

**SUMMARY REPORT OF THE ROUNDTABLE SERIES ON DELIVERING  
A DECARBONISED ELECTRICITY SYSTEM**

# How to decarbonise electricity in Great Britain by 2035

Between September 2023 and January 2024, the National Engineering Policy Centre convened a programme of roundtable discussions on how to deliver a decarbonised electricity system. The focus of this was to inform work of the then government on a delivery plan for their target of electricity decarbonisation by 2035. The aim was to provide valuable insights to decision-makers through a series of focused discussions on key aspects of this challenge by convening experts from across industry, research and policy. Summaries of these discussions have been published, and this paper synthesises their major conclusions. However, given that they are based on a series of five focused roundtable discussions, the conclusions are not a complete or comprehensive overview of all the requirements for electricity

decarbonisation. For instance, the roundtable discussions did not address the connections queue for projects, the exact mix of generating technologies, or the details of the market and regulatory reforms that will be needed. Similarly, while the project included a roundtable discussion on unlocking the role of consumers in demand response, this focused mostly on domestic consumers rather than industrial or commercial consumers.

This summary report does, however, provide a summary of the key takeaway conclusions from the five roundtable discussions that, in total, drew together around 80 senior leaders from industry, academia, civil society and government to discuss crucial systems-level challenges associated with delivering electricity decarbonisation by 2035.



# Executive summary

## Although much progress has been made on electricity decarbonisation, reaching a net zero system by 2035 requires a transformational shift.

In order to meet government ambitions, we need to permit, finance and build 50 GW of offshore wind and 10 GW of low-carbon hydrogen by 2030, and 24 GW of nuclear by 2050. Meanwhile, over the next 6 years we need to build transmission infrastructure that is 5 times greater in capacity than what was built in the last 30 years,<sup>1</sup> while also unlocking the power of digital transformation to enable flexibility and consumer engagement. These changes will fundamentally alter the geography and dynamics of supply and demand, change operational considerations for the electricity system and require reform of policy and governance arrangements. These changes will need to manage the intermittency of renewable forms of generation and will change how consumers need to understand and engage with electricity and their consumption of it but, in doing so, they are an opportunity to create a much more consumer-centric system.

This whole-system change calls for a vision of the future electricity system that defines the purpose, focus and prioritisation needed and requires a much higher level of planning, accountability for targets, and enablement to address gaps in the delivery system. Delivering this requires a paradigm shift across policy, industry and public engagement. It will require a step change across the generation, transmission, and distribution of electricity, and with that, the skills, investment and commercial models needed for delivery.

This report outlines a set of priorities that have emerged from a series of [roundtables](#) convened by the National Engineering Policy Centre (NEPC) to feed into the government's work on a delivery plan to decarbonise the electricity system by 2035. The report is intended to be an overview of key issues and a clear and concise summary of the full set of priorities that have resulted from this programme of work. At their highest level, the key priorities are outlined in the accompanying box. Detailed specific actions to deliver these are outlined in the report.

