

ENERGY STORAGE AND DISTRIBUTION
**MOVING ENERGY
ECONOMICALLY
AND EFFICIENTLY
TO WHERE AND
WHEN IT IS NEEDED**

WHY ENERGY STORAGE AND DISTRIBUTION?

WHAT WE ARE DOING?

- » ADAPTING AND DEVELOPING NETWORK DESIGNS TO ENABLE DELIVERY OF A COST EFFECTIVE AND SECURE FUTURE LOW CARBON ENERGY SYSTEM IN THE UK
- » DEVELOPING NEW INFRASTRUCTURE APPROACHES
- » DEMONSTRATING NEW INFRASTRUCTURE TECHNOLOGIES

Energy networks enable the transfer of energy. They are capital intensive, long life assets. They have to be robust to the requirements of the wider energy system. They operate within the backdrop of a highly regulated market.

The UK's energy networks will require substantial investment in new capacity, technology development and innovation to accommodate low carbon generation sources to ensure that they are fit for purpose to meet predicted future demand.

Therefore, networks must have the capacity to not only meet peak flow demand, but also build in extra capacity. There is every chance that there will be greater interdependence between networks in the future.

There is scope for significant innovation in the way that energy is delivered to end customers. In the future, there will be an important role for storage technologies to cater for more intermittent supplies.

Heat networks may also emerge as a critical new infrastructure requirement and there will be implications for the role of gas in the future energy mix together with investment in gas storage.

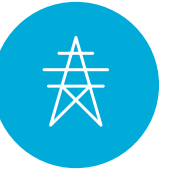
The core themes to the ETI's Energy Storage & Distribution Programme are:

- » Adapt and develop networks to enable the delivery of a cost effective and secure future low carbon energy system in the UK.
- » Develop and demonstrate new infrastructure approaches to support the energy transition out to 2050.



Researching the connection of offshore energy to the UK grid system.

[See page 8 for the full story](#)



WHAT HAVE WE DONE TO DATE?

GAS VECTORS PATHWAY DEVELOPMENT

THIS RESEARCH PROJECT, UNDERTAKEN BY DNV GL WILL LOOK AT FOUR INDEPENDENT FUTURE SCENARIOS AND SEEK TO PROVIDE A BETTER UNDERSTANDING OF THE IMPLICATION AND THE CHALLENGES THAT MIGHT ARISE AS A RESULT OF THESE MAJOR INFRASTRUCTURE TRANSITIONS.

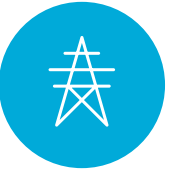
- » UK gas networks carry over four times as much energy as electricity networks
- » Gas networks have the potential to carry new gasses including hydrogen and synthetic natural gas
- » Research project will provide a better understanding of the implications and challenges of infrastructure transitions

At present in the UK, gas networks carry over four times as much energy as electricity networks and have the potential to carry a range of new gases including hydrogen and bio-synthetic natural gas. Additionally, the flexibility of gas in its various forms allows for the development of a wide range of production and delivery pathways, all of which could contribute to a future low carbon energy system.

This research project, undertaken by DNV GL will look at four independent future scenarios and seek to provide a better understanding of the implication and the challenges that might arise as a result of these major infrastructure transitions. This should help define how affordable any transitions could be.

The Scottish Hydrogen & Fuel Cell Association, University College London and the European Gas Research Group are subcontractors to DNV GL on the project.

We have taken the decision to close the project early. We intend to look for opportunities to deliver the project objectives through other means.



DISTRIBUTION SCALE ENERGY STORAGE

- » Demonstration of grid scale energy storage technology on a Western Power Distribution network site
- » Technology developed by Hampshire SME Isentropic – using a combined heat pump/heat engine to generate electricity to create temperature difference for storage efficiency

Hampshire SME, Isentropic have developed their own Pumped Heat Electricity Storage (PHES) technology for large-scale energy storage. It uses an innovative heat pump/engine which converts electrical energy to heat, stored in low cost gravel storage vessels. The process is reversible, with hot gas expanded in the engine to drive a generator with an achievable round trip efficiency of approximately 75%.

Using this technology, the project aims to develop and demonstrate a cost-effective 1.5MW/6MWh energy storage device that will operate on a Western Power Distribution network site.

