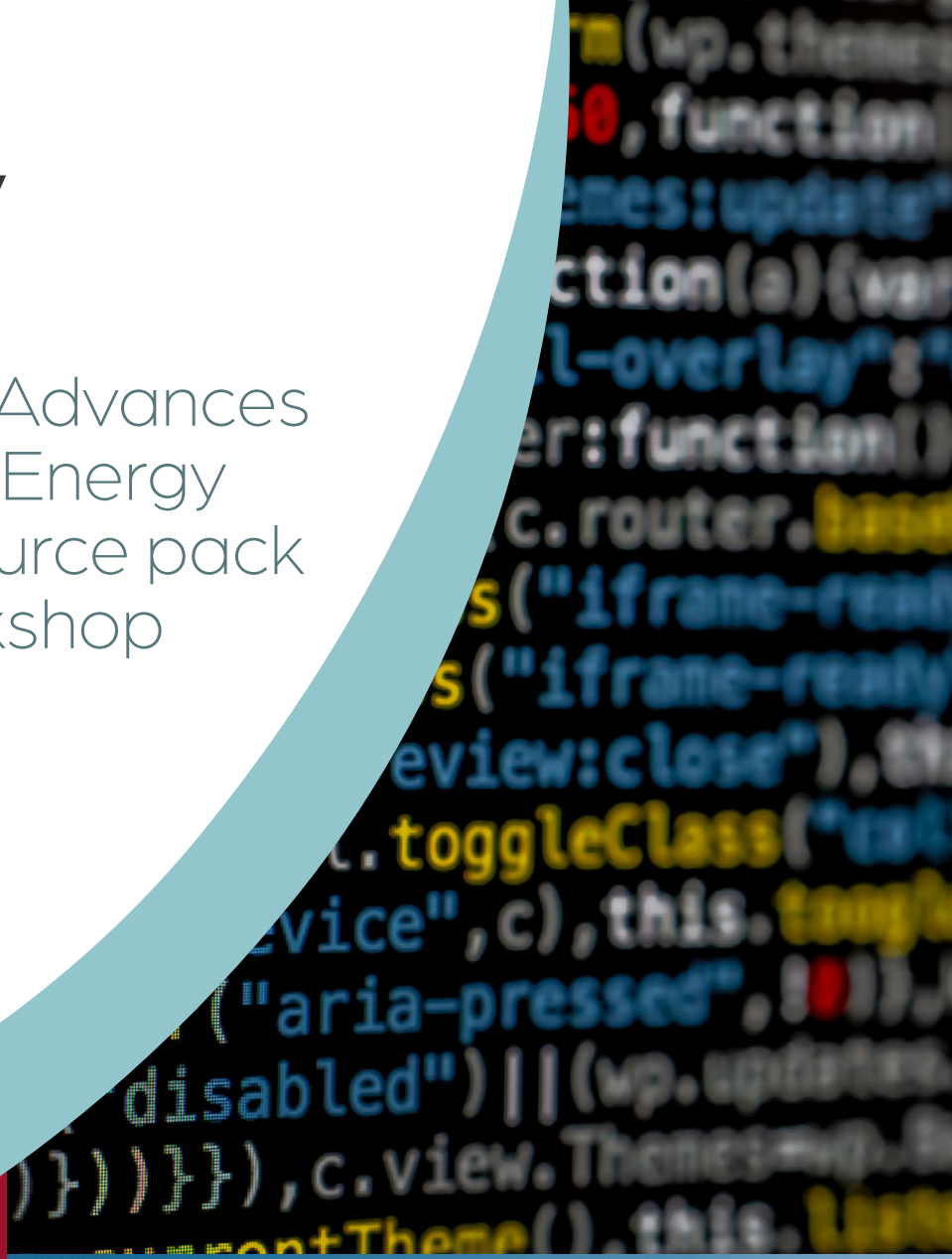
EnergyREV

Cyberphysical Advances in Smart Local Energy Systems: Resource pack for school workshop participants

Charlie Ingram, Alison Halford and Elena Gaura

Spring 2023



Smart local energy systems

Artificial intelligence

Data Digitisation

Ethics

INDUSTRIAL STRATEGY

UK Research and Innovation

Authors

- **Charlie Ingram** | Coventry University
- **Alison Halford** | Coventry University
- **Elena Gaura** | Coventry University

