

- Interoperable market development. For example, future flexibility is determined by investment and infrastructure decisions made today, yet there are no links between flexibility markets and long-term investment decisions in the markets,
- Consumer focussed flexibility. The industry often talks about paying customers for the inconvenience flexibility will cause, rather than demonstrating how flexibility is giving customers what they want at a price point they want to pay for it,
- Utilising digitalised flexibility offerings to avoid the risks of coincident responses to control signals and lack of diversity, integrated with critical national infrastructure,
- Proposing new technical and market structures, such as local energy markets, the role of the DNO/DSO in these markets and how they can be replicated / scaled,
- Researching and keeping up to date with latest technology and how the deployment of this could help in network design and operation for lower system operating costs.

In addition, a recent ESC project involving engagement with international research organisations, identified the following which would benefit from research under the IEA international platform:

- Security of supply and security standards:

The current security of supply limits were not designed for a flexible system and were built for old traditional systems with more predictable and controllable energy resources. Currently, there are security of supply standards that must be adhered to that determine the largest allowable losses in the event of a fault. In addition to maximum allowable demand losses after a system fault, in Great Britain this is a Loss of Load Expectation (LOLE). The question of security of supply is important because the standards set how we value meeting our demand needs every day and in exceptional circumstances, e.g., a wind drought or a cold winter. The current standards favour fossil fuel generation to meet the criteria as they are controllable and predictable, often at great cost. To move away from fossil fuelled generation, new security of supply standards are required to unlock the value of flexibility and storage.

Further research on security of supply to understand if and where these can be modified in the future net zero energy system would be beneficial. Further research on security standards may include cost-benefit analyses and simulations that demonstrate the impact of changing various operating parameters. Further research needs to be done on stress testing the system under simulated conditions with looser security parameters and economics.

- TSO-DSO coordination:

As we move towards net zero, a key question is *how do system operators incentivise market flexibility, whilst operating the system in a secure manner and maintaining the integrity of the grid?* The challenge is two-fold: encouraging adoption through creation of viable markets, as well as maintaining the reliability and resilience of the grid as electrification increases. There are various issues and trade-offs related to providing a flexible energy system. Some of these include wind farms being curtailed constantly with the end consumer picking up the costs for this (as the TSO's system balancing costs are recovered through billpayer payments), lack of storage available to DSOs and TSOs to actively balance the system; and current regulation which prevents alternative solutions (for example, currently storage must be provided by private entities). More flexibility is needed in both demand and generation areas. Enhanced market opportunities for participants at the domestic level are required to unlock flexibility across the whole system.

There are already some projects and considerations relating to this, including cross European projects under the European Commission H2020 and Horizon Europe frameworks. There are a number of areas that could be researched to support this, such as:

- More knowledge exchange between countries particularly related to regulation that enables and incentivises improved co-ordination and exchange,
- Design and development of tools to aid operators on using flexible loads (in combination) that can support real-time operational planning procedures,
- Cybersecurity and management of data exchange between different operators and market stakeholders.