UK Research and Innovation

Smart local energy systems: the energy revolution takes shape

Projects from **Prospering from the Energy Revolution**, a UKRI Industrial Strategy Challenge Fund programme

Rob Saunders
Challenge Director
UKRI Prospering from the Energy Revolution challenge programme

Introduction

We are in the midst of a revolution in the supply, storage and use of energy. Fundamental changes are resulting from our mission to reach net zero carbon emissions by 2050.

Traditional centralised energy systems have been inefficient and unadaptable – but new possibilities point to a future of flexible, clean energy systems, designed around consumers.

Great opportunity lies in smart, integrated local energy systems which use the latest advances in electric vehicles, renewable generation, batteries and digital data technology.

These systems have the potential to bring cleaner, cheaper, more efficient energy to our communities and to build local jobs and prosperity.

But building such integrated local systems at scale is new territory. It takes innovation, vision and collaboration. It involves new business models, advanced data management, and bold investment. It needs a supportive policy environment, and a shift in thinking.

And so, to prove what is possible, in 2018 UK Research and Innovation set up the Prospering from the Energy Revolution challenge programme. We are investing around £104 million, matched by industry, to help businesses, researchers and local communities develop, test and prove smart local energy systems.

This booklet presents many of the inspiring projects now in progress under the programme, all around the UK.

Driven by forward-thinking companies, researchers and communities, together they are showing how smart local energy systems can be part of a better net zero future.

Each project is different, but they share a common vision: to show that by innovating and working together, communities, businesses and investors can create smart local energy systems that build local prosperity and provide cleaner, cheaper energy for all.

Rob Saunders
Challenge Director
January 2022

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

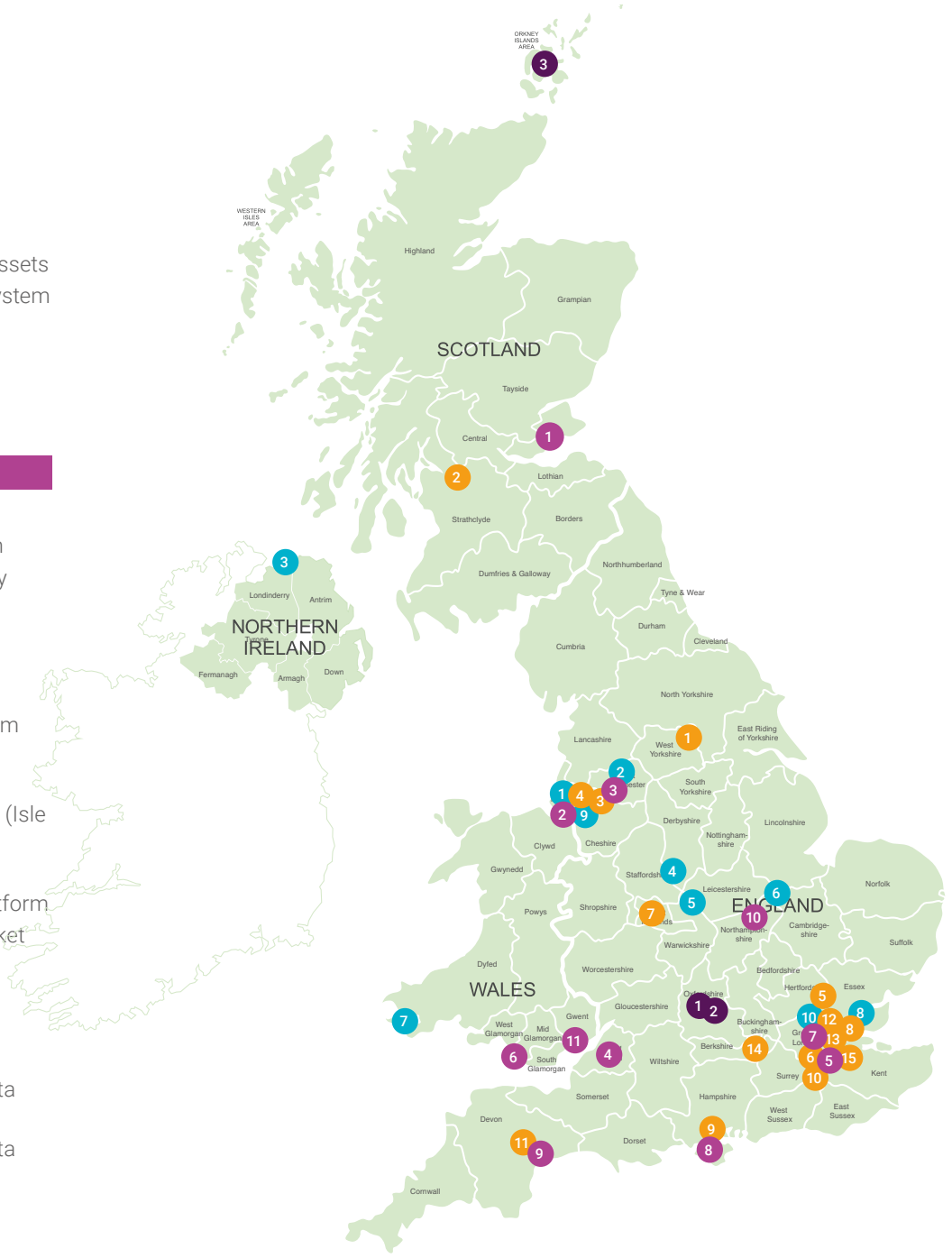
1. WESLID
2. E-Port Smart Energy Master Plan
3. Greater Manchester Local Energy Market
4. Bristol Energy Smart System Transformation
5. BankEnergi
6. Intelligent Bridgend energy system design
7. GreenSCIES
8. Energy Autonomous Community (Isle of Wight)
9. LEMDEx
10. DLT micro-grid management platform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



Click a project name to go to the relevant page. Each project page has a link back to this map.

The UK could save over

£8bn per year*

by 2040, if 50% of energy goes through smart local energy systems

29,060 households

4,776 electric vehicles

2,810 businesses and other organisations

. . . are expected to be connected to local energy systems through these projects by **April 2022**

Prospering from the energy revolution

5 years of smart local energy systems projects: 2018-2023

£104m government investment

£500m approximate industry investment expected

60 business-led projects around the UK, involving:

180 businesses, universities, local authorities and other bodies working together

* https://www.energyrev.org.uk/outputs/early-insights-into-system-impacts-of-smart-local-energy-systems

Smart local energy systems – the vision

Our centralised energy system has evolved to take advantage of cheap fossil fuel energy, distributing power, gas and fuels from central supply points in single directional flows.

While that has worked well, it is inefficient and emits huge amounts of carbon. It also fails to maximise the benefits of cleaner technologies now available, which need more flexibility in demand, two way energy flows and better connectivity across power, heat and mobility provision.

Joining things up at a local level brings a new range of opportunities to do just that.

This is because we live our lives locally. Our energy use in homes, schools and workplaces happens in those places; we travel in and between places; and our communities are based around local neighbourhoods.

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.

Smart local energy systems: the energy revolution takes shape

Proving what's possible, fast

In the race to net zero, progress is now urgent – and local integrated approaches to energy are part of the answer

But for smart local energy systems projects to grow and multiply, businesses, communities and investors first need to understand what is possible, what works, and where help can be found.

To help develop and trial these game-changing approaches, UKRI's Prospering from the Energy Revolution programme has co-funded over 50 smart local energy system projects around the UK.

They include:

3 full-scale demonstrators

11 concept design projects

10 detailed design projects

15 projects on key technology components

12 projects on energy data access and applications

18 earlier 'fast start' projects

The concept design projects have been completed, while the other projects are running until 2022 or, in the case of the demonstrators, 2023.

The programme also funds two important initiatives to increase knowledge and share best practice, for the benefit of everyone working to make the energy revolution a reality. These are EnergyRev, a large multi-university research consortium, and the Energy Revolution Integration Service (ERIS) run by the Energy Systems Catapult.

Through all these projects and programmes a body of evidence and expertise is rapidly growing – covering everything from regulatory hurdles to consumer attitudes, from systems thinking to data management, and from business models to investment criteria.

The focus on place is central to the idea of smart local energy systems. Most of these projects are working on the ground in towns, cities and communities throughout the UK.

Collaboration is also vital. Most projects feature a consortium of partners working together, who each bring their own expertise, influence and assets – from local authorities to gas and electricity companies, and from data experts to battery storage and electric vehicle specialists.

Each project is different, depending on its scope, objectives and local circumstances, but each has its own story to tell and is on its own exciting journey as part of the drive towards a net zero future.