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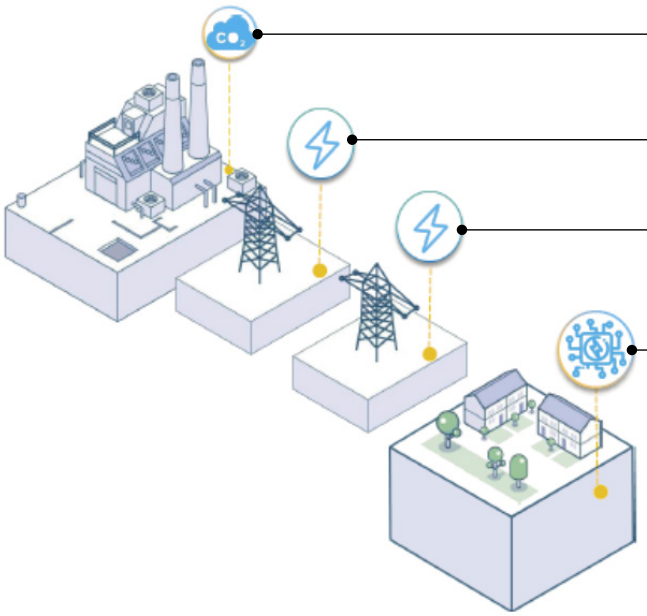
Contents

Our current energy system



Generation/Production
Largely centralised and sold via wholesale markets

Transmission
Via National Grid, Scottish Power Transmission and Scottish Hydro Electric transmission

Distribution
Via 14 Distribution Network Operators (DNO's)

Supply
Transactional, leading to an unengaged customers who only switch based on price

Source: Healey, D. (2021).

A centralised system that is...

Insecure

Old Equipment makes poor resilience and increases maintenance costs. Limited remote control and active monitoring

Ineffective

Old one directional layout leads to ineffectiveness through poor design, increased building costs and a reliance on customers to notify companies of outages.