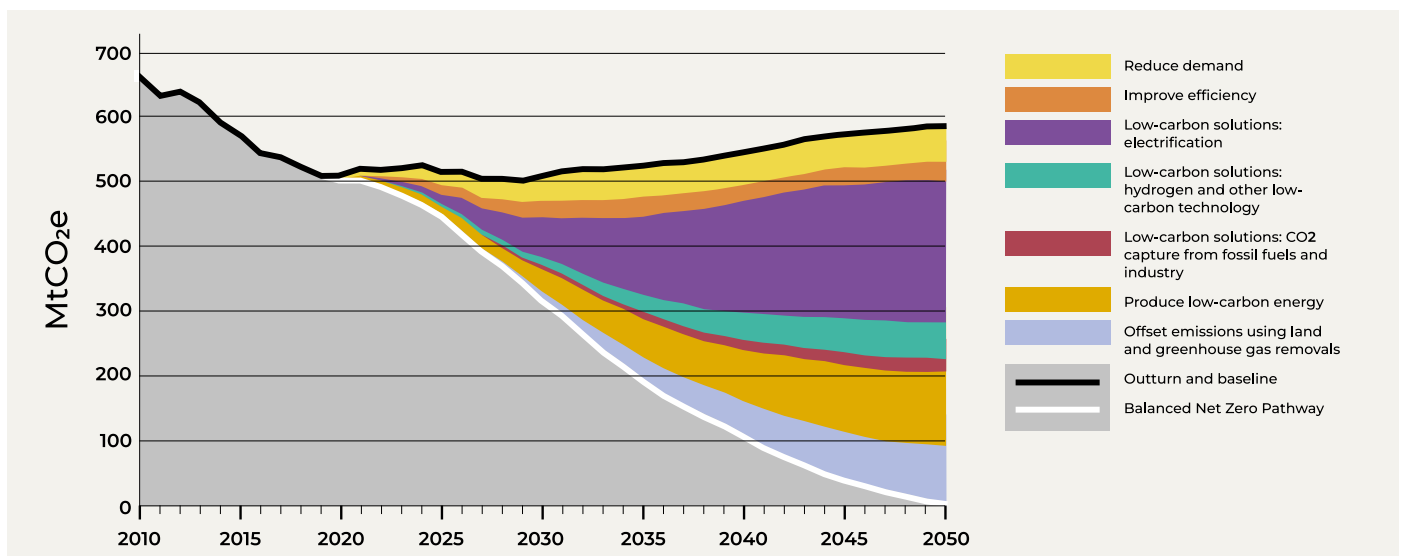
1. Make the key decisions that will drive the size and make-up of the 2035 system as quickly as possible, even in the face of incomplete information. This will require a greater risk appetite in policy making.
2. Provide a clear vision for the whole electricity system of 2035 and develop a comprehensive, realistic and spatially explicit plan that sets out what is needed and when.
3. Clarify and address gaps in governance arrangements.
4. Develop and enact an integrated delivery programme to drive the physical delivery of the assets and infrastructure needed, making timely decisions that reflect the urgency of delivery, the possibilities of failure, and the challenge of procurement, acknowledging that this will also require an appetite for risk in government. Crucial aspects of this delivery programme will include the remaining actions in this list.
5. Accelerate the consenting process to ensure timely delivery of a decarbonised electricity system.
6. Implement digitalisation and data sharing as a crucial part of a decarbonised electricity system.
7. Address major shortages in supply chains, manufacturing and construction services, capital investment and skilled workers across the whole project cycle to set the environment for a successful delivery.
8. Make energy efficiency and demand response more of a policy priority.

# Introduction

## Decarbonisation of the electricity system is a critical and core component of achieving the UK’s goal of net zero emissions by 2050.

The present (at the time that this work was conducted) target of decarbonised electricity by 2035 requires that we shift from incremental approaches to delivery and increase our risk appetite toward rapid system-wide transformation. This calls for a vision of the future electricity system that defines the purpose, focus and prioritisation needed and will require a much higher level of planning, accountability for targets, and enablement to address gaps in the delivery system. Delivery will require a paradigm shift across policy, industry and public engagement and innovation across the generation, transmission and distribution of electricity, and the skills, investment and commercial models needed for delivery. The Climate Change Committee (CCC) concluded

in 2020 that low-carbon energy can become 100% of the electricity supply by 2035 in the Sixth Carbon Budget.<sup>2</sup> In the following year, the government’s 2021 Net Zero Strategy contained a target to decarbonise the electricity system by 2035.<sup>3</sup> The Sixth Carbon Budget showcased that meeting the target to reduce emissions by 2050 will require a range of strategies and that over half the emissions savings will come from electricity generation from renewables or other low-carbon sources of energy, and the electrification of currently carbon intensive activities such as heating and land transport.<sup>2,4</sup> In other words, electricity can contribute to around half the emissions savings needed to achieve the goal of net zero emissions by 2050.<sup>i</sup>



The CCC’s 6th Carbon Budget showcased that the abatement strategies of producing low-carbon energy (in dark yellow) and the low-carbon solution of electrification (in purple) contribute to around 400 MtCO<sub>2</sub>e of emissions reductions by 2050.

This graph has been adapted from Figure 4 in the CCC’s 6th Carbon Budget<sup>2</sup> which takes its information from BEIS (2020) Provisional UK greenhouse gas emissions national statistics 2019 and CCC analysis.

Note: ‘Other low-carbon technology’ includes use of bioenergy and waste treatment measures. ‘Producing low-carbon electricity’ requires the use of CCS in electricity generation.

■ **Figure 1 | Types of abatement in the Balanced Net Zero Pathway**

i For more details on the abatement strategies towards achieving net zero, see Figure 4 in the CCC Sixth Carbon Budget.<sup>2</sup>

Though low-carbon generation is important, decarbonising the electricity system is a wider challenge than building more low-carbon generation capacity. The drive to expand low-carbon energy generation will fundamentally alter the geography and dynamics of supply and demand, change operational considerations for the electricity system and require reform of policy and governance arrangements. The need to manage the intermittency of renewable forms of generation will also change how consumers need to understand and engage with electricity and their consumption of it, but is also an opportunity to make the system much more consumer-centric, which in turn will drive efficiencies.