To find out more about the projects featured in this booklet, please follow the links after each entry where shown.

The giant hybrid battery system installed as part of the Energy Superhub Oxford project.

Project LEO will provide crucial research and learnings, accelerating the transition to new local energy systems and the move to a smart, flexible, low carbon future.

Stewart Reid, Head of Future Networks, Scottish and Southern Electricity Networks

1 Local Energy Oxfordshire (Project LEO)

Developing the electricity grid of the future

Project LEO (Local Energy Oxfordshire) is one of the most wide-ranging and holistic smart grid trials ever conducted in the UK. The £40 million project is running trials in Oxfordshire to build a broad range of reliable evidence of the technological, market and social conditions needed for a greener, smarter, more flexible, and fair electricity system.

It is exploring ways to meet the UK's increasing electricity demand, by releasing the potential of the network in a sustainable and flexible way. Using new smart technologies it aims to unlock opportunities for renewable generation and demand response that can help flexibly balance local supply and demand.

It aims to understand how this can bring value to consumers, as well as opportunities for communities and market providers. It will be doing this in a real-world environment, trialling new flexibility markets, informing investment models and ultimately assessing the benefits of flexibility to the energy system.

As part of the project, up to 90 plug-in projects – solar, heat networks, smart neighbourhoods, micro-grids, EV and transport hubs, new housing developments and large flexible loads – will demonstrate new models for investment in distributed energy resources.

Project LEO is replicating and trialling aspects of smart local energy system models already being explored by industry, government and the energy regulator, via the Energy Networks Association Open Networks Project.

Working closely together, the diverse partners in Project LEO are developing the future electricity grid – and creating learnings that can be shared across the country to benefit the whole of the UK in its journey to net zero.

James Ochiltree of Low Carbon Hub at the Rose Hill Primary School in Oxford.

UKRI funding: £15.2m

Project partners
Southern Electric Power Distribution plc (lead)
EDF Energy
Nuvve
Open Utility
Oxford Brookes University
Oxford City Council
Oxfordshire County Council
The Low Carbon Hub C.I.C.
University of Oxford

More information
project-leo.co.uk

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The City Council is working towards a Zero Carbon Oxford to tackle dangerous climate change, in the time available to us to save the planet. Uniquely, this £41m once-in-a-generation down payment will move the Council closer to achieving this vision.

Councillor Tom Hayes, Deputy Leader and Cabinet Member for Green Transport and Zero Carbon at Oxford City Council

2 Energy Superhub Oxford

A world-leading urban decarbonisation project

Energy Superhub Oxford (ESO) is a world-leading urban decarbonisation project which is helping Oxford to reach net zero by 2040.

The project is showcasing an integrated approach to battery storage, rapid electric vehicle (EV) charging, low carbon heating and smart energy management technologies to cut carbon and improve air quality across the city.

It will provide a blueprint for towns and cities globally to accelerate net zero, reducing emissions and improving public health by accelerating a switch to electric vehicles and decarbonising heat in homes and buildings.

Uniquely, ESO is connecting directly to the national high voltage electricity network, unlocking new energy capacity to support the electrification of heat and transport.

The £41 million project will use a giant hybrid battery – combining lithium-ion and vanadium flow systems – to help power more of our lives with renewable energy from the wind and sun. A machine learning optimisation and trading system will control the battery to provide vital flexibility to National Grid and make the best use of the different asset characteristics.

ESO will also install a powerful electric vehicle charging network, enabling the ultra-fast charging of electric cars, taxis, trucks and buses at key locations across the city. Ground source heat pumps will provide low carbon heating to homes and businesses, and smart management technologies will optimise their performance for cost and comfort.

The project has already reached several key milestones, with almost 60 heat pumps installed, the 50MW lithium-ion battery operating, 40 electric vehicles added to Oxford City Council's fleet, and work underway to install the high-powered EV charging network. In early 2022 the project expects to open the UK's largest public charging hub, offering fast to ultra-rapid charging for hundreds of vehicles per day.

Energy Superhub Oxford will enable rapid charging of the city's electric taxis.

UKRI funding: £10.3m

Project partners
Pivot Power – part of EDF Renewables
Habitat Energy
Invinity Energy Systems
Kensa Contracting
Oxford City Council
University of Oxford

More information
energysuperhuboxford.org
www.youtube.com/watch?v=Mehia3tArkg

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3 ReFLEX Orkney

Pioneering an integrated, affordable, low-carbon energy system for the future

Since 2013, Orkney in Scotland has met over 100% of its electricity demand from renewable energy (mostly wind and solar).

In an energy revolution led, inspired and supported by the community, Orkney already has more than 700 individual renewable energy generators.

However, heating and transport on the islands are still heavily dependent on oil. Now, the ReFLEX Orkney project is addressing the challenge of decarbonising the islands' full energy system.

The project is building an integrated energy system (IES) for Orkney – linking local electricity, transport and heat networks into one controllable, overarching system, and digitally connecting the islands' distributed and variable renewable power resource to flexible energy demand.

At the heart of the project is the demonstration of flexibility (the ability to modify electricity generation and consumption patterns in response to variability) using technologies like battery storage, electric vehicles, smart chargers and smart meters.

The project is also creating community-focused initiatives such as electric buses, a local electric car club and the integration of green hydrogen for storage and transport.

ReFLEX aims to take away the technical and financial pain of energy transition by making the technology choices very simple for people and by providing services on a pay-as-you-use, lease or rental basis.

Data collected from the people, homes and businesses who host these new energy technologies will help with further research into decarbonising energy systems.

In March 2021 ReFLEX Orkney won 'best onshore energy project' and 'best smart energy/carbon reduction project' at the Highlands and Islands Renewable Energy Awards.

ReFLEX Orkney: the project partners and co-funders.

UKRI funding: £8m

Project partners
European Marine Energy Centre (EMEC) (lead)
Aquatera
SMS
Community Energy Scotland
Heriot-Watt University
Orkney Islands Council

More information
reflexorkney.co.uk

Click here to return to project list

7 10 GreenSCIES and GreenSCIES 2

Integrating heat, power and transport

GreenSCIES, or Green Smart Community Integrated Energy Systems, was a concept design for highly efficient smart energy systems, using the London Borough of Islington as an example.

It devised a smart grid integrating heat sources such as the underground system, substations, sewers, supermarkets and data centres, with battery storage and electric vehicle-to-grid points.

After the success of the concept stage, GreenSCIES 2 is now developing detailed designs for technical and business models. In these, heating and cooling energy is exchanged between buildings through a heat network that uses distributed heat pumps and recovers waste heat from data centres. Decentralised energy centres provide solar energy hubs, alongside batteries for energy storage and electric vehicle charging. The hubs use an AI control system to operate on demand and flex with grid requirements, making the most of intermittent renewable energy and helping consumers always get the best tariff.

London's Islington is the initial focus of the GreenSCIES local energy integration project.

Currently focused on Islington with plans to replicate in the West Midlands and Sheffield, this is the first large smart energy system in the UK to integrate energy technologies across heat, power and transport – a key future solution for low-carbon cities. At the 2021 Association of Decentralised Energy Awards, the GreenSCIES consortium won the Integrated Energy category.

Combined UKRI funding: £3.31m

Concept design project partners
London South Bank University (lead)
Building Energy Solutions
Carbon Data Resources
Carbon Descent Projects
Grid Edge
London Borough of Islington
Transport for London
Ubeeqo UK
Engie Services Holding UK

Detailed design – above plus:
Building Low Carbon Solutions
Cenex
Consortio
Cullinan Studio
E.ON UK
Hanger19
Repowering
Silver Energy Management Solutions
West Midlands Combined Authority

More information
www.greenscies.com

3 2 Greater Manchester Local Energy Market

A local energy market to support a lower-carbon future

The Greater Manchester Local Energy Market (GMLEM) aims to change the way the market currently works by cultivating a peer-to-peer trading scenario suitable for the challenges of the mid-2020s.

The project is based on an ambitious whole-system vision for how energy is generated, traded, transported, supplied and used across the city region. It envisions localising energy systems, reducing the distance energy travels to its point of use and optimising consumption. This requires a unique new local energy market maker platform to integrate smart technologies across heat, power and transport and link together local demand with supply via local distribution and national transmission.

The system not only reduces carbon emissions but places the consumer at the heart of the design, aiming to cut costs for residents and local businesses and to protect the most vulnerable from rising energy bills. The project will build market confidence, leading to more local investment and speeding up deployment of renewable energy and storage assets.