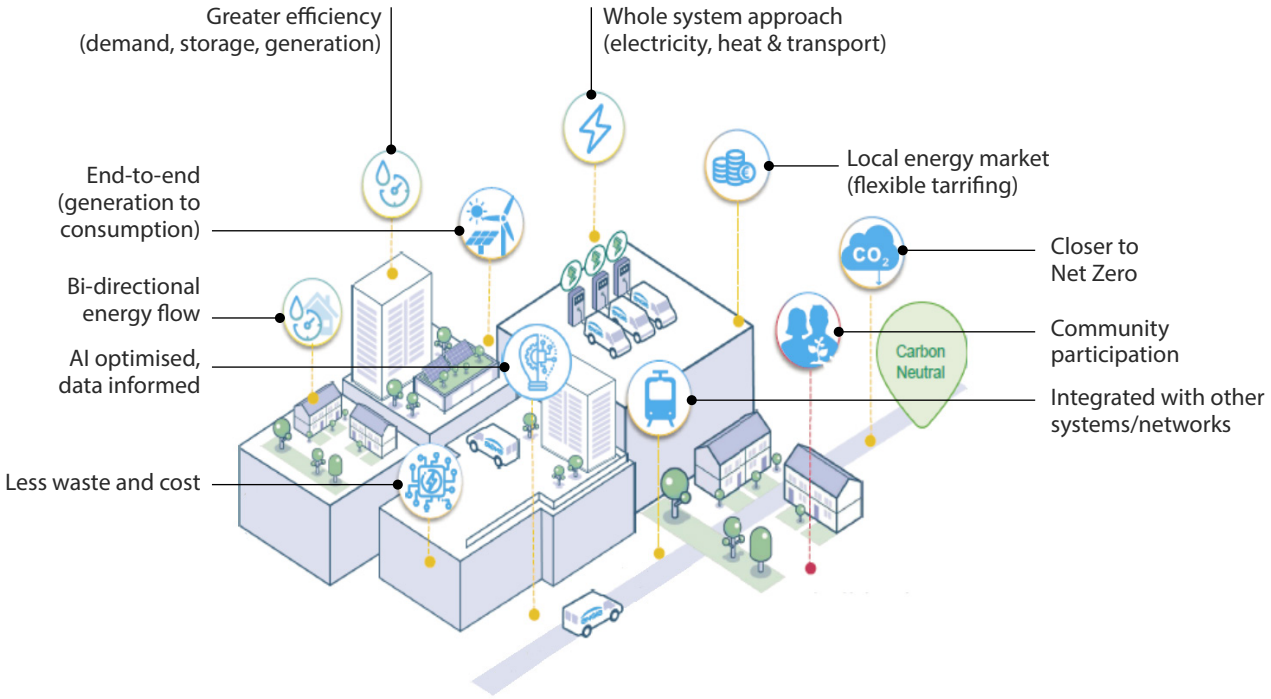
Inefficient

60% of energy is wasted in the process of generating power. 5-10% loss in delivering over long distances and further losses due to inefficient generation to demand.

Unsustainable

24% of UK CO2 emissions come from energy generation and supply.

Smart local energy systems



Source: Healey, D. (2021).

Decarbonised

Renewable-based low-carbon energy system. Competitive through a drop in production costs.

Decentralised

Local production methods allow for renewable energy to be generated and traded locally.

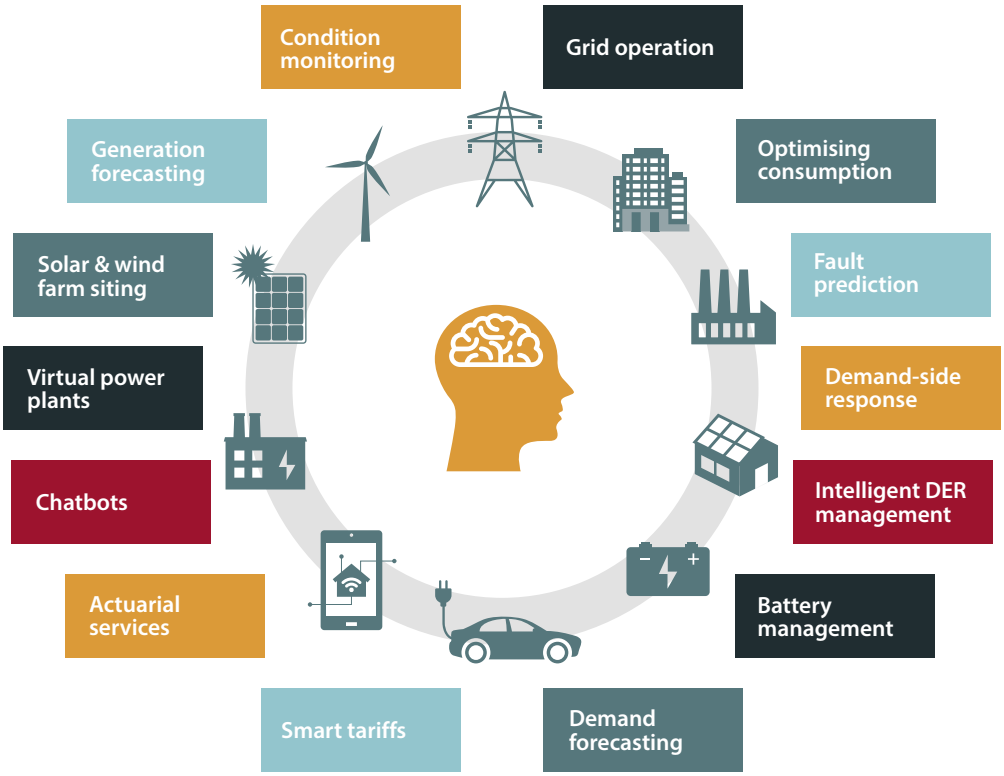
Democratised

Locally invested, to encourage behavioural and social changes required.

Digitalised

Digital network of production, distribution and supply. Enables local data tracking and responsive generation, reducing generation requirements

Why do we need AI?



Source: Morris, E., Stamp, K., Halford, A. and Gaura, E. (2022).