The National Engineering Policy Centre organised a series of roundtable discussions from September 2023 to January 2024 to discuss crucial systems-level challenges that need to be addressed to decarbonise the electricity system. This paper provides an overview of the key findings and priorities from this [roundtables series](#). It aims to communicate what a low-carbon electricity system can look like and what it will take to get there. Before providing more information on the roundtables themselves, some essential context underscoring the scale of the challenge is provided.

# Scale and nature of the challenge

## There are multiple challenges to decarbonising the electricity system.

As we transform the existing system in order to decarbonise, demand for low-carbon electricity is expected to grow considerably due to the expected electrification of key sectors such as heating and transport, as part of what is required in order to decarbonise these sectors.<sup>2</sup> Mean average electricity demand is expected to rise by 50% by 2035, and further double or treble by 2050.<sup>2</sup> The expected demand can range from 550 to 680 TWh in 2050, compared to 300 TWh in 2018.<sup>4</sup> The challenge is therefore to decarbonise the existing electricity system while ensuring its growth to deliver the low-carbon electricity needed for industrial, commercial and domestic needs in the decades thereafter.

Redesigning an electricity system that is fed by multiple different sources of low-carbon energy is a considerable challenge with many issues requiring significant planning to manage short-term and long-term risks. It is important to acknowledge some key considerations underpinning the scale and nature of the overall challenge.

First, there is the question of competing visions. There are multiple ways that the electricity system can evolve, and a range of end-states for a decarbonised system, each with their own characteristics in service of specific aims. While exploring and examining the challenges and opportunities within decarbonisation, it is necessary to consider why some outcomes are more desirable and/or realistic than others, and for whom. It will be important to keep in mind not just the goal of decarbonisation, but also the wider dimensions of social, economic, and environmental sustainability and resilience. These will need to include key priorities such as access and affordability of energy, security of supply and resilience of the overall system.

Second is the need to fully appreciate the scale of transformation involved in decarbonising the electricity system; just how much investment and redesign is needed within the target timescale, the

sheer volume of infrastructure build or upgrade and the skills needed for delivery.

The government's ambition for a decarbonised electricity system entails the following: 70 GW of solar power by 2035;<sup>5,6</sup> 24 GW of nuclear capacity by 2050;<sup>7</sup> 50 GW of offshore wind capacity by 2030;<sup>5</sup> and the UK to be a net energy exporter by 2040.<sup>8</sup>

To put these targets into context, current nuclear capacity is 9 GW, with 8 GW set to retire in this decade.<sup>4</sup> To meet our targets for offshore wind, we will need to install the same number of wind turbines in 6 years, than have been installed in the last 20 years: approximately 4000 turbines of 10 MW each, on anywhere between 5700-8000 km<sup>2</sup> of seabed.<sup>9</sup> Meanwhile, the role of hydrogen as a new energy vector is expected to grow. At present there is 0.005 GW of installed capacity for low-carbon hydrogen,<sup>10</sup> with the government ambition for low-carbon hydrogen set to 10 GW by 2030, with at least half of this produced via electrolysis using low-carbon electricity.<sup>11</sup> This ambition is for an increase of four orders of magnitude in the production capacity for low-carbon hydrogen.

Technology	Current installed capacity	UK ambition at the time of the roundtables	By	Percentage increase
<b>Nuclear</b> <sup>7,9</sup>	9 GW (of which 8 GW to retire by 2030)	24 GW	2050	2300% <sup>ii</sup>
<b>Offshore wind</b> <sup>5,13</sup>	14.7 GW	50 GW	2030	240%
<b>Onshore wind</b> <sup>13</sup>	15 GW	None		
<b>Solar PV</b> <sup>5,6,14</sup>	15.5 GW	70 GW	2035	352%
<b>Low-carbon hydrogen</b> <sup>11</sup>	0.005 GW	10 GW	2030	199,900%

■ Table 1 | UK targets for generation technologies <sup>iii</sup>

ii This figure assumes there will be no life extension of the existing plants which will retire by 2030. And it does not take into account the decommissioning of Sizewell B, planned for 2035, although life extension to 2055 is being considered.<sup>12</sup>

iii The figures in the table are current as of the time of writing, and aside from nuclear do not take account of any plant retirement prior to 2035.