Geospatial energy planning in the form of local area energy planning is core to the project. It is vital to understand the limitations and opportunities presented by the geographical and socioeconomic conditions of different areas, and how new local renewable generation, heating, mobility resources and infrastructures can best fit. GMLEM is working closely with local communities to draw up these Local Area Energy Plans that will support all the local authorities into the future.

Combined UKRI funding: £3.11m

Concept design project partners
Electricity North West (lead)
Greater Manchester Combined Authority (also detailed design lead)
Bruntwood
Hitachi Europe
Upside Energy (now Kraken Flex, part of Octopus Energy)

Detailed design – above plus:
Cadent Gas
Daikin Airconditioning UK
Cornwall Insight Group
Graham Oakes
Northwards Housing
Ovo Energy
Regen SW
The Society for the Reduction of Carbon

More information
www.greatermanchester-ca.gov.uk/what-we-do/environment/energy-supply/

Click here to return to the list of projects

3 Girona

Helping customers implement smart low-carbon energy solutions

In Northern Ireland, the Girona project is trialling the use of photovoltaic panels with battery storage across a range of homes and businesses, to help consumers use zero-emission energy and cut their electricity costs.

Girona Energy, the project leader, is a consortium of Poweron Technologies and GES Group. The project aims to make the energy market more democratic for both individuals and businesses, combating the current trend of users feeling powerless, uninformed and out-of-pocket.

In partnership with Causeway Coast and Glens Council, the Girona project is creating a micro-grid, working with around 60 homes in the Greater Coleraine. In the trial, consumers have the chance to install solar panels (if there is no renewable generation at the property already) and a Sonnen SB10 battery to store the energy. The cost is spread out over time and supported by investment from the Girona partners.

The system includes an app allowing customers to monitor and understand their electricity generation and consumption, helping them to potentially profit from unused capacity and to reduce their energy costs. Participants are expected to see an estimated 40% reduction on their current electricity bill.

In the longer term, the partners plan to work with housing associations, local councils and power network companies to expand the roll-out of the technology to the rest of the UK and Ireland.

UKRI funding: £2.11m

Project partners
Girona Energy (lead)
GES Group
Poweron Technologies (The Electric Storage Co.)

More information
gironaenergy.com

6 Peterborough Integrated Renewables Infrastructure (PIRI)

Integrating energy supply, demand and storage in cities

The PIRI project is the largest smart city energy regeneration project in the UK. It focuses on supporting sustainable growth and future expansion challenges in cities by developing enabling infrastructure integrating electrification, heat and mobility.

Electricity: Creating a local electricity network will balance production and use of energy locally and reduce the strain on the national distribution grid.

Heat: Peterborough has a waste-to-energy plant which generates electricity and produces steam – currently condensed back into water. A next-generation heat network using this wasted energy to heat businesses and homes would remove the need for individual boilers, reducing both cost and carbon emissions and improving local air quality.

Mobility: A low-carbon infrastructure network with widely accessible charging points will allow for the electrification of Peterborough's public transport system and council vehicles. The network will allow energy generated during the night – when demand is lower – to be used to charge vehicles.

UKRI funding: £0.98m

Project partners
Peterborough City Council (lead)
Cranfield University
Element Energy
Smarter Grid Solutions
SSE Utilities Solutions
Sweco UK

More information
pirienergy.co.uk/

Technology to balance demand and supply plays a major role in this scheme. The goal is to meet the fluctuating demands of the city by sharing and recycling energy within a flexible local system.

The project is part of Peterborough's drive towards a net zero carbon future and aims to create an investment-ready project that can be replicated by other local authorities. Through public-private collaboration, the partners are developing a whole systems design at a pace and scale not previously seen in the UK energy industry.

Peterborough's PIRI project integrates electrification, heat and mobility across the city.

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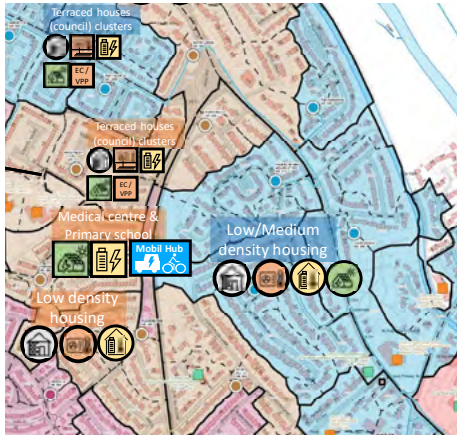
4 Zero Carbon Rugeley

A town-wide smart local energy system including the former Rugeley Power Station site

Zero Carbon Rugeley is a project to produce an innovative design for a town-wide Smart Local Energy System (SLES) including around 2,300 new homes at the former Rugeley Power Station site. The system will be sustainable and low-carbon, driving the regeneration of the town and its energy infrastructure while offering additional services and value to residents.

In designing the SLES, the project partners will take full advantage of the latest renewable energy technologies and smart control systems to deliver clean, affordable energy for residents, including mobility, housing retrofit and generation. The innovative Rugeley SLES will create a scalable energy solution that can be replicated in other areas in support of the UK's transition to a zero-carbon future.

At the centre of this pioneering project is the Rugeley community; residents, local businesses and commuters who access the area regularly. Crucially, 'User-Centric Design' is embedded in the proposed solutions, using innovative community engagement methodologies to ensure the wants and needs of the community are addressed. Zero Carbon Rugeley will create a 'bespoke Rugeley SLES', not simply an 'SLES for Rugeley', demonstrating how carbon emissions and energy costs can be reduced whilst simultaneously boosting local economic regeneration and social integration.



The Rugeley design includes a huge variety of assets and neighbourhoods across the town.

UKRI funding: £1.4m

Project partners
Engie Services (lead)
Cadent Gas
Chase Community Solar
Conigital
Connected Places Catapult
Keele University
Opus One Solutions
Regen SW
Stoke-On-Trent and North Staffordshire Theatre Trust
Sustainable Housing Action Partnership
West Midlands Combined Authority

More information
rugeleypower.com/zero-carbon-rugeley-project

8 Project REMeDY

A revolution in energy system design and green technologies

Project REMeDY is addressing the energy market's failure to capture the benefits from the green technology revolution.

To do this, it is developing a new business model for energy systems which are integrated horizontally (working across electricity, heat and mobility) and vertically (connecting generation, distribution, flexibility and supply).

The model integrates system operation and supply at a local level in a way that puts customers first. Additionally, it works for financiers and is compliant with current regulation. The model provides a blueprint for a new energy system design, enabling the progression from the faltering 'supplier hub' model to a highly efficient zero-carbon architecture.

Project REMeDY is based in Southend-on-Sea, Essex. The approach used will produce a contemporary local energy system design to cover Southend. The design will include new building developments, as well as aiming to introduce financially viable retrofit models. This design will be potentially replicable in other towns and cities in the UK.

A major investment prospectus will set out capital funding arrangements for the design, with work on the first major infrastructure projects planned for 2022.

UKRI funding: £2.34m

Project partners
Southend-on-Sea Borough Council (lead)
FutureGov
Imperial College London
Places for People Group
SMS
University of East Anglia
Vital Energi

More information
netzeroremedy.uk

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7 Milford Haven: Energy Kingdom

Exploring the role of hydrogen in a decarbonised energy future

This project focuses on the Milford Haven Waterway, the largest estuary in Wales. It aims to develop local markets which will help energy users make the transition to renewables, and particularly hydrogen.

The paths to this transition include meeting the heating and transport needs of local people; new transport solutions for Pembrokeshire's 4.2 million annual tourists; and using wind and solar power to produce hydrogen.

For example, the project is exploring the power of local hydrogen fuelling through consumer trials. Two Riversimple Rasa hydrogen-powered cars use a filling station at Milford Haven Waterfront, supplied by an electrolyser on site which makes hydrogen from water using renewable electricity.

For heat, the project is installing a smart hybrid heating system at the Port of Milford Haven, with an air source heat pump paired with a hydrogen-ready boiler. Smart controls use renewable energy to run the heat pump when available, and switch to gas or hydrogen at other times.

The project is also designing a flexibility trading platform which will lower costs for consumers and help lift constraints on the local development of solar, wind and offshore power generation by enabling the use of new hydrogen technologies.

By building hydrogen-ready technologies into the Port's housing, commercial and renewables projects and allowing local people to test real-world hydrogen vehicles and home heating, the project is paving the way for the energy transition.

