National Engineering Policy Centre

Royal Academy of Engineering

ROUNDTABLE SERIES ON DELIVERING A DECARBONISED ELECTRICITY SYSTEM

Delivering electricity decarbonisation by 2035: What do we need across industry capacity, procurement and skills?

Introduction

To achieve the government's target of a decarbonised electricity system by 2035, a whole systems approach is required. In order to inform the government's ongoing work on a delivery plan for a net zero electricity system, the National Engineering Policy Centre organised a series of roundtable discussions. The roundtables were convened with senior representatives from industry, academia, and government to discuss crucial systems-level challenges for an effective delivery plan. 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 implement a net zero electricity system.

This briefing summarises the discussions at the fifth roundtable, held on Tuesday 9 January 2024, with the title *Delivering electricity decarbonisation by 2035: What do we need across industry capacity, procurement and skills*? The roundtable was hosted by the Institution of Mechanical Engineers. The document does not intend to give a complete view of the whole discussion, but rather to summarise key themes. The aim of these discussions was not to reach a consensus on all topics discussed but to contribute to a better shared understanding through gathering key perspectives on important systems-level questions which need to be addressed for the delivery of a fully decarbonised electricity system. Given this and the broad range of stakeholders involved in the discussion, there was no definite consensus on all the topics listed below.

Roundtable 5: **Delivering electricity decarbonisation by 2035: What do we need across industry capacity, procurement and skills**

The fifth roundtable explored what contracting and procurement models, industry capacities, and skills were needed to deliver decarbonisation of the electricity system by 2035.

The following high-level questions formed the overall focus of the roundtable discussion

- What is a sustainable way of contracting and procuring major works over a long-term programme of projects and what are the right commercial frameworks?
- What commercial and industrial strategy does the UK need to decarbonise in a way that secures the industrial capacities and supply chains needed at pace in the short-term and maintain them for the long-term?
- What is necessary to close the skills gap and address short-term and long-term regional needs for a robust and active skills pipeline?

Key themes of discussion

The broad range of stakeholders at the roundtable[i] provided a diverse set of inputs, and several key themes emerged from the discussion.

The scale of the challenge

Decarbonisation of the electricity system by 2035 in Great Britain is a major and complex transformation of the system. It will require a massive increase in the speed and scale of delivery[1] which has profound implications for the skills and supply chain needed. Some examples illustrate the speed and scale of delivery needed:

- The government ambition for offshore wind capacity is 50 GW by 2030, which requires the deployment of three times as much offshore wind capacity in 6 years as in the last two decades.[2]
- The expansion of electrification for heating and transport will double the demand for electricity by 2050. The amount of transmission infrastructure to be built will need to be five times greater in capacity in the next seven years than what it was in the last 30 years[3] and there is a projected 49% growth in distribution substation capacity by 2035.[1]
- The transition will also require new technology such as hydrogen for myriad uses such as long-duration energy storage. Currently, around 27 TWh of grey hydrogen is made in the UK which needs to be decarbonised.[4] While 5 MW of hydrogen projects from renewable energy are operational in the UK, the government ambition for hydrogen is 6 GW from electrolytic production and 4 GW from natural gas with CCUS by 2030.[5,6] This ambition is for an increase in the production capacity of low-carbon hydrogen by 4 orders of magnitude.[4]
- The increase of renewable energy and the expansion of its necessary infrastructure will all demand a significant increase in the capacity of supply chains.

To address these challenges effectively, investment is needed to increase capacity. Policymakers could promote this by increasing their risk appetite through longer-term policy certainty and by allowing multi-year portfolios of infrastructure programmes. This would instil greater confidence among investors in the pipeline of forthcoming

i All stakeholders are listed at the end of the document

work, facilitating investment in expanding capabilities across the supply chain. This in turn would foster trust and promote growth in the GB market. In comparison, both the US and the EU have initiated policies to inspire investor confidence to meet the scale of decarbonisation, through the Inflation Reduction Act (IRA)[7] and the Temporary Crisis and Transition Framework.[8] The UK would benefit from similar levels of ambition.