The National Audit Office (NAO) has highlighted that the £280-£400 billion figure for the cost of new energy generation and flexible assets (as provided by the government in the 2021 Net Zero Strategy),<sup>3</sup> does not include the cost of other aspects of decarbonisation such as network construction.<sup>9</sup>

There remain questions and infrastructure challenges on the transmission, distribution, operations and consumption of low-carbon energy and its wider cross-system dependencies. One challenge is the connection of offshore wind for transmission onshore as well as the need to connect across long distances between areas of generation to areas of high demand. Electricity transmission is projected to triple from Scotland to the rest of Great Britain between now and 2030. Overall, National Grid has assessed that the amount of new electricity transmission infrastructure installed will need to be 5 times greater in capacity in the next 6 years than was installed in the last 30 years.<sup>1,15</sup> Meanwhile, interconnector and storage capacity is projected to match or exceed transmission connected generation in South East England by around 2030.<sup>16</sup>

Finally, the need for low-carbon electricity is transformative since it will radically change the sources of electricity and will therefore change the design of the system in comparison to the historical electricity system. Renewable energy such as wind and solar are not only highly distributed geographically, they are intermittent sources of generation and bring associated challenges to maintaining grid stability, inertia, and synchronisation.<sup>iv</sup> Intermittency also adds further challenges to maintaining resilience in the system, especially with regards to extreme

situations requiring black start.<sup>v</sup> Differing generation sources will also radically change participation in the electricity system, including who counts as producer or consumer and their respective roles and responsibilities. There is potential for the electricity system to become more distributed and decentralised with consumers also becoming producers of energy (so-called 'prosumers'), and this may open new spaces for microgrids or semi-autonomous grids.<sup>21</sup> These and more examples represent a wide range of possibilities in what will over time become a radically altered system.

These challenges are not unique to the GB electricity system. Much of the world is on a similar path on similar timescales. This has major implications for the supply of equipment, services and skills to deliver a decarbonised electricity system.

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iv Intermittency is an inherent feature of renewable energy generation such as wind and solar. Due to seasonal or climatic conditions, solar and wind energy generation can vary on an hourly, daily, monthly or even yearly basis. For example, solar energy is only available during daylight hours. This is a challenge to providing enough energy as per demand, as well as to operating the electricity system. This can be addressed by storing excess energy during windfall periods and periods of low demand, by innovating on how the system is balanced using a range of flexibility services and technologies, and by maintaining a reserve of dispatchable back-up generation.<sup>17, 18</sup>

v Black start is the process of restoring electricity to the transmission and distribution system for operation, from a state of total or partial shutdown. Doing this involves a range of strategies, from having black start sources to detailed system restoration plans, to ensure the return of electricity to power homes and businesses after a major blackout.<sup>19, 20</sup>

# National Engineering Policy Centre (NEPC) programme on decarbonising the electricity system

To inform the government's ongoing work on delivery of a net zero electricity system, the NEPC convened a series of roundtable discussions with around 80 senior leaders from industry, academia, civil society and government to discuss crucial systems-level challenges associated with effective delivery. The intention of the roundtables was to

build a greater shared understanding and recognition of the actions and barriers that need to be addressed to deliver the government's target of a decarbonised electricity system by 2035. [Five roundtable discussions](#) were held during the latter half of 2023 and early 2024 addressing the following themes:

## Roundtable 1

**Decisions now for a future system:** Making design and construction decisions for the electricity system of 2035 and of 2050 (held 15 September 2023)

## Roundtable 2

**Local, regional and national:** What interests, opportunities and challenges exist at these levels? How does each contribute to net zero? (held 29 September 2023)

## Roundtable 3

**Consumers, flexibility and efficiency:** How can consumption contribute to the decarbonisation of the electricity system? (held 20 October 2023)

## Roundtable 4

**Governing transformation, transforming governance:** Managing ambiguity, interconnections and digitalisation (held 22 November 2023)

## Roundtable 5

**Delivering electricity decarbonisation by 2035:** What do we need across industry capacity, procurement and skills? (held 9 January 2024)

[Summaries of each of the roundtables](#), published separately, go into more depth on the detailed themes and discussions from each event than the summary contained here. What follows is intended to be a clear and concise summary of the full set of priorities that resulted from this programme of work, noting that the nature of roundtable discussions is that they are not comprehensive.

# Delivering a decarbonised electricity system: key priorities for now, next and in the future

**The priorities identified from the roundtable series have been organised in a framework according to those actions that are needed in the ‘now, next, and future.’**

This provides a timeline of necessary actions required for the short, medium and long-term needs of a decarbonised electricity system. The framework is intended to denote the following:

**Now:** What needs to be actioned now to ensure the delivery of a decarbonised electricity system by 2035?

**Next:** How should immediate actions be further strengthened?

**Future:** What is also needed to achieve the longer-term target of net zero emissions in the GB economy by 2050 whilst decarbonising the electricity system by 2035?

