A flexible grid for the future

An energy security and net zero committee inquiry

techUK response

August 2023

About techUK

techUK is a membership organisation launched in 2013 to champion the technology sector and prepare and empower the UK for what comes next, delivering a better future for people, society, the economy, and the planet. It is the UK’s leading technology membership organisation, with more than 1,000 members spread across the UK. We are a network that enables our members to learn from each other and grow in a way which contributes to the country both socially and economically. By working collaboratively with government and others, we provide expert guidance and insight for our members and stakeholders about how to prepare for the future, anticipate change and realise the positive potential of technology in a fast-moving world.

Smart Infrastructure and Systems Programme

Our Smart Infrastructure and Systems Programme is the champion for smart infrastructure deployment and governance in the UK, and the economic and societal benefits that smart technologies can deliver. We focus on the innovative application of emerging technologies to traditional forms of infrastructure (such as mobility, energy, water, and the connected home), bringing expert communities together to consider how to reduce costs, increase efficiency and resilience, and deliver better performance.

Smart Energy and Utilities Group

The Smart Energy and Utilities Programme provides a strong platform of technological solutions in support of delivering a competitive, dynamic, and flexible market. The aim of the programme is to provide leadership in emerging technologies and innovation benefits with a focus on decarbonisation, affordability, accessibility, and reliability.

**Call for Evidence**

Questions:

1. Does the current national and DNO grid deliver the capacity needed for the future and, if not, what are the solutions?
2. Has the organisation of the National Grid proved a barrier to the installation of renewable energy sources, and if so, what could be done to remedy this?
3. Should there be more innovation and devolution in the development of the Grid?
4. What changes should be made to the planning system to enable it to increase the use of renewable energy?
5. Is our planning system able to deliver more rapid development of new local infrastructure?
6. Would regional, or nodal, pricing of energy facilitates a more flexible development of Grid infrastructure?
7. What can be usefully learned from power transmission systems in other countries?

**Introduction**

techUK appreciates the opportunity to contribute to the committee's call for evidence. Our response focuses on the technological landscape and the pivotal role that innovation and digitalisation play in realising a sustainable energy system. We highlight the potential of digital infrastructure, the integration of renewable energy sources, challenges in adoption, and the imperative for collaboration between industry stakeholders.

**UK’s tech Sector[[1]](#footnote-1)**

The UK has established itself as a leading tech economy, with a strong digital sector and globally leading research and start-up ecosystem. The tech sector is one of the UK’s modern economic success stories, with its contribution to the economy rising over 25% between 2010 and 2019, and now adding £150 billion to the economy every year.

This makes it one of the country’s most valuable economic assets and the leading tech sector in Europe. However, our success must not breed complacency. There is now a fierce global race over the key technologies that will shape the future: from AI and Quantum to green technologies and semiconductors, competition between governments to attract talent, bring in investment and grow tech clusters is greater than ever. If the next Government does not make the most of the UK’s strengths, there is a real risk of it falling behind.

Technology is often perceived as a standalone sector; however, government needs to understand that to become a competitive economy we must apply this thinking down to each of our infrastructure sectors, in particular our energy system and utilise longstanding expertise within the UK.

**Grid Connection Reform**

[Ofgem](https://www.techuk.org/resource/ofgem-open-letter-on-future-reform-to-the-electricity-connections-process.html) and [National Grid](https://www.nationalgrid.com/document/149496/download) have already identified the need for reforming grid connection times, processes, and investment. Industries looking to build new infrastructure are restricted due to connection constraints and long queues.

[Over 40% (120GW)](https://www.ofgem.gov.uk/publications/open-letter-future-reform-electricity-connections-process?utm_source=twitter&utm_medium=ofgem&utm_term=&utm_content=&utm_campaign=) of all new generation capacity holding transmission connection agreements today have connection dates of 2030 or beyond – with the impacts of these issues cascading down into the distribution network. Investor confidence in grid connection reform is of utmost importance. We are not only striving for a fully electrified infrastructure (energy, heat, transport) but also to become a science and tech superpower. To be able to attract investment we must address with immediacy how we plan as well as recognise that digital such as machine learning, AI, quantum computing, and digital twins could make power dispatch more efficient and accurate.