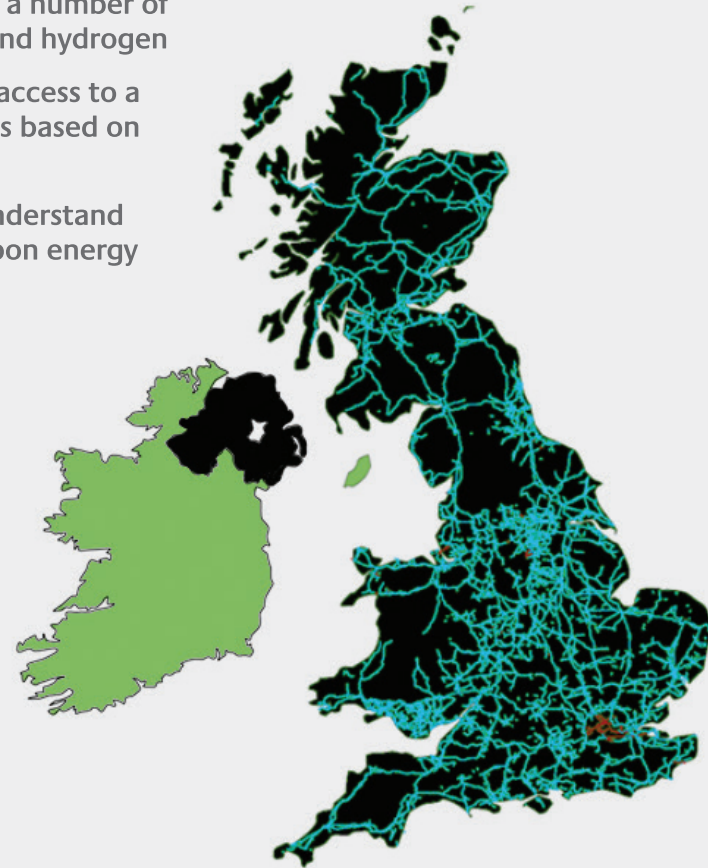


WHAT HAVE WE DONE TO DATE?

CONTINUED »

INFRASTRUCTURE COST CALCULATOR

- » The Infrastructure Cost Calculator was developed to allow users to calculate and compare network transition costs across a number of scenarios and vectors, including electricity, gas, heat and hydrogen
- » The Infrastructure Cost Calculator provides users with access to a robust, centrally stored database of infrastructure costs based on current industry data
- » Users can define and compare different scenarios to understand long term investments for a UK transition to a low carbon energy network

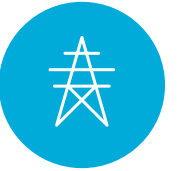


In order to assess the opportunities for meeting long term emissions reductions targets, it is necessary to understand the costs and performance of the energy infrastructure that will carry energy from where it is generated, to where it is consumed.

This £600,000 research project led by international consulting engineers Buro Happold, provides users with data on the costs and performance associated with key types of fixed energy infrastructure.

Example capabilities of the Infrastructure Cost Calculator include:

- Impact Analysis: testing new innovations to understand how they impact on the cost of networks.
- Sensitivity Analysis: investigating how cost changes based on future scenarios impact upon lifetime network costs.
- Transition comparisons: investigating the difference between the costs of pathways to reach a low carbon energy network.
- Time implications: analysing the financial impacts of carrying out infrastructure changes over different time periods.



PRE-SATURATED CORE FAULT CURRENT LIMITER

- » Development and demonstration of a pre-saturated core fault current limiter
- » Product design offers advantages of a non-superconducting pre-saturated core fault current limiter with instant response and recovery, a small footprint based on established transformer design and build process
- » Commissioned into service in May 2013 at a UK Power Networks primary substation in Newhaven

Designed by GridON, this pre-saturated core fault current limiter uses a direct current coil to magnetically saturate the iron core, providing a very low impedance during normal operation and a high impedance in response to a network fault. It is based on combining industry standard proven transformer technology and GridON's concept of magnetic flux alteration to saturate the iron core.

The limiter is fully scalable for use at voltage levels on both distribution and transmission systems. Its design removes the need for superconducting components or associated cryogenic systems.

It was commissioned into service in May 2013 at a UK Power Networks main substation in Newhaven.

The £4million project is due to complete in 2016.

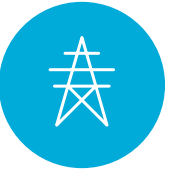


£4m

The Fault Current Limiter, developed during this project by GridON, was commissioned into service in May 2013 at a UK Power Networks main substation in Newhaven. It has successfully suppressed multiple faults during its service

WHAT HAVE WE DONE TO DATE?

