV (Braunholtz-Speight et al. 2020).

In contrast to community energy as civil-society led action, **local energy** is increasingly used to describe multi-actor partnerships to promote local economic growth, job creation, and skills development, as well as to develop replicable, scalable business models (Bridgeman et al. 2019).

Projects have moved from niche (e.g., remote island) to subsidy-driven (e.g., renewable power) to value-driven investments (e.g., providing flexibility and local balancing services to the grid) (Delta-ee 2019). Low carbon goals are also increasingly important amid proliferating declarations of local climate emergencies.

In this policy briefing, we focus on **local energy system projects** that seek integrated or 'systems' type solutions across supply, distribution and demand. This broadly follows the UKERC definition of **energy system demonstrators** and the CSE definition of **integrated local energy projects** (Box 1). This means we do not focus on other types of community and local energy such as community-owned renewable power projects (Braunholtz-Speight et al. 2020).

Local energy system projects can be led by private, public or civil society organisations, but do not tend to emphasise strong civic engagement (Bridgeman et al. 2019). Local authorities have varying capacities, competences, and experience to lead or participate in local energy projects (Kuzemko and Britton 2020). Limited policy remits and dramatic budget cuts post-financial crisis mean local authority-led energy activities to-date have been uneven, relatively small-scale, and focused on building stock improvements and energy supply (e.g., combined heat and power, building retrofits) (Webb et al. 2017). Consequently local energy system projects tend to be private sector led, although often with diverse project partners.

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Box 1: Different terms and definitions for community and local energy projects

Community power (WWEA): projects majority owned and controlled by local stakeholders with the majority of social and economic benefits distributed locally ; see also (Walker and Devine-Wright 2008).

Community energy (UKERC): small civil society organisations or social enterprises running local projects that generate renewable electricity or encourage energy saving and efficiency (Braunholtz-Speight et al. 2020).

Local energy (BEIS): any collective action project led by local organisations (public, private, civil society) to reduce, purchase, manage and generate energy for local benefit.

Integrated local energy projects (CSE): place-based solutions combining elements of demand and supply, involving more than one technology or service (Bridgeman et al. 2019).

Energy system demonstrators (UKERC): deployment and testing of more than one technology type that could underpin the operation of a low-carbon energy infrastructure in the future (Flett et al. 2018).

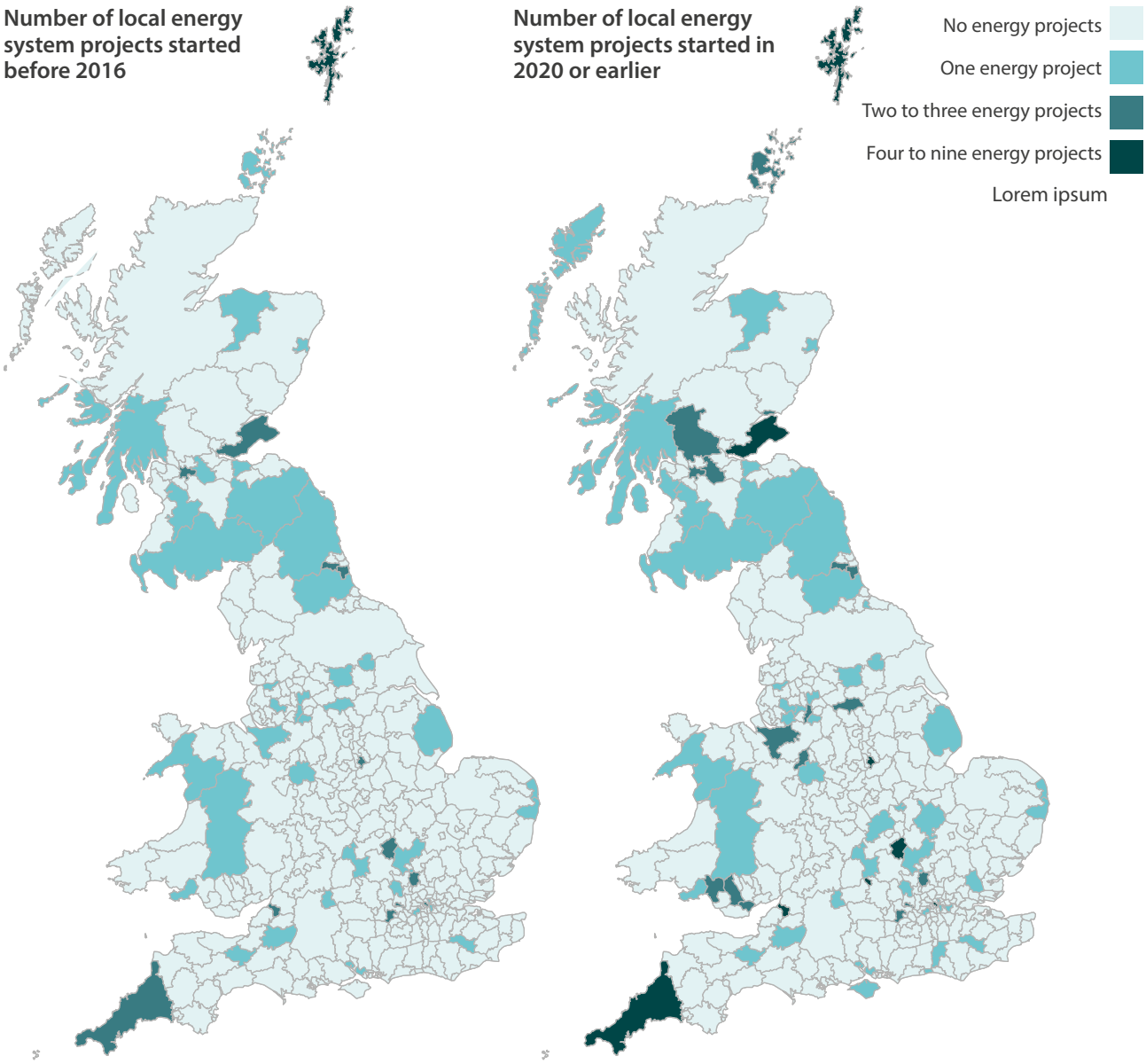
Smart local energy systems (PFER, EnergyREV): defined not by what they are, but by what they do in delivering cleaner, cheaper and more resilient energy services.