**Leveraging Digital Infrastructure for a Sustainable Energy Ecosystem**

We emphasise the significance of digital infrastructure as a fundamental enabler of the energy transition. Digitalisation allows for efficient real time monitoring, predictive analytics, and data driven decision making across the entire energy value chain. The adoption of smart grids, IoT enabled devices, and advanced data analytics empowers utilities to optimise resource allocation, reduce waste, and enhance overall system efficiency.

Quick adoption of digital technology can reduce greenhouse gas emissions by up to 20% by 2050 in the three highest-emitting sectors: energy, mobility, and materials, according to the World Economic Forum. Data transparency, digital talent and partnerships are critical for companies to rapidly adopt the technologies and realise their net zero ambitions faster.

**We urge the government to support initiatives that promote the deployment of digital technologies to accelerate the transition towards a cleaner energy ecosystem.**

**Renewable Energy and Decentralisation**

Addressing the current, acute energy cost crisis must go hand in hand with pursuing the strategic economic opportunities presented by leadership on climate action.

For years the UK energy system has been one to generate energy and distribute it to consumers on the basis of predictive models. Today’s vision of the energy system is not a linear one but rather complexed and ambitiously changing to foster innovation and a change at pace. Decentralisation of energy is inevitable so to be able to generate and use the best possible resource available to the nearest location to us.

The National Grid’s future energy scenarios have identified that decentralised generation will account for up to [30% of total electricity generation capacity by 2030](https://www.ukri.org/wp-content/uploads/2023/02/IUK-03022023-Enabling-Decentralised-Energy-Innovation.pdf). In addition, the Climate Change Committee suggest we will need to deploy over [12 million electric vehicles and EVs and 5.5 million heat pumps to meet the 6th Carbon Budget](https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf).

There is enormous potential to move at pace to replace fossil fuel capacity with low carbon flexibility afforded by Electric Vehicles, the electrification of heat, and the rapid development of domestic and grid scale batteries. Technological advances mean these low carbon technologies can now be programmed to optimise the support they provide to the electricity system and help reduce emissions at peak consumption periods.

techUK recognises the challenges associated with decarbonisation and the integration of renewables. As technology solutions evolve, there is a clear opportunity to harness the potential of renewable energy sources.

Energy storage technologies, such as household smart devices, batteries, and grid scale storage, are instrumental in addressing intermittency issues associated with renewable generation and ensuring a reliable power supply. By leveraging innovative solutions, such as demand side management and energy storage systems, we can mitigate the challenges posed by decarbonisation of the energy system.

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| **Case Study – Electralink - Grid-level digital platform (Flexr)** |
| In 2019, ElectraLink launched Flexr as a pilot study to see how data sharing could help bring about innovation and help to create a flexible grid. Flexr leveraged DNO data sharing by providing real-time, static, and low carbon technology and distributed energy resource data provision, including data curation, presented in an interoperable and user-friendly environment with maps, downloads, and API access. This data is provided to a variety of DNO stakeholders and flexibility market participants. It is designed to meet DNO data sharing obligations in an interoperable manner to accelerate industry innovation and flexibility market development.    The platform will provide DNO’s and energy sector with the following capabilities:   |  |  | | --- | --- | | * Aggregated reliable GB Smart Meter consumption data (including metadata) with data curation to deliver standardisation, track compliance, and meet the Ofgem requirements ahead of the deadline. * Highly secure cloud-based, serverless design, which is fully scalable to manage billions of rows of data. * Securely manage sensitive data to ensure full compliance with data privacy rules and adaptable to meet future needs. * Considered and controlled user-centric access for DNOs and other energy participants, ensuring data is accessed by those with the correct permissions. * Standardised, interoperable approach for data across energy including Dublin Core and current industry best practices. | * Robust governance, policy, permission rule and safeguards that are compliant with all data privacy rules (including SLC10A) based on 25 years’ experience in managing the DTS and data access. * Data catalogue, adapting existing catalogues to include DNO data and potentially develop a GB centralisation data catalogue. * GB-wide flexibility asset data that will help support the DSO transition and flexibility market growth (with the potential to adapt as the flexibility requirement matures including the interaction with DSO and ESO markets). * User-friendly, visual, and adaptable dashboards that allow users to analysis GB data and develop insights. | |

**Integrating Domestic Flexibility**

Domestic flexibility will become an important component of our Net Zero transition. According to [National Grid ESO Future Energy Scenarios and Bridging the Gap](https://www.nationalgrideso.com/future-energy/future-energy-scenarios-fes/bridging-gap-net-zero) work, 20 – 30GW flexibility will be required by 2035, with 40 – 50% of this predicted to come from domestic and SME assets. It is vital we create cost effective technology solutions to enable this and implement well-functioning markets for flexibility services.