To help achieve Net Zero emissions by 2050, AI can help us by:

Optimising performance by modelling virtual representations of energy infrastructures
Improving the maintenance of energy systems and cyber security
Aiding consumers in decision making around their energy usage
Generating market innovation by automating energy trading between consumers who also produce energy

Barriers for SLES

Strategy, policy and regulation

- Centralised decisions
- Lack of vision
- Prescriptive regulation
- Lack of local-government powers

Markets and business

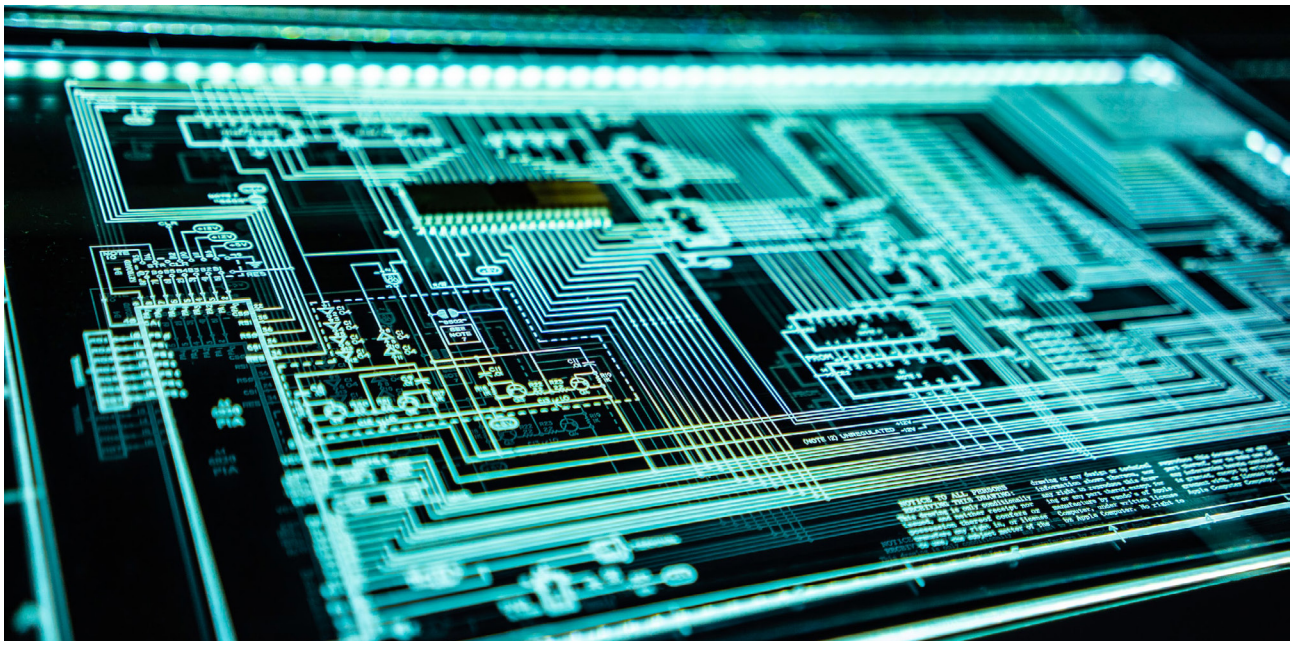
- SLES can't access local value
- Wider benefits blur traditional boundaries
- Business models don't fit licences

Scalability & skills

- Case Study SLES projects
- Lack of learning from mistakes
- Skills vary regionally
- Time lag on skills development

Engagement

- Lack of supportive culture
- Some households could be excluded from SLES
- Data protection



Source: Hardy, J., and Morris, M. (2022).

Ethical considerations

Regulatory concerns:

As technology evolves, there is a need for regulation, legislation and guidance to shift and change in response to changing requirements, such as the increasing use of AI and energy data.

End user awareness

By participating in a SLES, users of energy will need to provide data on usage habits at a minimum, which could lead to identification through energy use patterns. It is essential that end users are fully informed on what data is collected and how it is used or inerpreted.

Responsible and secure data handling

As SLES require a huge amount of data handling, there needs to be strategies in place to ensure that data is held and transferred securely, and protected from cyber attacks.

Education in the energy sector

Companies currently are not sharing data due to a fear of ethical and privacy-based malpractice, which stalls technological advancement.
In response, companies should invest in programmes, including training that raises awareness of ethical considerations, to create a community of practice and an ethics-conscious culture that promotes innovation.

Source: Morris, E., Stamp, K., Halford, A. and Gaura, E. (2022).