UKRI funding: £2.04m

Project partners
Pembrokeshire County Council (lead)
Milford Haven Port Authority
Offshore Renewable Energy Catapult
Riversimple Movement
Wales & West Utilities

More information
pembrokeshire.gov.uk/mh2-energy-kingdom

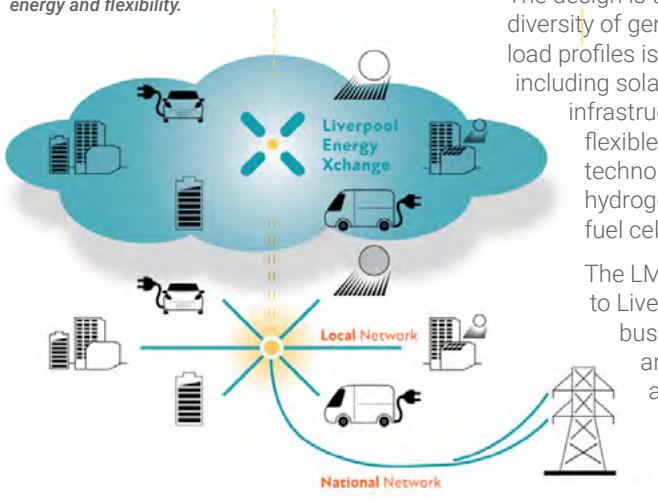
1 Liverpool Multi-vector Energy Exchange

A city-wide marketplace for local trading of energy and flexibility

The Liverpool Multi-vector Energy Exchange (LMEX) project is rethinking local energy business models in a more prosumer-centric world. The team is designing a market platform where businesses, universities, homes, landlords and institutions can trade their surplus energy with one another, and sell flexibility services to local and national system operators, in order to reduce energy costs, access new energy revenues, and support their city.

LMEX is developing new technology to enable effortless, automated trading on a secure platform, matching the needs of energy users with local energy production, and managing surplus and deficit via the national market.

LMEX: A citywide marketplace for local trading of energy and flexibility.



UKRI funding: £1.35m

Project partners
New Resource Partners (lead)
Decentralised Energy Solutions
Regent Capital Public
Smart Power Networks
SP Energy Networks
SP Manweb plc
University of Essex

More information
liverpoolenergyexchange.co.uk

The design comprises two critical layers: a Smart Network Controller to orchestrate energy assets; and a pool-based trading platform which co-optimises and clears bids and offers for energy and flexibility on a half-hourly basis.

The design is technology agnostic, and diversity of generation technology and load profiles is key to the business model, including solar arrays, EV charging infrastructure, heat pumps, and flexible loads, as well as new technologies such as green hydrogen electrolysis and hydrogen fuel cells.

The LMEX design is not confined to Liverpool: the technology and business models are versatile and replicable for roll-out across the UK and worldwide.

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9 REWIRE NW

Redefining the role of community in energy

REWIRE NW, which is led by community energy and sustainability charity Pure Leapfrog, is designing a smart local energy system for Warrington in Cheshire, with the future potential for wider rollout.

A core principle of this project is the belief that if value is created locally, it should be distributed locally.

The project's mission is to create a smart local energy system that is not only optimised in energy terms, but operates at maximum efficiency for the welfare and benefit of all of its stakeholders including the local community.

To achieve this, the project is developing new market arrangements that pave the way for change.

A market system architecture, centred on energy data and enhanced by 5G technology, will operate under a new entity, the Smart Local Energy Company. Together, these elements will drive the energy system towards a lower cost and lower carbon outcome.

REWIRE NW aims to demonstrate the benefits of increasing the role of the public and community sector in energy alongside commercial ownership, redefining the role of community in energy, and designing a system that prioritises local social and economic objectives.

UKRI funding: £1.40m

Project partners
Pure Leapfrog (lead)
Altana Wealth
Cadent Gas
Cornwall Insight Group
Gridserve Sustainable Energy
Integrated Environmental Solutions
Qbots Energy
SP Energy Networks
Switch2 Energy
Together Energy
University of Strathclyde
Warrington Borough Council

More information
https://carboncopy.eco/initiatives/warrington-rewire

5 West Midlands Regional Energy System Operator (RESO)

Designing a future energy system from the bottom up

This locally-driven project aims to maximise economic opportunities in clean growth and future mobility, and deliver local policy objectives, by designing a future energy system from the bottom up, to establish a cleaner, lower-cost and fully integrated energy system, using Coventry as the testbed.

The RESO design is a partnership approach that brings key decision makers together to enable the integration of new energy technologies into the existing energy, transport and economic infrastructure of the region – including low-carbon vehicles and transport models, energy storage, renewable energy technologies, and energy efficiency.

The project includes a capacity and flexibility trading mechanism which will be readily accessible to both energy users and suppliers – where 'suppliers' include electric vehicles and energy efficiency in buildings.

A key focus is encouraging investment in smart local energy systems, through an innovative governance design which allows a combination of strategic investment planning and virtually real-time system optimisation, which uses local price and value signals across electricity, gas, and heat distribution network assets.

The principle of intelligent control to manage local energy flows is already being demonstrated by a real-world system established on the University of Warwick campus, a community of over 30,000 people.

The RESO project is working to show how this can be replicated at city scale. Focusing first on Coventry, the team will then test how the design can be replicated more widely.

The West Midlands RESO project is planning Coventry's low carbon future.

UKRI funding: £2.04m

Project partners
West Midlands Combined Authority (lead)
Coventry City Council
Enzen
Western Power Distribution plc
Cadent Gas
Camirus
Electron Global
Places in Common
University of Birmingham
University of Warwick

More information
energy-capital-tfwm.hub.arcgis.com/pages/coventry-eiz

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2 Domestic Infrastructure and Network Optimisation (DINO)

The DINO project aims to address the fact that increasing reliance on electricity is causing issues for the operators of domestic electricity networks, which were designed to handle relatively low consumption.

Digging up streets to reinforce electrical infrastructure is counterproductive - both economically and from a carbon emissions perspective – so a smart solution is needed for local networks to allow households to share the available energy 'bandwidth'.

Project DINO is developing a load management platform that will allow network assets to communicate with household equipment. This network-to-device interface, enhanced through artificial intelligence, can warn household systems when the local network is under stress and automatically relieve that stress.

If an electric vehicle is charging rapidly at home but won't be needed until morning, the technology would temporarily reduce its charge rate to share the available energy across the neighbourhood – keeping the lights on while making sure the car still has a full battery by morning.

The DINO project is prototyping such a system using real-time power flow and consumption information from a new-build housing estate in Glasgow, combined with models of electric vehicle charging and heat pump usage. With a focus on developing a smart, scalable software platform, this is a first-of-its-kind prototype.

Project DINO: manage and balancing increased electricity demand.

UKRI funding: £343k

Project partners
Evergreen Smart Power (lead)
Energy Assets Networks
myenergi

More information
evergreensmartpower.co.uk/what-we-do/project-dino

10 Maximising Grid Services from Electric Vehicles (M-GSEV)

National Grid predicts that there will be 11 million electric vehicles (EVs) in the UK by 2030 and 36 million by 2040.

The transition to low-carbon vehicles is vital for net zero, but if unmanaged could disrupt electricity distribution networks and require large-scale upgrades. To prevent networks from being overwhelmed, effective managed charging solutions are needed. A trial by My Electric Avenue suggested that such solutions could reduce upgrade costs by more than £2bn by 2050.

To help address this, the M-GSEV project is developing a solution through which households can provide charging and flexibility services to the grid.

The existing ev.energy platform manages EV charging across the grid by optimising charging times and loads, saving owners money by using off-peak tariffs and reducing grid congestion.

In this project, ev.energy is partnering with app developer Gen Game to integrate 'gamification' features into the platform to maximise smart-charging behaviour amongst EV owners. The team is working on a range of gamification features and testing them across the UK, working with National Grid and UK Power Networks to measure benefits to the grid and to consumers.

UKRI funding: £343k

Project partners
ev.energy (lead)
GenGame

More information
ev.energy

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14 ADVENT – Advanced Data-driven Virtual Electricity Network Tracking

With the rapid changes affecting electricity grids, both in use and generation of power, new approaches are needed to monitor the health of the evolving electricity network.

The ADVENT project is developing and testing a new way of checking the resilience of the network and spotting problems before they occur, by monitoring voltage as widely as possible around a system.

Trials are currently under way in Harbury in Warwickshire, Writtle in Essex and Marlow in Buckinghamshire.

In each area the team is installing voltage recording devices in multiple homes, collecting voltage data from the homes' own circuits and from smart devices such as electric car chargers. The readings are compared against those taken at substations.

The project is exploring whether taking readings from multiple homes will allow voltage estimates to be made more widely, offering a more cost-effective solution than existing monitoring solutions for load, voltage and unreported micro-generation.