The current approach to accessing flexibility markets is based on each device (domestic EV charger, heat pump, other smart domestic platforms), or site, being a large energy generator or consumer. This is not appropriate for small assets in households, a change in approach is needed. Data based verification and billing mechanisms are universally used in the mobile, banking, and on-line transaction sector. There should be no reduction of quality of data emanating from a digital rather than a hardware solution and in many instances metering equipment is less reliable both in terms of equipment and information than through just in time data flows.

The aggregation of large numbers of domestic assets to participate in flexibility markets statistically increases the accuracy of the data being utilised, effectively making extra requirements redundant (such as Measuring Instrument Regulation), as accuracy is less reliant on a single measurement.

Most smart appliances can measure electricity consumption, but the right market conditions and barriers need to be in place, such as:

* Ensuring domestic assets in aggregate can participate in flexibility services and markets, from wholesale to ancillary services.
* Ensuring customers continue to invest in smart technology and trust what is being sold to them in good faith such that it is 'future-proof' and able to participate in future flexibility services.
* Ensuring standardisation and to simplify options available for end consumers.
* Ensure consumers see economic benefits from demand side response participation and have confidence in these services to ensure high levels of participation.

**Challenges and Opportunities in Technology Adoption**

While innovation is crucial, its successful adoption and scaling are equally important. Industry wide collaboration, regulatory clarity, and investment incentives are vital to overcoming adoption barriers. We urge the government to streamline regulations and create a supportive policy environment that encourages technology deployment. Furthermore, initiatives to facilitate knowledge sharing, pilot projects, and testing platforms can help build confidence in modern technologies and encourage their rapid uptake.

**Digital Twinning and Advanced Modelling Tools**

We underscore the potential of digital twinning and advanced modelling tools in optimising energy systems. Digital twins, which replicate physical systems in a digital environment, enable more accurate predictions, simulations, and optimizations. By creating virtual replicas of energy assets and infrastructure, stakeholders can test different scenarios, optimise energy flows, and make informed decisions that lead to resource efficiency and reduced carbon emissions. We advocate for increased investment in research and development to accelerate commercialisation of these technologies that support informed decision making across the energy ecosystem.

While digital twins are already enabling the UK’s energy system to transition to flexible, decentralised, and renewables-dominated service models, adoption remains immature and disjointed relative to other sectors.

An energy sector-wide approach to accelerating the development, adoption, and diffusion of connected digital twins will support enhanced strategic planning, drive performance optimisation of critical energy infrastructures, and enhance the UK’s resilience in the face of unprecedented levels of uncertainty and complexity.

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| **Case Study -** **Digital Twin of the Welsh Energy System – Partnership project between the Welsh Government, CGI, National Grid Electricity Distribution and National Grid Electricity Transmission, the ESO[[2]](#footnote-2)** |
| Employing digital twin technology can support the Welsh Government which recently consulted on increasing the bold targets it set in 2017 to meet 70% of its electricity requirements from Welsh renewable energy sources by 2030.  **Creating better system visibility and new transmission opportunities**  Digital twin technology has the power to equip Wales with a whole-system view of its electricity transmission and distribution network, enabling a wealth of opportunities. The system will help partners identify how networks can enable greater use of Welsh renewable electricity from a whole system perspective, aiding the progress in delivering the Welsh government’s decarbonisation goals. The project will help demonstrate the benefits of interoperable digital twins and will contribute to the aim of generating enough renewable energy to meet the needs of Wales.  Digital twin technology can also be used as an effective capacity management tool, helping manage the network’s connections and constraints, enabling greater system flexibility.  This project will help identify opportunities for Welsh renewable sources and empower communities by proactively suggesting actionable, location-specific solution options. Utilising digital twin technology will help to address the local needs of Welsh communities, enabling home-produced, low-cost renewable electricity generation. By monitoring data, we will also be able to better understand how the electricity network can support local needs for the decarbonisation of electricity, heat, and transport. |

**Innovation and the Path Forward**

techUK firmly believes that innovation is central to achieving energy security and net zero targets. The innovation ecosystem encompasses startups, established industry players, research institutions, and policy makers. By fostering an environment that encourages experimentation, risk-taking, and technological breakthroughs, we can expedite the transition to a sustainable energy future.