What are the characteristics and spatial distribution of local energy system projects in the UK?

We analysed the geographic, scale, technological, and institutional characteristics of 147 local energy system projects in a dataset initially compiled by UKERC (Flett et al. 2018) and subsequently extended as part of the EnergyREV project. As noted, the dataset does not capture all community and local energy, but a subset of 'integrated' or 'systems' type projects. The dataset is limited in its characterisation of projects. For example, projects also vary by purpose, value streams, and revenue sources, as well as social, environmental and financial outcomes, but these are not included in our analysis. There are 42 different types of technology used across the projects. We categorised these into 6 technology groupings to reflect different project rationales:

- **Variable Renewables**: intermittent or variable renewable power generation technologies
- **Generation & Storage, excluding Renewables**: distributed generation and storage technologies
- **Electricity Grid Integration**: flexibility and power grid integration technologies
- **Local Electricity Networks**: technologies for managing and balancing local power systems
- **Energy Carriers & Coupling**: alternative energy carriers and coupling between energy vectors
- **Energy End-Use**: energy end-use, management and control technologies

Figure 1 shows the spatial diffusion of projects by local authority area over the past decade in England, Scotland and Wales. (Only one project in the dataset was in Northern Ireland). Roughly half the projects in the sample started in 2016 or later. We found earlier and later projects shared similar characteristics with a few exceptions: later projects were significantly more likely to have larger budgets (>£2.5m), multiple energy vectors, and technologies in the Energy Carriers & Coupling grouping.



Later projects were also significantly less likely to be led by network operators because dedicated network funding rounds were largely completed before 2016. Very recent projects (started in 2018 or later) reinforced this trend, with projects led by local authorities and civil society also becoming less common.

Figure 1: Spatial diffusion of local energy system projects in England, Scotland and Wales. Maps show cumulative number of projects started by 2015 (left) and by 2020 (right) at the spatial resolution of local authorities. Data extended by the authors from (Flett et al. 2018).

What are common types of local energy system projects in the UK?

Cluster analysis is a statistical procedure that links cases with similar characteristics together in groups or 'clusters' while ensuring clear distinctions between each cluster. Using this procedure, we identified four clearly distinct types within the overall dataset of 147 projects. We describe the distinctive features of each cluster, further illustrated by a representative project from the dataset. We also show median (interquartile range) project budgets in £ million for each cluster.