The need for new infrastructure and assets described above already allows for significant other measures to reduce demand, such as: improved energy efficiency and demand response.[ii] Building that infrastructure will require expanding a skilled workforce; tackling new developments as programmes not projects, and; standardisation across the industry. All of these areas have been underserved by policy.

Shortages risk delaying the transition

Many utility companies and generation developers are facing three major shortages: across supply of equipment and components, supply of construction services, the availability of capital, and in their internal capabilities such as a skilled workforce.

The lead times for critical equipment such as High Voltage Direct Current (DC) cables and converters are currently up to seven years in the UK and for many other countries. There is rising competition to secure procurement for future capacity. Meanwhile, the amount of steel required for offshore wind turbines for Scotwind Round 1, is around 8.6 Mt.[10] This estimate does not include the steel needed for the supporting structures such as foundations or substations, and some estimate that this could easily double the total amount needed. Capital requirements are also proving a major strain on utilities management and on suppliers' ability to scale. In the UK, these challenges are further compounded by how commercial risks are allocated and are not always backed by regulation. Fixed price contracts for time-certain delivery, with transfer of much of the risk to the supply chain, were appropriate to a buyers' market, but not to a sellers' market such as the current one, with high volatility of costs and in the availability of key inputs. There may be a need for new mechanisms to share risks in a rapidly evolving marketplace where the costs of materials and skilled people are not stable.

Critical skills shortages also remain in the services required to build the infrastructure. During the roundtable discussion, it was mentioned that based on insights gained from interactions with industry clients, there appears to be a demand for three to five times the current number of conductor stringers and overhead lines workers. All these shortages are major barriers to reaching the decarbonisation target by 2035 for which delivery now is crucial.

Addressing these challenges presents the potential opportunity to build domestic manufacturing and high-value jobs in the UK in those areas where we can be competitive. This would require large scale investment in manufacturing. A clear and visible pipeline of demand/opportunities, along with predictable returns on investment, are needed for manufacturers, contractors and other service providers to expand their capacity to provide the equipment and services needed.

It is also important to recognise that the energy sector is not the only sector which would benefit from improved manufacturing and procurement capabilities. Other sectors such as aerospace and defence can also benefit from and make use of similar capabilities and services while contributing funding and investment as an enabler. Opportunities and demand across these sectors can and should be consolidated to address the pressing constraints in manufacturing, supply chains and procurement.

ii To learn more about energy efficiency and demand response, see the summary of roundtable 3 – Consumers, flexibility, and efficiency: How can consumption contribute to the decarbonisation of the electricity system?[9]

The need for standardisation

To address these challenges, there is a need for cross-sector optimisation along the supply chain in order to address fragmentation. There is a need for design and systems engineering to develop multi-year portfolios that treat procurement as a wider programme of work and to develop design principles and standardisation.

Procurement and supply chains would benefit from some level of standardisation. Standardisation across processes, contracting, components and equipment can introduce efficiencies, bring down costs and enable faster deployment. Without it, the transformation of the electricity system will be more costly. In mega-projects there has been a tendency to push for bespoke or specific standards for each project, which lead to higher costs for delivery. Since supply chains are international, there will be a need to procure as much as possible to international standards but there is still an opportunity to introduce greater levels of consistency and standardisation domestically since standards across the three Transmission Owners are not always the same.[11]

As highlighted and promoted in the recent review by the Electricity Networks Commissioner (ENC), clear design principles and standards can also provide clarity and a clear basis for decision making on what infrastructure will be in place, how it will look, etc.[11] This then provides a clear and transparent set of expectations and basis on which to engage affected communities. The ENC recommends that standardisation, such as for equipment and via updating the principles and guidance around route design, will make it easier for planners and regulators to review programmes and plans. This will have the added benefit of streamlining the training programmes needed for such work.