Our energy utopia

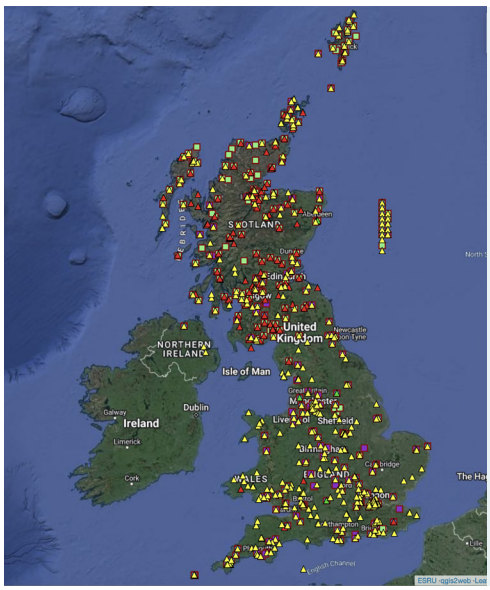
Policymaking and Governance to allow for local authorities to trade, regulate and supply energy in a devolved model of energy distribution.

Smart local Energy Systems are a significant part of the fabric of the energy system, reducing emissions and hitting the Net Zero Target by 2050.

Energy data is shared across multiple organisations and users. Data is secure and in line with data protection laws and regulations.

The use of **Artificial Intelligence** and **Machine Learning** are bolstered by big data sets, and real- world case study experimentation.

Useful visualisation tools

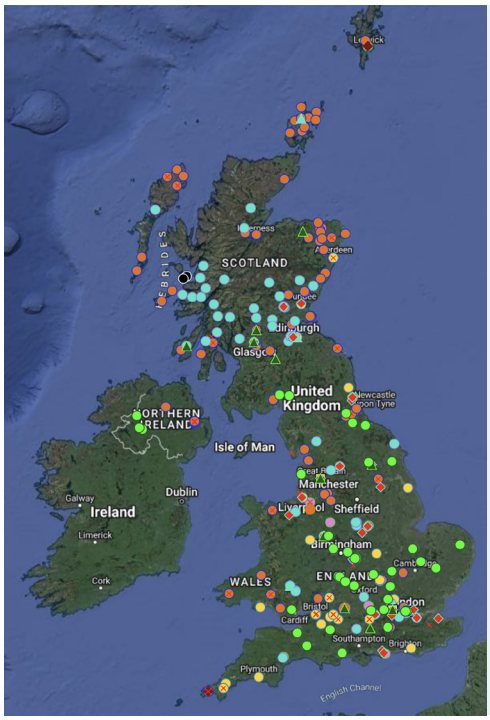


A GIS map of local and community energy projects across the UK

Source: Rae, C., Kerr, S., and Maroto-Valer, M. (2021).

As part of our ongoing research into the barriers faced by previous and existing Smart Local Energy Systems in the UK, the EnergyREV team at Heriot-Watt University have compiled a database of local and community energy projects in the UK.

The EnergyREV UK Local Energy Map combines data from a number of existing sources to form a single, comprehensive and freely available source of information on current and historic local energy projects in the UK.



A GIS map of local and community energy projects across the UK

Source: Fuentes Gonzalez, F., and Webb, J. (2021).

The EnergyREV Business and Finance Research Team, with the technical support of researchers based at the University of Strathclyde, have built a GIS map of local energy businesses in the UK.

The companies included illustrated on the map are defined as local based on at least one of the following:

1. a business with relationships to local stakeholders
2. involvement in local decision-making, and/or
3. (some) local ownership of assets.

This is an exploratory approach to classifying businesses as local and will be further developed over time.

Further resources

Insights and tools

In our words: Dr Callum Rae on System integration

In our words: Dr Mike Fell on Interdisciplinary knowledge synthesis

Pathways for the upscaling of smart local energy Systems

The practice of AI and ethics in energy transition futures

Beyond the pilots: Current local energy systems in the UK

Cybersecurity in Smart Local Energy Systems: requirements, challenges, and standards

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This document is part of 'The state of energy data in the UK landscape: gaps, challenges, actors and networks project' (EDUL), as part of WP1.1 Cyberphysical Advances in Smart Local Energy Systems.

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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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