The priorities outlined have been compiled from the roundtable series discussions encompassing the five thematic areas. As previously noted, while the actions outlined are necessary for decarbonising the electricity system, this does not claim to be a fully exhaustive list of all the actions needed to achieve decarbonisation by 2035.



## **1. Make the key decisions that will drive the size and make-up of the 2035 system as quickly as possible, even in the face of incomplete information. This will require a greater risk appetite in policy making.**

There are a range of decarbonisation targets and pathways that could achieve the 2035 and 2050 net zero goals. However, the development of a decarbonised electricity system is not progressing at the required pace.<sup>23</sup> This is further hampered by an understandable but unhelpful desire to know all

future system components and an unrealistic expectation of certainty in technology readiness.

Decisions must be made acknowledging that there will be uncertainty and that building a decarbonised electricity system and its requisite supply chain takes time. Significant progress in delivery requires government to have a risk appetite that accepts this uncertainty and its potential consequences.

Despite incomplete information, we have substantial knowledge about the necessary elements of a functional decarbonised electricity system, including low- and no-regrets options.

It is also clear that individual projects or approaches may fail or become delayed, meaning a resilient plan needs to make appropriate allowances for contingencies. This creates a risk on the upside that more assets are built than are needed at a point in time. A greater risk appetite is therefore required to make key decisions on the network and generation needs for the energy transition.

The high anticipated demand for electricity and networks means that the risk of stranded assets remains low, as new demand is likely to arise where capacity is available, and the consequences of insufficient generation or network would be much more serious for the economy and for decarbonisation.

Key decisions driving the 2035 system's size and composition will need to address the areas covered by the remaining priorities that follow.



## **2. Provide a clear vision for the whole electricity system of 2035 and develop a comprehensive, realistic and spatially explicit plan that sets out what is needed and when.**

A comprehensive vision and plan that describes the parameters of the future electricity system, as well as a guide on how it would interact with the wider future energy system, is crucial. This plan needs to outline the necessary energy resources, their locations, and the required infrastructure and assets for their use, including generation technologies, energy storage, and transmission and distribution networks. These are the key decisions that will drive the size and make-up of the 2035 system and beyond. The vision and plan needs to account for the projected 50% rise in electricity demand by 2035 compared to pre-2020 levels, and a subsequent doubling by 2050 due to the electrification of heating, transport and industrial sectors. The Strategic Spatial Energy Plan, as recommended by the Electricity Networks

Commissioner (ENC), can form a core part of the development for this vision and plan.<sup>24</sup> There is an immediate need to further clarify the roles and responsibilities of the National Energy System Operator (NESO) and the relationship between other relevant bodies.

In the longer term, definitions and measures of resilience and reliability need to be rethought and redefined to account for the rise of distributed and intermittent assets, the increasing reliance on electricity as an energy vector with the electrification of heating and transport, and escalating climate risks to electricity infrastructure and adjacent systems, such as telecommunications. Current definitions and measures are inadequate for the evolving energy landscape. With this challenge, there is an opportunity to achieve net zero cost-effectively by utilising flexibility strategies like demand response and household-level storage in batteries and electric vehicles while also improving grid resilience and reliability, however risks need to be proactively managed and resilience planned for.

### **NOW**

- **Clarify the roles and responsibilities of the National Energy System Operator (NESO), including in relation to the other relevant bodies, government departments and local and regional authorities in order to improve coordination and planning, and accelerate delivery, and take steps to ensure that all parties are adequately resourced to undertake their responsibilities.**

### **NEXT**

- **Build on the spatially and temporally explicit planning above to further incorporate analysis of the risks of failure or delays to key aspects of delivery, monitoring these on an ongoing basis. The plan should be resilient to reasonable scenarios of failure or delays in the delivery of discrete assets.**

### **FUTURE**

- **Rethink and redefine both resilience and reliability across the electricity system to align with the rise of distributed and intermittent assets, increasing reliance on electricity as an energy vector with the electrification of heating and transport, and escalating climate risks to electricity infrastructure and adjacent systems, such as telecommunications.**
- **Re-evaluate the definitions, responsibilities and accountabilities for cross-sector risks and dependencies the electricity system has with other systems such as water, transport and telecoms. Require the development of aligned or shared resilience standards that ensure coordinated risk management under uncertainty and in accordance with needs. This will also require clear mechanisms for dispute resolution during conflicts of interest among the stakeholders across the system.**



