Supergen

Energy Networks

THE ROLE OF ENERGY NETWORKS TOWARDS THE 2035 EMISSIONS TARGET

POLICY PAPER SERIES

Challenges for Energy Networks to Support Net-Zero, Technical Working Group

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August 2021

Policy Brief: Challenges for Energy Networks to Support Net-Zero, Technical Working Group

Supergen Energy Networks Hub

Overview

- Electrification of heat and transport and readying the electricity network is likely to be the most significant technical challenge facing the UK energy networks to reach the net-zero targets.
- Unlocking flexibility and demand side participation will be essential to integrate low carbon technologies and reduce energy network reinforcement costs.
- Hydrogen and district heating could be used for decarbonising heat but unlikely to be ready in the short-medium term to deliver the urgent carbon reductions.
- The interacting, interdependent multi-energy network architecture of the future will be much more complex and will require significant co-ordination to design and operate
- The current workforce will need to acquire new skills urgently
- Energy network professionals are encouraged to creatively communicate the scale of the challenge.
- It's time to move out of the comfort zone, to take bold actions and to demonstrate net-zero solutions for energy networks in real world applications

1. Background

The energy sector is undergoing an unprecedented and transformative change, to deliver on the government's target of reaching Net Zero by 2050.
At the heart of enabling this change are the energy networks such as electricity, gas, and district heating infrastructure.

Traditionally, these networks worked independently from each other, but as the energy sector is moving away from fossil fuels, the networks are being integrated into a multi- vector energy system that is interdependent.

As such, they will all have a role to play in meeting the emissions targets. For instance, gas networks can be repurposed for hydrogen while electricity will continue to be integrated with renewables to electrify transport and heating.

In June 2021, the SUPERGEN Energy Networks Hub organised a series of workshops with key stakeholders who were asked what 2035 means for the energy networks.
The purpose of this paper is to outline some of the key insights from the workshop on technical challenges facing energy networks in light of the 2035 target.

2. Insights

Insight # 1: Whole energy network transformation and significant investments
The UK's energy network infrastructure will undergo a transformation in the coming decades where the electricity networks will be revamped, repowered, and digitalised to deliver zero-emission electricity; gas network repurposed for transporting green gases and new energy infrastructures such as district heating and cooling networks emerging to supply energy efficiently to dense urban areas.
Significant investment in the whole energy network infrastructure will be required over the coming decades to support the economy-wide decarbonisation. Ofgem approved a £40 billion+ investment programme by the country's energy network companies between 2021- 2026 for a stronger, greener, and fairer GB energy system.
Decarbonisation of heat, transport and the industrial sector will be the most significant challenge that would dominate the technical developments and would drive the transformation in energy networks.

Insight #2: Electrification of heat and transport and technical challenges facing the power network
The electricity network will play the central role in the economy-wide decarbonisation, and it is essential it delivers zero-carbon electricity well ahead of other sectors that will take longer to decarbonise.
The UK government plans to ban the sale of new diesel and petrol vehicles from 2030 and have also banned new homes from installing gas and oil boilers from 2025 onwards instead will use low-carbon alternatives.
The electricity network is expected to absorb this additional demand from the heat and transport decarbonisation which currently accounts for 37% and 27% of the UK's overall emissions
The electricity networks are already struggling with low capacity particularly in distribution networks, so readying the network will be key.
Electricity network reinforcements and intelligent control of power generation and demand to maximise utilisation of existing assets will be required to avoid significant constraint costs caused by accelerated renewable connections and increased electrification of heat and transport.
A significant challenge would be to update the grid codes and standards on time to support and enable this transition.

Insight #3: Unlocking flexibility and its value
The electricity network will need to react to more intermittency and dynamic demand whilst ensuring balancing and stability requirements are met.
Unlocking flexibility from the demand side and active network management at the distribution level will be important drivers to support electricity network decarbonisation and to keep costs low.
A recent project[2] led by Carbon trust found that investing in flexibility is a no-regrets decision as it has the potential to deliver material savings of up to £16.7bn per annum across a number of possible energy system scenarios studied for 2050.
Embedding flexibility in low carbon heat and transport solutions now will help to reduce their system impact and costs, making the decarbonisation of these sectors more economical.

Insight #4: Role of the gas network in a Net Zero world and uses of hydrogen in the economy
There is ongoing uncertainty about the role of the gas network in contributing to the 2035 target.
The gas network repurposing for hydrogen/green gases is anticipated. However, the pace of development is not in alignment with timelines for net-zero.
Questions around where and how the hydrogen would be generated will need to be addressed.
The gas network is expected to provide diversification and a security of supply role (e.g. peak winter period) particularly during the transition period and also help manage intermittency in the power grid.
Hydrogen will be important to decarbonise hard to decarbonise sectors such as heavy transport and industry. For example, in South Wales Industrial Cluster many industries might rely on hydrogen as a means of decarbonisation.

Insight #5: Managing complexity in interconnected multi-energy networks
The complexity of the overall national energy network infrastructure will increase significantly with increased interactions and interdependencies among different energy networks.
Managing this complexity will be a key challenge.
All stakeholders will need to coordinate developments so that the solutions being provided individually work together as a whole.
There is a need for a network architect, i.e., an entity who can look at the entire system, plan for the future and make some of the most difficult decisions, many of which might sit uncomfortably with the public. In other words, there is a need to identify “no regrets” decisions now to ensure we meet the targets.

Insight #6: Communication of technical information
Network challenges as well as opportunities to meet the net-zero challenge need to be communicated not just with the policymakers, but also planners and urban developers.
Energy networks take years to build and are costly so planning of cities should go hand in hand with the planning of the networks.
Clear information and the use of creative communication channels to deliver information should be taken up.

Insight #7: The skills gap
The current workforce will need to acquire new skills urgently
Now is the time to invest in green jobs and skills development.
There is a need to train the current workforce to be agile and visionary when dealing with challenges.

Insight #8: Being bold to try
Energy networks are already in process of transformation, and there is an enormous potential to seize the opportunities to go even further.
To reach the 2035 and the 2050 targets, the networks community will need to work together but more importantly, have a bold vision.
Being frank and open about the challenges and how to meet the targets should be encouraged.
Some of the technological concepts, like peer-to-peer energy networks that have been discussed in academic circles 7 years ago, are now being realised and are seen as a way forward for some of our customers.
The communication between academic and business sectors is fruitful and should be encouraged.

References:

[1] **Attendees:** Muditha Abeysekera (Cardiff University, SEN), Lindsey Allen (Newcastle University, SEN), Jenny Cooper (EPSRC), Paul Glendinning (WSP), Roger Hey (WPD), Rui Jing (Cardiff University), Victor Levi (Manchester University, SEN), Furong Li (Bath University, SEN), Stephen McArthur (Strathclyde University), Keith Owen (Northern Gas Networks), Alessandra Parisio (Manchester University, SEN) Robin Preece (Manchester University, SEN), Karolina Rucinska (Cardiff University, SEN), Mahesh Sooriyabandara (Toshiba), Peter Taylor (Leeds University, SEN), Phil Taylor (Bristol University, SEN), Sara Walker (Newcastle University, SEN), Beth Warnock (ESC), Bethan Winter (Wales & West Utilities), Jianzhong Wu (Cardiff University, SEN)

[2]Project Report on Flexibility in Great Britain, available to read at <https://publications.carbontrust.com/flex- gb/report/>