Clear design principles and standardisation can also help address the long lead times on the programmes needed for delivery. The key will be to achieve consistency in technology and products for the same applications and, where possible, to avoid bespoke solutions thereby giving us the benefits of consistency across the UK and other markets. Domestic standards for local needs, such as around size, technical characteristics, and modularity would be beneficial.

Programmes instead of projects

The energy transition requires a transformational system change across the energy system at a pace no one working in the industry in the UK today has experienced. There is no longer time for incremental approaches. Procuring on a project-by-project basis can only drive incremental changes. A shift is therefore needed to treat procurement as a much wider and longer-term programme.[iii] This change is underway as procurement shifts from project specific spot tenders to bulk sourcing across projects with multi-year portfolios.

There may be concerns around uncertainty, potential risks, and opportunity costs in the transformation required, for example, the risk of building over the capacity ultimately required may increase, but this risk should be manageable in a system with growing demand for electricity where the impacts on the economy of an early delivery versus late delivery are asymmetric. Multi-year portfolios with longer-term procurement and greater standardisation will reduce risks for all stakeholders and will be more efficient than the current process of procuring individual bespoke projects. It is also probably the only way to secure access to key components and capabilities in what has become a sellers' market and will almost certainly be lower in cost. The UK is in competition with Europe, the USA and elsewhere for supply chain capacity.

iii The Royal Academy of Engineering published a report 'Public projects and procurement in the UK' (2014) outlining how procurement processes could be improved to help meet the government's tactical, operational and strategic objectives.[12]

Expanding the supply chain 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. Procurement frameworks should 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. Expanding supplier participation would foster competition and allow for choice and variation across the supply chain, in turn offering value for money. Long-term procurement and standardisation would ensure a steady stream of opportunities for future projects and attract new suppliers, while inclusive procurement frameworks would accommodate diverse market participation and bolster resilience. Identifying areas within the supply chain where new suppliers and technical innovation can enhance competition is needed. The Infrastructure and Projects Authority has implemented new measures to facilitate SMEs participation in public supply chains.[13,14]

As well as increasing the pace of delivery, a programmatic approach to decarbonisation which provides a visible pipeline of work over decades can also help bring down the total cost of the transformation needed but the right commercial frameworks will need to be put in place to drive the cross-sector engagement needed to scale up the industrial capacities required. It is important to note that a supply chain capable of meeting further demands beyond 2035 will be needed, driven by the electrification of heating and transport as part of the net-zero goal by 2050 as well as a likely large increase in demand from data centres as the use of artificial intelligence becomes pervasive.

Continued cross-party support is needed for an infrastructure strategy

Infrastructure strategy is politicised in the UK and this brings with it uncertainty and undermines the trust and confidence needed for investment. An apolitical framework that is national, cross-party and long-term, is needed for delivering infrastructure development. It is not enough to talk about targets, a planning and delivery roadmap is needed that is not vulnerable to political change and which builds collaboration across policy, industry and consumer stakeholders from national to local levels. Cross-party support can be developed with an emphasis on the opportunity for delivering a legacy and that the infrastructure will be used across several generations to come. This should then be focused on a long-term infrastructure strategy and delivery roadmap that can propel the investments needed.

Given the scale of the transmission required for a decarbonised electricity system, a new approach is required for investment in transmission networks. A spatially and temporally explicit plan for transmission networks such as is planned by the National Energy System Operator (NESO) is needed and can provide clarity. A country wide study on what is needed where and by when, such as the recent Electricity System Operator's Beyond 2030,[15] blueprint can help make the case for the investment and stimulate progress.