UKRI funding: £324k

Project partners
Crowd Charge (lead)
Hanger19
University of Reading
Western Power Distribution plc

More information
https://crowd-charge.com/project/advent/

12 EV Fleet-Centred Local Energy System

The rapid expansion of electric vehicle (EV) use will pose key challenges for both electricity network operators and vehicle fleet operators.

The EV Fleet-Centred Local Energy Systems (EFLES) project aims to reduce the barriers to commercial EV fleet transition and the large-scale installation of public charge points by reducing costs and increasing revenues. At the same time it will facilitate the use of distributed energy resources, such as solar power generation in depots, to support electric fleets and minimise their impact on the network.

The project is developing a software and commercial framework for local energy systems serving EV fleets. The solution is a bottom-up approach that provides flexibility services to the electricity network by monitoring connection capacity, local demand, distributed energy resources and vehicle charging. It enables fleet operators to manage their portfolio to provide optimal support to the network.

Building on its existing GridShare platform, Moixa Technology is building the integrated system to monitor and forecast energy demand and optimise energy assets. Coupled with flexible tariffs and demand data, the system will handle hundreds of energy variables to optimise performance.

The test bed for the project is the London depot of UPS, the global package delivery and supply chain management company, which has recently committed to buy 10,000 electric delivery vans from startup Arrival.

UPS's London depot is the focus of the EFLES fleet charging project.

UKRI funding: £163k

Project partners
UK Power Networks Services (Commercial) (lead)
Cross River Partnership
Moixa Technology
UPS

More information
https://crossriverpartnership.org/projects/ev-fleet-centred-local-energy-system/

13 Smart HOme Control for ENergy System Integration (SHOCENSI)

Powervault is a fast-growing British start-up that manufactures, sells and manages fleets of battery energy storage systems in households and small businesses.

This project is studying the feasibility of integrating new digital technologies into Powervault's storage systems to create an intelligent platform for a home, which can control the loads of multiple energy sources and devices and optimise them against local and national price signals. It would then select the best actions to take to maximise net benefit for the user and the system.

The system will allow households to optimise energy management in accordance with the rest of the smart home ecosystem, reducing bills by storing free solar energy or cheap, off-peak electricity from the grid, as well as facilitating extra revenue streams for households through demand side response, frequency response and peer-to-peer trading.

UKRI funding: £126k

Project partner
Powervault

More information
www.powervault.co.uk

15 Guru Engage

The resident experience is critical to the success of heat networks.

The Guru Engage project focuses on helping heat networks to fulfil their potential in supporting decarbonisation.

The resident experience is critical to the success of heat networks, yet studies have shown relatively low customer satisfaction and poor outcomes among many users.

One of the key factors is often a lack of transparency and limited communication with residents – exacerbated by the fact that many do not speak English as their primary language.

The Guru Engage project aims to eliminate several of the causes of low satisfaction among customers and to enable innovative customer-centric service models to be developed. For example, installing smart meters on all new heat networks can help consumers understand and monitor their usage and spending with an in-home display (IHD), which in turn helps them budget for energy costs.

The project builds on Guru Systems' long experience of using the Internet of Things and data analytics in heat networks, and uses Guru's hardware and software platforms to improve customer engagement and put residents at the heart of local energy systems.

UKRI funding: £300k

Project partners
Guru Systems (lead)
FairHeat

More information
gurusystems.com

7 Rail-Charge

Rail-Charge investigates using railway power to charge electric taxis and cars.

The Rail-Charge project is developing a local energy management system that uses the power supply from electrified railways to charge electric taxis and other vehicles at stations.

This has the potential to allow vehicle charging without expensive upgrades to the distribution grid and with no disruption to railway operations.

By taking advantage of both the low price of electricity paid by railway operators and the power generated by trains' regenerative braking ability, this system will reduce charging costs for electric vehicle users.

The controlled connection to the rail electrification network also helps to offset the load against the power generated by local renewable energy sources - smoothing peaks and managing periods of higher load due to more trains.

The project team is analysing the rail power infrastructure to assess the capacity available for vehicle charging, and studying the demand of vehicles using the railway stations.

A new power converter is being designed to connect the rail power network with the charging points, together with an energy management system to ensure the sharing of the infrastructure and vehicle charging at minimal cost.

The team is examining the influence of the new charging stations on electricity grid loading, using a smart micro-grid powered by renewables, to assess the potential for operating as an independent local energy system.

UKRI funding: £346k

Project partners
Rina Consulting (lead)
EB Charging
University of Birmingham

4 v-powerChain

The installation of renewable energy sources has slowed in recent years. As subsidies recede, new solutions are needed to maintain momentum.

v-powerChain is a virtual powerplant (VPP), designed to significantly improve the efficiency of whole local energy systems and so encourage more installation of micro- to medium-scale renewable energy generation.

Using blockchain technology and artificial intelligence, v-powerChain takes a holistic approach to local energy systems, going beyond single technologies providing or storing power/heat, to focus instead on integrating several types of power sources to provide a reliable power supply.

Being trialled in partnership with Oldham Council, this is a decentralised, fair and efficient VPP system that aims to deliver wide benefits, including supporting peer-to-peer trading, and create more prosperous and resilient communities.

Among the benefits will be the ability to create innovative business and pricing models for distributed renewable energy resources that can maximise their return on investment.

UKRI funding: £209k

Project partner
UrbanChain

More information
www.urbanchain.co.uk

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9 Port Energy Systems Optimisation (PESO)

Portsmouth International Port is exploring how energy storage can help cut carbon emissions.

The Port Energy Systems Optimisation project (PESO) is responding to the pressing need to find a way to de-carbonise the UK's ports, using Portsmouth as the location for a pilot system.

Ports are major users of energy. Whilst many are working to reduce their use of fossil fuels and to transition to electricity, initiatives to electrify infrastructure or to install renewable power generation on site are often stalled by the requirement for expensive network reinforcement to meet the potentially higher electricity loads – whether drawing energy from, or supplying it to, the grid.

PESO is working to overcome this problem by integrating a large-capacity hybrid lithium-ion and lead-acid battery into the port's energy network, optimised to suit the port environment. Energy generated on site can be stored in the battery until it is needed.

An advanced energy management system optimises the energy flow around the port and coordinates with the grid, in order to optimise the cost-effectiveness of the overall system and reduce or eliminate the costs of reinforcing the grid.

UKRI funding: £322k

Project partners
Blue Tech Ventures (lead)
Portsmouth International Port
Swanbarton
The Energy Systems Catapult

More information
https://mseinternational.org/projects/?collection_id=38

11 Heat networks as flexible grid assets

This project is investigating the way buildings and individual homes on heat networks heat up and cool down, to understand how the timing and amount of heat delivered across the network can be flexed whilst maintaining comfort levels.

Heat pumps and energy-efficient combined heat and power plants are increasingly being used to provide heating for heat networks. Using machine learning, this project aims to use the variability of heating demands and the way buildings store heat to enable these heating systems to take advantage of changes in energy prices and provide flexibility services to the electricity grid.

Through this project, homes that are supplied by heat networks will benefit from additional value thanks to being able to change when and how their homes are heated.

This adaptability will introduce much-needed flexibility to local energy networks whilst reducing household heating costs.

UKRI funding: £134k

Project partner
Minibems

More information
minibems.com

3 Urban local energy trading exchange (Urban-X)

In the Urban-X project, Keele University is working with Qbots Energy to create a local energy trading and optimisation platform. The aim is to enable local energy markets that incentivise local generation and demand management while reducing costs for consumers.

Distribution system operators aim to reward customer flexibility in energy use, but this requires customers to have systems that can respond to variable market price signals.

Qbots' technology collects and analyses data from half-hourly and smart metered sites, energy monitoring sensors, building management systems, solar generators and battery storage – enabling energy trading and optimisation.

Using this technology, the Urban-X project is developing a local system trading energy between buildings at Keele University. The team is building a grid-connected test-bed, using data from the university buildings run through an artificial intelligence based intermediary service platform.

The system balances the supply and demand of energy across a network by optimising energy use and storage in real-time – maximising the use of locally generated energy, minimising buying from the national grid, and reducing stresses on the network from demands such as electric vehicle charging.

A trial is under way with a commercial customer in Greater Manchester, with potential future customers including city centre developments, universities, business parks, science parks and airports.

UKRI funding: £316k

Project partners
QBots Energy (lead)
University of Keele

More information
keele.ac.uk/business/newsandevents/ournews/2020/april/qbots/keele-partners-with-qbots-to-develop-energy-trading-platform.php

8 Hypervolt

The rapid rise in electric vehicles (EVs) presents a significant economic risk in terms of grid integration costs, as EV charger deployment today is growing rapidly and directed by user preference, with little consideration of impacts on local grids.