- Cluster (1), n=41: Local energy system projects led by 3rd or public sector organisations and including demand-side technologies and sectors; median budgets of £3.3m (£0.6m - 7.2m);
  - » illustrative project: Active Homes Neath led by the Pobl Group in south Wales to integrate renewable technologies and reduced energy consumption in social housing.
- Cluster (2), n=24: Local energy system projects led by private firms (but not DNOs) with narrower budgets and scopes to cover supply-side integration of electricity technologies in a single sector; median budgets of £2.4m (£0.4m - 5.8m);
  - » illustrative project: Bus2Grid led by SSE in London bus depots to demonstrate electric vehicle-to-grid technologies and business models.
- Cluster (3), n=34: Local energy system projects led by private firms (but not DNOs) with broader scopes and larger budgets to cover multiple energy vectors integrating across demand, distribution networks, and supply-side technologies; median budgets of £4.0m (£1.2m - 13.4m);
  - » illustrative project: ReFLEX Orkney led by the European Marine Energy Centre to inter-link local electricity, transport and heat networks into a single controllable system including demand-side and storage resources.
- Cluster (4), n=47: Local energy system projects led by DNO or similar firms and focused on electricity network improvements; median budgets of £1.8m (£0.4m - 10.1m);
  - » illustrative project: Low Carbon Hub led by Western Power Distribution in East Lincolnshire to integrate significant amounts of low-carbon generation on to electricity distribution networks while avoiding network reinforcement costs.

Three of the PFER demonstrators lie within Cluster 3 which defines projects led by private firms, with an average of six other partners, involving multiple energy vectors and full system integration.[1] (The fourth PFER demonstrator, Project Leo, lies in Cluster 4 as it is DNO-led even though its broad technological scope is more characteristic of Cluster 3). Although the PFER programme aligns most clearly with Cluster 3, this is only one part of a much broader local energy system project landscape shown by the different clusters. Cluster 2 projects are more supply-side focused, Cluster 4 projects more network-focused, and Cluster 1 projects more demand-side focused, although projects in all of these clusters may include other elements.

It's also important to re-emphasise that the full UK landscape of community and local energy is wider still as the dataset analysed excludes projects without 'system' characteristics (Box 1). For example, a large number of community-led renewable power projects may be similar in technical configuration to local energy system projects in Cluster 2 but are not included in the dataset analysed.

Although project objectives were not measured in the dataset, the clustering suggests a wide range of motivations and rationales, ranging from projects with clear social purpose involving public actors tackling energy end-use (Cluster 1) to those addressing wider energy-system challenges from electricity supply integration (Cluster 2) and electricity network balancing and management (Cluster 4) to flexibility through vector coupling and integrated system management (Cluster 3).

1 The Prospering from the Energy Revolution (PFER) programme initially funded four smart local energy system (SLES) projects as demonstrators: Energy Superhub in Oxford, ReFLEX in Orkney, Local Energy Oxford (Leo), and Smart Hub SLES in Sussex.

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These different project rationales are evident in both urban and more rural locations, at specific sites and dispersed across multiple sites, and involving public and 3rd sector partners as well as private firms.

There are some differences in the clustering both spatially and through time. Over half of all projects are in SE England and Scotland, but Scotland had a significantly higher proportion of Cluster 1 projects, whereas SE England had higher proportions of Cluster 2 & 3 projects. This points to a more conducive regulatory and funding environment for public sector and civil society-led projects in Scotland. Similarly there are some significant differences temporally. Recent projects started in 2018 or later are less likely to be in Clusters 1 & 4, and more likely to be in Cluster 2. This points to reductions in local authority capacity (austerity budget cuts) and available revenue support (feed-in tariff cuts) which have pushed projects to capture more diverse value streams.

Why is it useful to know about common types of local energy system projects?

Local energy system projects are designed and implemented for a wide variety of reasons. They also vary in their geographical, technological, and institutional characteristics. Understanding this heterogeneity supports analysis and policymaking. It makes clear there are no one-size-fits-all policy support mechanisms for local energy system projects. To be effective, specific funding and skills development programmes need to match the needs and characteristics of desired project types. Societal engagement is needed to discuss whether each project type merits similar levels of public policy support and funding, drawing on evidence of the different types of value created by each type at local and national levels.

Analysis and modelling of local energy system projects integrated into regional and national systems similarly needs to account for project heterogeneity. The project archetypes identified in this report capture variation while offering a parsimonious framework for case-specific modelling. These findings will support further analysis by the EnergyHub and UCL-BRAIN modelling teams within the EnergyREV consortium.

There are important limitations to this analysis of local energy system projects noted through this briefing. First, the dataset only captures a sample of local energy system projects so is not representative of the much broader landscape of local and community energy in the UK. Second, the dataset does not measure rationales, value streams nor success criteria per project, so we cannot assess if and how some common types of project were more successful than others, nor whether later projects learnt from earlier projects in this respect. Third, the dataset is biased towards projects with capital funding from public or public-private sources for which data are more transparently reported. Many additional projects using private capital funding are not included in the analysis.

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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.

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