**Collaboration for a Holistic Energy Ecosystem**

Collaboration between government, industry, academia, and civil society is pivotal to achieving energy security and net zero goals. techUK emphasises the importance of partnerships that foster cross-sectoral knowledge exchange, innovation diffusion, and effective problem solving. Initiatives like public private partnerships, innovation hubs, and collaborative research projects can drive the development and deployment of cutting-edge technologies that contribute to a sustainable energy future.

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| **Case Studies – AVEVA**[[3]](#footnote-3) |
| Players such as Orsted in Denmark, Equinor in Norway and AGL in Australia are leading the way by committing to ambitious decarbonisation targets and using digital tools to get there.  Improving measurement and sharing innovations opens the path to systemic change. Existing leaders and new players are investing in new processes and greenfield plants by using leading-edge technologies such as carbon capture and storage, green and blue hydrogen, and renewables. It’s clear that digital technologies can support the rapid scaling up of the green economy.  Norway’s Equinor is using AI-enabled innovation to realise their decarbonisation vision with digital engineering, process modelling, and development of the Dolwind wind farm in the Norwegian North Sea. The first phase is to review the digital engineering to drive efficiency. The second is to gather data from many hundreds of turbines to optimise entire wind-power fields to play to the prevailing winds.  Spain’s Repsol is taking it one step further, using deep reinforcement learning alongside process simulation to build an AI “brain” that optimises performance and accelerates process times by 40% across their renewables fleet. |

**Conclusion**

In conclusion, techUK is grateful for the opportunity to contribute to the Energy Security and Net Zero select committee's call for evidence, focusing on the pivotal role of innovation and digitalisation in shaping a sustainable energy system. Our response underscores the immense potential of digital infrastructure, the integration of renewable energy sources, the imperative for collaboration, and the challenges associated with technology adoption.

Grid Connection Reform: The need for reforming grid connection processes and investment has been emphasised as a critical step towards attracting investments and fostering confidence in the energy sector. By harnessing digital technologies such as AI, machine learning, quantum computing, and digital twins, we can enhance the efficiency and accuracy of power dispatch, thereby contributing to a more resilient and flexible energy infrastructure.

Leveraging Digital Infrastructure for a Sustainable Energy Ecosystem: Our response highlights the transformative power of digitalisation in revolutionising the energy landscape. By adopting smart grids, IoT enabled devices, and advanced data analytics, utilities can achieve resource optimisation, waste reduction, and enhanced overall system efficiency. Embracing digital technologies offers the potential to reduce greenhouse gas emissions significantly, advancing the UK's journey towards a net zero future. The imperative of collaboration and the urgency of embracing digital solutions to address decarbonisation challenges are vital for achieving energy security and a cleaner energy ecosystem.

We urge the government to prioritise initiatives that accelerate the deployment of digital technologies, fostering innovation, and collaboration across the industry. By embracing digital twins and advanced modelling tools, we can optimise energy systems and drive informed decision-making. Innovation is at the core of our vision, and by fostering an environment that encourages experimentation and partnerships, we can steer the UK towards becoming a global leader in sustainable energy solutions. Collaboration among stakeholders, including government, industry, academia, and civil society, is essential in realising our shared goal of a holistic and resilient energy ecosystem that propels us towards a net zero future.

1. [A UK Tech Plan: How the next Government can use technology to build a better Britain (techuk.org)](https://www.techuk.org/resource/a-uk-tech-plan-how-the-next-government-can-use-technology-to-build-a-better-britain.html) [↑](#footnote-ref-1)
2. https://businessnewswales.com/powering-wales-renewably-through-digital-twins/ [↑](#footnote-ref-2)
3. https://www.aveva.com/en/perspectives/blog/digital-thinking-enabling-the-energy-industry-to-connect-the-networks-of-the-future/ [↑](#footnote-ref-3)