It has been estimated that when 40-70% of households have EVs, over 30% of medium and low voltage electricity networks will require upgrading or replacement – costing billions per year. The challenge is to enable market-wide adoption of EVs without these costs.

Combining home charging with variable electricity pricing to encourage off-peak charging helps manage demand, but smart tariffs such as these are based on national price signals and long-view regional grid infrastructure costs, without accounting for real-time local grid conditions. There is a 'blind spot' in our electricity system.

Hypervolt is developing a smart charging platform that allows users to opt in to support their local electricity system. Using algorithms and demand prediction, the platform automatically schedules charging within and across neighbourhoods, maximising charging for drivers whilst minimising impacts on local grids.

Through this project, the prototype is being developed and trialled in the field. The aim is to show how using a local smart grid, EV charge points can be rapidly rolled out, even in grid-constrained areas, whilst limiting infrastructure investment costs.

UKRI funding: £107k

Project partner
Hypervolt

More information
blog.hypervolt.co.uk/government-backing-smart-charging

Hypervolt aims to enable faster EV charger rollout by setting up smart charging platforms in local grids.

1 Open protocol cloud metering for heat networks

Internet of Things (IoT) networks and connected devices enable a low cost, open protocol way of measuring, monitoring and controlling heat and utility networks.

Through this project, Sycous is working to future-proof heat networks by developing open protocol systems for billing and metering technology. The open protocol approach means that suppliers' equipment can operate without the need for a proprietary interface or gateway.

Enabled by greater data transparency, customers can avoid being locked into a single service provider for operation, support and maintenance.

The new Sycous system uses IoT devices and infrastructure, together with blockchain technology, to produce a cloud-based logic model allowing customers to use heat on a 'pay as you go' basis. This can be used in conjunction with entirely open protocol metering equipment and valves.

The system uses encrypted and secure two-way communication with devices across an entire energy network, and can collect data from a wide range of compatible devices, opening up new opportunities beyond the world of conventional metering and billing.

The Sycous system also allows metering data to be readily available to third-party systems for other purposes, such as energy analytics.

UKRI funding: £205k

Project partner
Sycous

More information
www.sycous.com

5 Thermochemical seasonal solar energy storage for building applications (SeasonalStorage)

Thermochemical energy storage uses a reversible chemical reaction. For example, heat is used to separate the components of a chemical compound; the components are stored separately at room temperature and, when recombined later, produce heat.

In this way, energy from renewable sources can be captured during times of low demand, stored for long periods – such as from one season to the next – and then used when demand is high.

The SeasonalStorage project is designing, developing and building a prototype solar-powered thermochemical energy storage system to achieve this. The technology combines photovoltaic cells and novel hollow fibre heat exchangers, storage using novel environmentally-friendly thermochemical materials, and a smart controller.

The storage solution can be run stand-alone or as a key component integrated into existing local energy systems.

This will potentially change the way we access energy for our buildings – reducing costs to homeowners, helping to bridge the gap between energy generation and demand in community buildings, and reducing CO2 emissions overall.

UKRI funding: £394k

Project partners
Environmental Process Systems (lead)
Arkaya Energy
P.A.K. Engineering
University of Nottingham

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5 6 BankEnergi

Currently, the many suppliers of energy to buildings are developing their own approaches and systems for balancing energy supply with individual site demands.

This project is developing a software specification that the energy sector can use to create an end-to-end energy trading solution, from local buildings to national energy markets.

This will provide benefits across the sector – for end users, energy suppliers, traders, technology platform providers and associated services.

BankEnergi is building a framework for the technology integrations needed to enable trading – both between energy suppliers and among their customers.

The key technology component is the specification of a common process to integrate local and national electricity markets across a number of different energy suppliers. The solution enables different buyers and sellers of energy and flexibility to trade using a common interface.

This common set of standards will harmonise the various processes that are emerging and give confidence to end users in industry, commerce and the public sector.

Following a successful concept design project in 2019, the project consortium gained funding for a key technology components project to take the concept to the next stage.

With additional partners involved, the team is now testing the energy trading platform on five sites in the South Bank area of London – including healthcare, commercial and government buildings and South Bank University.

With wind and solar generation intermittent, and electric vehicle charging unpredictable, trading platforms enabled by BankEnergi will bring greater optimisation and more accurate forecasting, help balance demand and supply, reduce the need for costly grid reinforcement and help maximise savings in costs and CO2 emissions.

BankEnergi's aim is to export the model to other regions and cities, nationally and globally.

Combined UKRI funding: £475k

Partners for concept design
Consortio (lead)
Bouygues E&S FM UK
Building Sustainability Services
King's College London
London South Bank University
Qbots Energy
South Bank Employers Group

Partners for key technology component
Consortio (lead)
4D Energy Advisory
CarbonTRACK
E.ON UK
Fintricity Group
Ibeccs
London South Bank University
Tonik Energy
Wales & West Utilities

More information
bankenergi.com

BankEnergi's head project partner Rajvant Nijjhar (l) and research fellow Catarina Marques.

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6 Intelligent Bridgend energy system design

This project looked at decentralising, localising and integrating energy generation, heating, power and mobility in Bridgend in South Wales.

The area already has decentralised energy assets around Parc Stormy Energy Park, with solar and wind power generation, a combined heat and power plant, battery storage, electric vehicle charging points and plans to develop into a renewable energy transport hub and enterprise park. The project explored integrating these through a digital platform, monitoring and predicting energy demand and generation, and providing low-carbon transport micro-hubs to support the central hub at the Energy Park.

The project has given rise to a Smart Local Energy Plan, initially focusing on decarbonising the domestic energy sector.

UKRI funding: £117k

Project partners
Cenin Renewables (lead)
Bridgend County Borough Council
Cardiff University
First Cymru Buses
Hitachi Europe

1 Whole Energy System: Levenmouth Integrated Demonstration (WESLID)

Focused on Levenmouth in Scotland, this design project looked at developing the technical software specification for a vector integration platform (VIP).

The aim of a VIP is to move from considering various energy vectors (electricity, heat, transport) in isolation, to creating a dynamically balanced and flexible low-carbon local energy system, taking a 'whole systems' approach. This kind of multi-vector energy system could control supply and demand assets across multiple energy vectors under a variety of different regulatory and market arrangements, whilst returning a profit for both the owners and end users.

A major outcome of this project was the understanding that hydrogen would play a crucial role in a local energy system that sought to integrate heat, power and transport – with potential for domestic and industrial heating, freight transport fuelling and energy storage.

UKRI funding: £142k

Project partners
ORE Catapult Development Services (lead)
PassivSystems
University of Strathclyde

8 Energy Autonomous Community (Isle of Wight)

In 2019 the Energy Autonomous Community project began investigating the opportunity to develop a virtual power network (VPN) and flexibility marketplace on the Isle of Wight. It explored the potential for a smart local energy system that could enable the island to improve its local energy management and usage and to progress its vision to be self-sufficient in electricity from renewable sources.

The study included options for load shifting: using and storing electricity (both thermally and electrically) during periods of high renewable generation, and reducing demand when production is low.

The 6-month study was focused on the West Wight area of around 15,000 homes. Its success has led to a new initiative, Project ISLE, which aims to design and implement a comprehensive local energy market to cover the whole island.

UKRI funding: £86k

Project partners
Isle of Wight Council (lead
E.ON Energy Solutions
KnowNow Information
Newcastle University
University of Portsmouth

2 E-Port Smart Energy Master Plan

This project developed a design for a local, smart energy system around Ellesmere Port in Cheshire. The high-level feasibility study explored how energy use across electricity, gas, heat and transport can be optimised, helping energy-intensive industries benefit from lower-carbon, lower-cost energy.

Where possible the design is based on existing energy consumers and network infrastructure, and existing and planned renewable energy sources. It uses emerging technologies including internet-of-things devices, data analytics and measuring and monitoring technology, together with advanced digital intelligence to create seamless market trading platforms.

The result is an optimised concept design with an associated ten-year investment plan, identifying opportunities for private investment and providing a nationally-replicable model for multi-vector, low-cost, low-carbon energy systems.

UKRI funding: £104k

Project partners
EA Technology (lead)
Burns & McDonnell Europe (UK)
University of Chester

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11 An energy revolution for the market town of Caldicot

This project looked at the commercial feasibility of a low-carbon energy system in the Monmouthshire town of Caldicot. The design is for a self-balancing virtual private network that tests a new regulatory market structure.