### 3. Clarify and address gaps in governance arrangements.

Considerable gaps and ambiguities exist in the current governance arrangements which are inadequate for governing a more complex, distributed, and diversified electricity system and for the transformation needed to decarbonise. These gaps and ambiguities have practical implications for the suppliers and users of the system. For example, the escalating costs of constraint payments that have arisen out of our lack

of ability to plan and deliver network infrastructure in a timely way are costing consumers money. Progress has been made in governance reform, principally with the establishment of NESO as a coordinating body. However, significant efforts are still required to clarify and build effective governance arrangements for regional and local levels. The focus now needs to be on clarifying and building the roles of Local Area Energy Planning (LAEP)<sup>25</sup> and the proposed Regional Energy Strategic Planners (RESPs)<sup>26</sup> and how they will act to develop coherent strategic energy plans at local and regional levels and bring together national targets and scenarios with local and regional insight.

#### NOW

- While progressing delivery within current governance arrangements, undertake a review to create a governance framework suited to the future system, to be in place by 2030 at the latest.
- Develop an agile governance model, that can be continuously updated to respond to emerging circumstances.
- Define the roles and responsibilities of the RESPs which, if set up and resourced effectively, should be well-placed to coordinate the development of strategic energy plans at the regional level, bringing together national targets and scenarios with regional and local opportunities, insights and stakeholder communities. The creation of the RESPs has the potential to be a positive and impactful development but the nature and form of the regional role requires definition and development and is a key priority.
- Establish governance mechanisms for decision-making and the authority to assign decision making to responsible parties, with explicit monitoring in place.
- Strengthen the role of LAEP<sup>27</sup> and smart local energy systems,<sup>28</sup> including addressing the skills and resource requirements of Local Authorities and recognising the co-benefits of smart local energy systems, developing a clear business case for increased resources for local authorities to develop these where it would be impactful.

#### NEXT

- Clarify the function of systems operations when developing the RESPs. As the electricity system is decarbonised, distributed assets will be increasingly used to balance the system in real time. The same assets can be used for local and national level markets or purposes. It is important that these markets are coordinated both when the assets are designed and when these are operational, and that responsibilities and roles for system operation at different scales are clarified when developing regional system planning.
- Continuously assess the governance arrangements in place both to deliver the 2035 decarbonisation target, and to ensure a long-term functioning and affordable electricity system that works in the interest of its users. This will include taking opportunities to distinguish and clarify the functions that are performed by governance, the institutional arrangements where those functions are implemented, and the artefacts and effects that are to be produced from these arrangements where ambiguities, gaps or needs arise.
- Develop a regulatory environment that drives the system's expansion and growth rather than treating the changes required as exceptions to the norm.

#### FUTURE

- Rethink and redefine both resilience and reliability across the electricity system to align with the rise of distributed and intermittent assets, increasing reliance on electricity as an energy vector with the electrification of heating and transport, and escalating climate risks to electricity infrastructure and adjacent systems, such as telecommunications.



**4. Develop and enact an integrated delivery programme to drive the physical delivery of the assets and infrastructure needed, making timely decisions that reflect the urgency of delivery, the possibilities of failure and the challenge of procurement, acknowledging that this will require an appetite for risk in government.**

Electricity decarbonisation will be delivered by multiple parties, enabled by a range of delivery approaches and vehicles. The pace and scale

involved mean a planned, programmatic approach that is driven centrally is needed to address dependencies and to create sufficient momentum. While not an exhaustive list of priority actions, an integrated delivery programme will need to include the remaining priorities identified from the roundtable series and detailed in the remainder of this list namely: the acceleration of the consenting process, increased digitalisation and data sharing, action to address shortages in key areas across supply chains, manufacturing, construction services, capital investment and skills, and making energy efficiency and demand response a greater priority.



**5. Accelerate the consenting process to ensure timely delivery of a decarbonised electricity system.**

The current planning and regulatory systems and electricity markets were developed for an energy system much different from the one needed in 2035. The transmission and distribution systems are the backbone of the electricity system and

without timely network reinforcements, decarbonisation will not be possible. Achieving the network expansion needed will require changes to the planning system while simultaneously working to engage the public and affected communities effectively and transparently. The Electricity Networks Commissioner (ENC) made 18 recommendations to accelerate planning and network development while improving public and community engagement with infrastructure build.<sup>24</sup>

**NOW**

- **Implement the 18 recommendations made by the ENC, including:**
  - **Set up an Energy System Delivery Board to monitor and drive delivery of the electricity transmission network delivery programme with a whole energy system remit but initial efforts to be focused on transmission infrastructure.**
  - **Make adjustments to environmental impact assessments and introduce regular updates to the energy National Policy Statements (NPS).**