CONTINUED »



NETWORK CAPACITY

- » Research project into new technology solutions that can enhance transmission and distribution capacity in the UK
- » Assessing the feasibility of technologies to provide improved management of power flows and increased capacity
- » Seeking to enable the increased deployment of low carbon energy sources in the UK

The Network Capacity research project identified and assessed new technology solutions that could enhance transmission and distribution capacity in the UK.

It assessed the feasibility and quantified the benefits of using innovative approaches and novel technologies to provide improved management of power flows and increased capacity, enabling the deployment of low carbon energy sources in the UK.

The £600k project was undertaken by the management, engineering and development consultancy Mott MacDonald and completed in 2010.

OFFSHORE CONNECTION

- » Research project into the connection of offshore energy to the UK grid system
- » Consideration of the impact of large-scale offshore development
- » Analysis of designs and strategies to collect, manage and transmit energy back to shore

This project examined the specific challenges and opportunities arising from the connection of offshore energy to the UK grid system and considered the impact of large-scale offshore development.

It also looked into the novel electrical system designs and control strategies that could be developed to collect, manage and transmit energy back to shore and identified and assessed innovative technology solutions to these issues and quantified their benefits.

The research was delivered by Sinclair Knight Merz, a leading projects firm with global capability in strategic consulting, engineering and project delivery. This £250,000 project was completed in 2010.

HEAT STORAGE

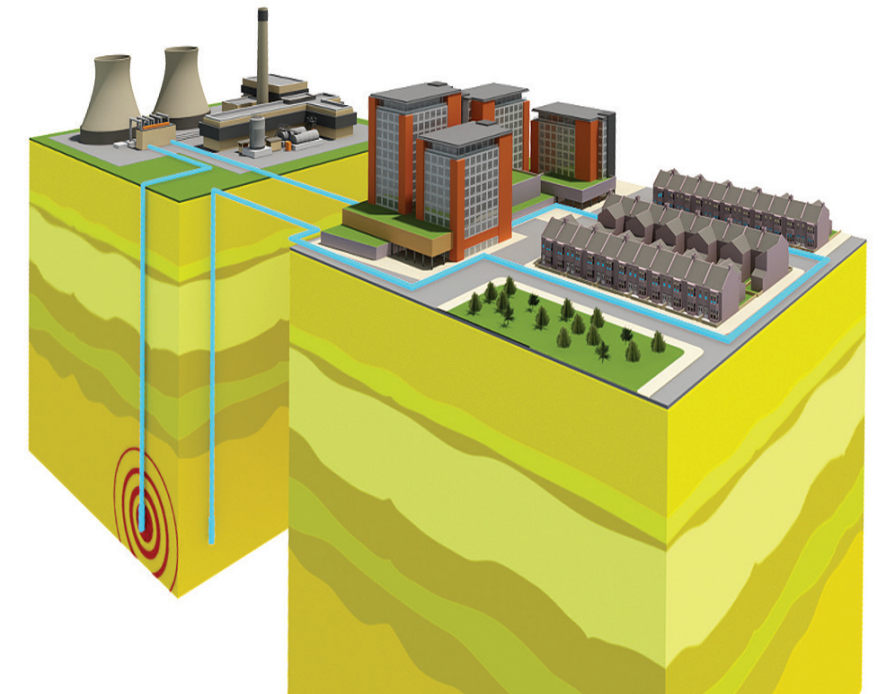
- » Examination of the feasibility of capturing large quantities of waste heat from power stations and industrial processes then storing it underground
- » Investigation into the cost effectiveness of storing large quantities of heat for long periods of time
- » Evaluating the practicality and technology needs of such storage schemes

Heat is the biggest end use of energy in the UK – most of it is used for heating homes and providing hot water.

This research project examined the feasibility of capturing large quantities of waste heat from power stations and industrial processes and then storing it underground for later use in homes and offices.

It investigated the cost effectiveness and practicalities of storing large quantities of heat for long periods of time to meet a significant proportion of the UK's winter heat demand. It evaluated the practical limits for this type of storage, the technology development needs and where in the country large-scale heat storage could be most effectively exploited.

International consulting engineers Buro Happold completed the £140k research project in 2011.



£140k

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ABOUT THE ETI

The Energy Technologies Institute is a partnership between global energy and engineering companies and the UK Government.

Its role is to act as a conduit between academia, industry and government to accelerate the development of low carbon technologies.

It brings together engineering projects that develop affordable, secure and sustainable technologies to help the UK address its long-term emissions reduction targets as well as delivering nearer term benefits.

It makes targeted investments in a portfolio of nine technology programmes across heat, power, transport and the infrastructure that links them.



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