The model incorporates renewable electricity generated at the local 5MW solar farm, battery storage, and a retrofitted district heating network using heat from water extraction by Network Rail. It accounts for variable increases in technology such as solar panels, electric vehicles, and vehicle-to-grid charge points, as well as infrastructure. The team modelled the variable demand profile across the network, to determine reliability and tolerances and constraints.

The multi-vector energy modelling environment that the project produced, called Jigsaw, will inform the town's future strategic decisions.

UKRI funding: £127k

Project partners
Monmouthshire County Council (lead)
Cenex
Wales & West Utilities
Western Power Distribution (South Wales) plc

4 Bristol Energy Smart System Transformation

The consortium behind the BESST project designed a customer-focused way to deploy smart energy and digital technology at scale. The approach focused on reducing energy system costs and delivering a radically new customer experience for local consumers and businesses.

The design focuses on a cluster of smart homes and businesses across four wards in west Bristol, including the Avonmouth and Severnside Enterprise Area. By linking energy demand to local generation, and incorporating new electricity demand from heat and transport within an overall energy flexibility platform, the design allows consumers to trade the flexibility of their demand to help balance the local energy network.

Solutions and propositions from this concept design study are being integrated into the wider Bristol City local area energy planning programme.

UKRI funding: £139k

Project partners
Bristol Energy & Technology Services (Supply) (lead)
Bristol City Council
Bristol Community Transport
Bristol Energy Network C.I.C.
Regen SW
SevernNet
Upside Energy (now Kraken Flex, part of Octopus Energy)

9 LEMDEx - Local energy market in Devon and Exeter

The premise of the LEMDEx concept design is that many UK energy users, from community energy groups to industrial and commercial consumers, and from local generators to investors, want better access to energy markets than the current centralised UK energy system provides.

The study aimed to investigate the commercial requirements for deploying a local energy market, including any dependencies on regulatory change, and design a solution. The team developed a local energy market approach based on peer-to-peer energy trading, to provide greater opportunities for local engagement and better use of local energy assets.

The project successfully brought stakeholders together to define the commercial opportunity presented by local energy markets, laying out the regulatory steps that would be needed to progress the vision.

UKRI funding: £129k

Project partners
Swanbarton (lead)
Devon County Council
Exeter City Council
Exeter Community Energy
University of Exeter

10 The development of a distributed ledger technology micro-grid management platform (Corby)

With this project, Power Transition showed how local energy markets can be built using distributed ledger technology, as a faster more energy-efficient alternative to blockchain. The software architecture provides secure access to data, with the goal of empowering organisations and individuals to take control of their energy.

The Corby project uses this technology in an energy microgrid which can track, optimise and balance energy transactions in real time, increasing throughput and performance while reducing costs and energy consumption. Storage and advanced power management systems optimise multiple sources of energy supply and demand, allowing flexible energy trading and improving efficiency.

The concept design phase concluded with 47 zero-carbon smart homes under construction, designed to work with this technology.

UKRI funding: £151k

Project partners
Power Transition (lead)
Cardiff University
Electric Corby CIC

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Modernising Energy Data Access (MEDA)

Data is the single biggest enabler of a decarbonised, decentralised and digitised energy future. It is the tool that will bridge the gap between where we are now and where we need to be to achieve net zero.

However before it can be used, data has to be accessible.

In 2019 the Energy Data Taskforce report recommended creating three 'building block' digital services to help modernise energy data.

In 2019 Innovate UK, working with BEIS and Ofgem, launched the £2 million Modernising Energy Data Access competition – to find the best ideas to test and deliver ways to make these digital services operate with each other effectively.

The competition aimed to generate a ground-breaking solution which would tackle the difficulties of data access, enabling energy data to be open-sourced for the benefit of society.

To ensure a rapid and 'agile' but rigorous process, the funding competition had three separate phases.

PHASE 1: Discovery

Three winning companies were granted funding for a six-week discovery phase to tease out the requirements for their solution.

Open Energy – Icebreaker One

Icebreaker One has its roots in open banking. The company's Open Energy project worked on an open standard for data sharing in the energy sector. Its aim: to enable energy network and market stakeholders to share data robustly, legally and securely, driving the use and adoption of innovation across the sector.

Your Online Digital Architecture – Siemens

In this project, Siemens aimed to deliver a digitally-integrated, modern energy data system that supports a common data architecture concept. Underpinning the vision was an open data platform built on the requirements of the users, and based on a sector-specific standard of metadata so that data has commonality and can be exchanged effectively between users.

ContainER – Electron

Electron's ContainER project developed a data coordination platform that enables industry participants to discover and access data, mastered by the most suitable data owner. The project is based on the principle of integration and coordinating existing datasets across the industry, using modern distributed system architectures.

PHASE 2: Alpha

Two of the companies were selected to develop an 'alpha' prototype over three months.

All three projects put forward ambitious, distinctive approaches for developing prototype solutions, but after careful judgement, Icebreaker One and Siemens were selected to progress to Phase 2.

PHASE 3: Beta

Following Phase 2, a single winner was chosen to build the 'beta' solution over a six-month period during the first half of 2021.

Icebreaker One's Open Energy project was selected for Phase 3.

Progress updates
https://energydata.org.uk/

Access to data is vital for a decentralised energy future (Credit: Solo Energy).

Modernising Energy Data Applications (MEDApps)

Access to data is not enough; innovative applications using that data will be needed to maximise the benefits of smart local energy systems.

In 2020, UKRI launched the Modernising Energy Data Applications competition, sponsored by BEIS and Ofgem, for feasibility studies into such data applications. To win funding, projects had to demonstrate benefits to users, offer scalable commercial opportunities, and use the Open Energy data architecture being developed under the previous MEDA competition.

In Phase 1 nine projects were funded, to a total value of £1.3 million

Supporting fuel-poor households through data integration and AI

This project uses UK-wide smart meter system data, combined with other data and artificial intelligence, to identify households that are in fuel poverty or could benefit from energy efficiency programmes, and propose actions.

UKRI funding £150k Led by Urbantide

AI for low carbon technology site optimisation

This project adds new data to an existing digital 'twin' of the UK's low-voltage electricity grid, giving developers of technologies such as electric vehicle charge points much better sight of opportunities to connect to the grid.

UKRI funding £145k Led by Alian

Net-zero operation map

This project is working on a system which combines digital management of energy for growing crops – speeding up or slowing growth by varying energy input – with local grid flexibility requirements, saving costs and CO2.

UKRI funding £150k Led by Brits Energy

Future energy and transport tool

This project is enhancing and building new data into an online comparison tool that helps consumers make the right choice of electric vehicle, as the start point in their journey towards a zero carbon lifestyle.

UKRI funding £150k Led by Power My Hub

AI generative design tool for low-cost district heating networks

This project is building a tool which uses artificial intelligence and geographic data to automate the design of district heat energy networks, so that projects can be specified to the right scale for optimum efficiency and viability.

UKRI funding £149k Led by City Science Corporation

Electric vehicle infrastructure investor app

This app gives financiers looking to invest in electric vehicle infrastructure up-to-date understanding of current and planned initiatives and the energy system, tapping into network operators' data to help build workable models.

UKRI funding £150k Led by Zuhlke Engineering

Energy-focused geospatial system using multi-sectoral data to deliver net-zero

This project will link geospatial data to energy data on issues such as electric vehicle charging or smart metering – helping businesses and planners to create more complete models and better local low-carbon energy solutions.

UKRI funding £145k Led by Mind Foundry

Smart metering leak detection

This project aims to analyse data gathered by smart gas meters and use it to identify gas leaks and inefficient appliances, plan network maintenance and tracking, and help support the future introduction of hydrogen.

UKRI funding £109k Led by GL Industrial Services UK

LAEPapps

Data issues can make creating local area energy plans (LAEPs) difficult and costly. The project aims to integrate existing and new data into an up-to-date online visual resource, with mapping, making the process quicker and easier.

UKRI funding £150k Led by Advanced Infrastructure Technology

In Phase 2 of the competition, five of these were awarded further funding to help them move towards commercialisation: the projects led by City Science, Urbantide, Advanced Infrastructure, Alian and Mind Foundry.

EnergyRev

Providing evidence for scaling up smart local energy systems

Smart local energy systems (SLES) can help to achieve our critical net zero targets and ambitions and provide considerable market opportunities. But to unlock their potential, the opportunities and challenges around policy, regulation, user engagement and digitalisation of energy systems must be well understood.

EnergyREV is a consortium of more than 60 academics across 22 universities with the multi-disciplinary expertise to address these issues.

Evidence is needed to inform change, both in the UK and internationally, and provide new tools and insights to accelerate the delivery and roll-out of these systems. EnergyREV is doing this by considering the whole-system integration required.