**NEXT**

- **Sustain community dialogue, and ensure and enact community benefits for network development (which is part of the recommendation to establish a clear and public set of guidelines for community benefits).**



## 6. Implement digitalisation and data sharing as a crucial part of a decarbonised electricity system.

Digitalisation has a major role to play in the transformation of the energy system. Data collection, governance and sharing are important issues across local, regional and national scales, and across systems that are interdependent with electricity such as transport, water and telecoms. It is not readily apparent what data is needed across organisations for specific but important

functions and data is not routinely or readily shared and is instead highly siloed. For new systems to be successful, it is important that data management and agreements for appropriate access to data, are established. This is because the real time control of distributed assets, as well as key aspects of the future system such as demand response, require digital information flows. Enabling these flows across different institutions is critical for robust analysis, efficient energy management and reliable system operation, and to unlock distributed solutions (including using end users' assets) as cost-effective alternatives to some larger scale construction.

### NOW

- **Accelerate development of the means necessary for the collection, sharing and governance of data required across national, regional and local levels, and for managing the interaction between energy and other key systems such as water and telecoms. This includes implementing the recommendations of the Energy Digitalisation Taskforce (2022)<sup>29</sup> on the interoperability of digital assets and infrastructure, a new digital governance approach and digitalisation entities, digital security measures, carbon monitoring and accounting and on instituting a Chief Data Officer.**

**Of particular relevance to electricity decarbonisation is building trust and protections for consumers to facilitate consumer engagement with energy assets.**

### NEXT

- **To manage a huge number of distributed energy assets, develop and build a digital spine<sup>vi</sup> which will enable a minimal layer of operational critical data to be processed, standardised and shared in near real time. The governance and risk management of digital assets will be key.**
- **Ensure arrangements are in place for the design and integration (on an ongoing basis) of the software-based assets needed to manage the electricity system.**
- **To ensure the quality of digital tools and infrastructure, address the skills demand for managing the digital infrastructure for the electricity system, with the need to assure the quality of data and the use of AI with the specific needs and requirements of the wider energy system.**

vi A digital spine is a network of connected nodes used by organisations across the energy sector. Each node gathers and processes data about the energy system and focuses on select critical operational metrics, then standardises this information, and provides a basic overview of the status of the system. Each node functions as a standard interface that can be accessed by the other nodes in the network. The node owner can choose to share raw data or aggregated information where more sensitive information is present.<sup>29</sup>



## **7. Address major shortages in supply chains, manufacturing and construction services, capital investment, and skilled workers across the whole project cycle to set the environment for a successful delivery.**

Decarbonising the electricity system demands rapid and extensive expansion in delivery capabilities. While current constraints pose a risk of delay to achieving national targets and increased costs, this also presents an opportunity to bolster the UK's engineering and manufacturing sector in areas where the UK has, or could develop, a comparative advantage. Ramping up engineering and manufacturing, will contribute to energy security, with jobs and economic benefits in the long-term. Expanding the supply chain also offers a chance to build in resilience, develop strategies for more inclusive procurement frameworks, to

encourage technical innovation, and to build new businesses for market participation. Expanding supplier participation would foster competition and allow for choice and variation across the supply chain, in turn offering value for money. Providing policy certainty, along with an apolitical and long-term commitment on infrastructure strategy with reliable cross-party support, would improve investor confidence and give the direction needed to expand supply chains and delivery capabilities and services and to invest in skills for the transition.

Much of the world is seeking to deliver similar transformations to the UK electricity system, on the same time scale. All aspects of relevant global supply chains are substantially under-sized for this challenge. The UK is in a race for capacity, and will need to act boldly to gain access to equipment, delivery capacity and skilled people, and to capture the economic value it wishes to.