EnergyREV shares knowledge and research findings across the community involved in the Prospering from the Energy Revolution programme – and wider stakeholders including policy makers, the academic community, industry and the public. The team provides value and insight through:

- position papers and whitepapers which unlock key insights and learnings relevant to the SLES journey;
- workshops and events designed to inform, inspire and support change;
- models, data and tools that can be practically applied; and
- academic novelty and advances.

The role of EnergyRev in the programme is to use its academic expertise, previous research and international networks to:

- inform future plans for delivery and scaling of the projects;
- integrate knowledge from global activities into the Prospering from the Energy Revolution programme; and
- provide systematic research into longer-term needs and innovations.

More information
energyrev.org.uk

ERIS

Unlocking potential through tools, insights and analysis

The Energy Revolution Integration Service (ERIS) is an important element of UKRI's Prospering from the Energy Revolution programme. It focuses on helping the wider sector, in particular UK local authorities, start their journey to joined-up local energy, unlocking the benefits of smart local energy systems (SLES) for people, place, and planet.

ERIS is motivated by the potential of local energy and the major contribution it can make to delivering the UK's net zero ambitions and a brighter social and economic future for UK citizens.

Supported by UKRI, ERIS sits within the Energy Systems Catapult – an independent not-for-profit centre of excellence set up to accelerate the UK's energy transformation and ensure businesses and consumers capture the opportunities of clean growth.

ERIS is at the vanguard of the Catapult's work on smart local energy systems, and uses learnings from its work with local and national government, investors, the energy sector and the UK's world-leading demonstrators and detailed design projects to develop practical tools, insights and analysis that will help these stakeholders make sustainable local energy a reality.

More information
es.catapult.org.uk

How ERIS is unlocking the potential of smart local energy systems for the UK:

- Helping key actors and enablers understand the benefits of smart local energy systems.
- Creating a framework to help new local areas scope, plan, design and deploy a smart local energy system.
- Developing tools and evidence to enable private investment in local energy.
- Evaluating the energy outcomes of the UK's world leading SLES demonstrators and detailed design projects.
- Fostering enabling conditions for smart local energy systems by facilitating national and local policy discourse.
- Developing a UK Net Zero Toolkit – a practical, accessible, and expert resource to help local authorities realise, replicate, scale, and link local energy projects.

Fast start projects

In 2018 innovate UK funded a number of short 'fast start' energy projects, which then became part of the Prospering from the Energy Revolution programme.

Development of a prototype MOF coated heat exchanger for heat pump applications

Successfully developed a good quality multilayer Metal Organic Framework (MOF) based coating for heat exchangers, to be used in adsorption heat pumps and improve performance compared to conventional materials.

UKRI funding: £140k Partner: MOF Technologies

Multi-sites, actors, vectors, energy services (Multi-SAVES)

Demonstrated the feasibility and value of a virtual private wire network (VPWN) across multiple sites, designed to reduce energy costs and carbon emissions and increase energy security. The full system was created and successfully tested as a model with real data from university estates in Oxford.

UKRI funding: £159k Partners: University of Oxford (lead), Siemens

CryoHex – Ultra-efficient cryogenic heat exchangers for liquid air energy storage

Illustrated the benefits of an innovative coating technology for the surfaces of cryogenic heat exchangers, for use in liquid air energy storage (LAES) systems. Tests showed up to a 20% improvement in heat transfer, demonstrating the potential for LAES to be a leading technology for energy storage.

UKRI funding: £221k Partners: Oxford nanoSystems Limited (lead), University of Birmingham

HyStERIAA – Hydrogen storage to energise robotics in air applications

Developed a large-scale hydrogen storage system using chemical conversion to a solid. The system is safer, lighter and occupies half the volume of commercially available pressure tanks, and has potential for storing energy in many contexts including unmanned aerial vehicles.

UKRI funding: £286k Partners: H2GO Power (lead), Imperial College London

Cheaper waste heat recovery through improved screw rotor technology

Demonstrated an improved engineering design for the intermeshing screw rotors that are used in waste heat recovery systems. The new design was shown to improve the cost effectiveness, operating range and reliability of machines used for recovering waste heat from steam.

UKRI funding: £46k Partner: Rotor Design Solutions

Solar energy inverter maximizer

Developed a process to increase the energy gained from photovoltaic panels by retrieving energy currently lost through heating effects. The new method increased the energy converted into electricity by up to 30% against a leading commercial inverter, and delivered more energy to the grid.

UKRI funding: £113k Partners: PulsiV Solar (lead), Eastmap

Waste ammonia to hydrogen production using electrochemical and ecological processes (WAHEEP)

Focused on the potential of electrolysis for producing hydrogen from ammonia-rich wastewater such as effluent. The project aimed to develop and test robust, efficient materials for coating the electrodes to be used in electrochemical cells.

UKRI funding: £174k Partners: Living Water Ecosystems (lead), University of Warwick

HALLO – High and low light OPV

Focused on ways to manufacture low-cost flexible organic photovoltaic (OPV) cells which can harvest solar energy effectively throughout the day, even when light levels are low. The robust, flexible and light weight modules offer lower balance of systems costs compared to silicon-based photovoltaic systems.

UKRI funding: £286k Partners: Eight19 (lead), Imperial College London, Swansea University

Frankenstack

Investigated re-using components of the 'stack' at the heart of hydrogen-producing electrolysers, to reduce costs and open up new business models. The team built a 'frankenstack' using recycled components at 29% of the materials cost of a new stack, with average performance only 2% lower.

UKRI funding: £101k Partner: ITM Power (Trading)

Low cost Li-Ion battery storage from recycled cells for distributed power generation using renewable resources

Successfully demonstrated an innovative low-maintenance battery system that uses recycled Li-Ion battery cells to store energy from renewable sources, for example as part of a small-scale distributed power plant.

UKRI funding: £70k Partner: Alp Technologies

GENSSIS (Gravitational energy storage and synchronous inertial stability) Phase 2

The GENSSIS project is developing a robust system which uses the power of gravity to store and release energy. It has potential to help integrate wind and solar energy into the grid on a large scale, as an alternative to battery storage systems. This second phase of the project finalised the designs.

UKRI funding: £720k Partners: Energy SRS (lead), Caley Ocean Systems, D Bayliss Consulting, P R Marriott Drilling, UK Power Reserve, University of Bristol

Low cost energy vectors for a microwave induced plasma gasification system

Developed a Microwave Induced Plasma (MIP) Gasification process (Plasmergy). This aims to provide a more environmentally-friendly and efficient method for disposing of clinical waste than incineration, while simultaneously generating a hydrogen-rich gas that can provide low-carbon energy.

UKRI funding: £190k Partners: Stopford Projects (lead), Ceres Power, Lancaster University, Unilever UK Central Resources

Developing a buildings and energy data platform

Developed the prototype for a self-learning platform for gathering and processing data, to help with managing energy efficiency, energy purchasing and demand response. The project's ultimate aim is to help customers reduce their energy consumption and profit from participating in the smart grid.

UKRI funding: £112k Partners: Lightbulb ES (lead), University College London

Thermal energy storage system (TESS)

Developed a prototype for a novel thermal energy storage system allowing solar-generated power to be stored for later use – separating generation from demand, enabling more electric vehicle uptake and helping to balance the grid.

UKRI funding: £199k Partner: Nemein

N-SYNTH

In industry, nitrogen fixation makes atmospheric nitrogen usable – for example in fertilisers – but relies on expensive reactors and huge natural gas reserves. N-SYNTH developed a low-cost modular process plant, powered by low-carbon electricity, for more environmentally friendly, localised fertiliser manufacture.

UKRI funding: £52k Partner: C-Tech Innovation

Zero waste hybrid biomass micro-CHP

Aimed to develop an advanced technology to efficiently convert agricultural waste into heat and power using gasification in a micro-generator, and assess the market potential.

UKRI funding: £70k Partner: Alp Technologies

Smart microgrids in Tanzania

Worked to create transparent energy marketplaces around micro-grids in Tanzania. The concept involved encouraging and developing small-scale energy entrepreneurs, advising them and their communities about energy efficiency and giving them an incentive to generate more solar power.

UKRI funding: £167k Partner: I-Renewable Energy

Find out more and stay in touch

Prospering from the Energy Revolution is a challenge programme managed by UK Research and Innovation, as part of the Industrial Strategy Challenge Fund.

The programme is delivered by Innovate UK, part of UKRI. For an overview of the programme, see the UKRI website. We aim to share information on the projects' development and progress. To stay in touch, sign up here.

For the latest smart local energy systems research, visit the EnergyRev website.

#EnergyRevolution

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