### **NOW**

- **Rapidly move procurement models from a project-by-project basis to major programmes with multi-year portfolios.**
- **Standardise procurement processes, equipment and manufacturing where possible.**
- **Prioritise where UK economic value is sought and be proactive in attracting and supporting supply chain investment.**
- **Communicate the ambition of the energy transition as a major national goal to young people to stimulate their interest in developing a career in this area.**
- **Identify areas within the supply chain where new suppliers and technical innovation can enhance competition and build inclusive procurement frameworks that allow for the participation of new suppliers, particularly small and medium enterprises (SMEs) who can contribute their innovation and agility often as subcontractors to larger firms or as a percentage of contract value. Inclusive procurement frameworks are crucial to accommodate diverse market participation and bolster resilience.**
- **Provide public support for securing sufficient manufacturing capacity for key components to be developed in or outside the UK.**

### **NEXT**

- **Develop a range of programmes on skills across re-skilling, upskilling, micro-credentials, apprenticeships, and bursaries, to equip and facilitate both the existing and incoming workforce.**
- **Provide economic incentives, such as pay progression and job security to attract and retain the volume of the needed skilled workforce.**



## 8. Make energy efficiency and demand response more of a policy priority.

Energy efficiency and demand response are neglected but urgent policy areas. The efficient use of energy is vital for decarbonisation, aiming to maximise output with less energy input or achieve the same output with reduced energy input. Enhancing energy efficiency conserves resources, cuts costs for consumers, reduces fossil fuel dependence, and bolsters energy security.

Demand response is a strategy that enhances electricity system flexibility by adjusting consumption patterns through intentional modifications to the timing, level, or total electricity use by consumers. Enabled by smart meters and tariffs, consumers can monitor and adjust their consumption in response to signals or incentives, reducing peak demands on the overall system and therefore the overall required network and generation capacity. This contributes to balancing supply and demand, enhancing the stability and reliability of the electricity system by providing frequency response and managing network congestion. As part of a wider range of flexibility services and technologies, demand response also enables access to cheaper electricity, benefiting both consumers and the energy system.

Energy efficiency and demand response can

therefore reduce consumer bills and contribute to broader decarbonisation efforts. Without these measures, building electricity networks at higher capacity or more investments on low-carbon energy generation would be needed, significantly raising overall the cost of decarbonisation.

However, the effects of the Review of Electricity Market Arrangements (REMA) will have limited impact on progressing flexibility services and technologies, before the 2030s. This means there is a need for additional ways to stimulate flexibility services, for example, to achieve the price signals needed to encourage the shift or reduce peak demands and provide the access to the economic savings this can provide to consumers.

There is also a need for adequate incentives for suppliers and protections for consumers. Balancing the level of consumer protections is essential to avoid stifling innovation while ensuring that vulnerable consumers are safeguarded and that the benefits of demand response are accessible to as many as possible. These measures also foster trust between consumers and the industry. Fairness in accessibility and incentives is vital to prevent the cost burden of non-participation in demand response from falling on those with limited means. Addressing diverse needs and capabilities across different user groups, such as homeowners, renters, and businesses, is necessary to promote consumer participation. This will require tailored approaches.

### NOW

- **Double down on efforts to reach the current ambition to reduce the UK's final energy consumption from buildings and industry by 15% by 2030.<sup>30</sup>**
- **Introduce national targets for flexibility<sup>30</sup> and appoint a Flexibility Commissioner<sup>vii</sup> to lead on the rapid development of policies for increased demand response, including identification of the responsible bodies and the effective mechanisms and incentives to drive rapid progress.**
- **Provide economic incentives to consumers – domestic, commercial and industrial – to increase uptake of demand response, as well as for suppliers and Distribution Network Operators (DNOs) to provide them.**
- **Increase responsibility on electricity suppliers and DNOs to proactively increase the roll-out of smart tariffs and smart technology. It is vital for the industry to lead and rationalise the current variation in provisions.**
- **Implement suitable and ongoing consumer protections so that consumers get the services they need via systems they can access and use. Vulnerable consumers need to be protected. Critically, introduce strong regulatory incentives for industrial consumers to improve energy use efficiently.**

vii This work should follow the model of the Electricity Networks Commissioner, bringing together an expert team to give detailed but rapid consideration and to make recommendations that have ownership within government.

## **NEXT**

- **Develop a national campaign on the benefits of demand response and energy efficiency. This should include information about potential savings for individual households and businesses through half-hour metering, as well as the benefits to the whole system.**
- **Develop targeted campaigns to address areas lacking in investment and infrastructure, as the potential for flexibility will vary across different regions.**
- **Coordinate the provision of trusted independent expertise to help consumers develop the trust and confidence they need to contribute to the energy transition. The proposed RESPs could be provided with the funding to support local community energy initiatives that provide this advice.**

# Members of the NEPC working group on decarbonising the electricity system

The roundtable series was convened by the National Engineering Policy Centre (NEPC).

The working group included representatives from the Institution of Engineering and Technology (IET), the Energy Institute (EI), the Institution of Mechanical Engineers (IMechE), the Institution of Civil Engineers (ICE), the Permanent Way Institution (PWI), the Royal Academy of Engineering, and the Energy Systems Catapult.

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