It is important to note that a supply chain capable of meeting further demands beyond 2035 will be needed, driven by the electrification of heating and transport as part of the net-zero goal by 2050

v To learn more about public engagement, see the summary of roundtable 3 – Consumers, flexibility and efficiency.[7]

Complexity of UK business models increase risks for the supply chain

One of the major barriers for suppliers to build localised supply chains and invest in the UK is policy uncertainty and complicated business models. For example, the Contracts for Difference (CfD) auction process means that the size of the market is unclear beyond the current auction and project developers are unable to commit to supply chains until they have reached a late stage of the project. The complexity of some of these models and approaches in the UK contrasts with simpler tax credits available in the US and EU. Suppliers have so far chosen to locate where the risks are lower.

Closing the skills gap

Decarbonising the electricity system will require a skilled workforce; both attracting young people and retaining the present workforce with competitive economic benefits and training is crucial.

The industry has a niche and highly specialised workforce, but it currently lacks the total workforce it needs. The industry also faces competition for skilled workers from other sectors such as finance and information technology.[16] There are therefore twin challenges of capability, where skilled workers are needed for specific jobs, and capacity of the sector to secure and ensure skilled workforce required. This is a major challenge not just in the UK but internationally. The roundtable heard examples from Germany and elsewhere of Transmission System Operators (TSOs) struggling to find staff and investing significant time and resources into recruiting and training staff from adjacent fields. The need to develop a skilled engineering workforce for the energy transition is a huge opportunity for the UK. It should be noted that the skills shortage is a much wider challenge across all of engineering and will require major interventions for developing engineering skills as a whole.[17,18] Developing an adequate workforce with engineering skills requires a short-, medium- and long-term strategy that will reap dividends in the future.

Beyond engineering, decarbonising the electricity system will require a range of associated skills and jobs to manage the interface between the energy system and consumers. A more diversified and distributed energy and electricity system will lead to a rise in the capabilities needed to help consumers utilise the range of services available as well to help them participate, contribute to and benefit from the transition, for example participating fully in demand response.[9] Ensuring that there are pathways to train the workforce in fields other than specialist engineering jobs will be necessary for a just transition, and again should be seen as both a major reskilling challenge and opportunity.

Overall, roundtable participants discussed three major skills areas that will be required: those within the engineering sector; network programme, project management and delivery; and the skills required to manage the interface between the energy system and consumers. The spectrum of needs within engineering should not be underestimated due to the high demand for skills across the lifecycle of engineering: from research engineers and development, through production and installation, to operation and maintenance.

Skills for the future

To meet the demand for a skilled workforce, attention is rightly paid to the cohort of students currently in the education system. However more needs to be done to attract young people into engineering and into jobs that contribute to the energy transition. Young people and their parents and teachers are not sufficiently aware of the scale of the transformation needed and of the opportunities within the electricity sector. Awareness of this as a public commitment could help stimulate interest. A national campaign which is part of a coherent and coordinated skills strategy could help attract the young people needed for the goals of the net zero transition. This could also help build trust and confidence in a sector that is not necessarily considered attractive after the large-scale decommissioning of manufacturing in recent history.

Having a vision that is communicated to young people via people they trust such as parents and teachers could help build the trust and confidence needed to attract skills. There is a need to showcase why engineering is important to the energy transition and how it is an important societal priority. An example of this is the National Grid communication around the Great Grid Upgrade.[19] The narrative needs to be that working in the energy transition is structurally important and will benefit society. Engineers are needed to equip the discussion with facts and figures, but also to humanise the profession and help develop trust and buy-in.

A recent survey by Public First indicated that a majority of young people have a very limited understanding of green jobs and that they care more about job security than job role, including pay progression.[20] To ensure sufficient recruitment to the energy transition, talking about sustainability will not be enough. Publicising the energy transition as a major, long-term ambition for the UK could encourage young people to pursue a career in it, not motivated by sustainability alone but by job security. To address the competition from other sectors, competitive salaries and pay progressions must be established.

Alongside this there is a need to rethink the apprenticeship system, which has been in steady decline,[21] as well as to explore bursaries for engineering graduates going into key areas of the energy transition. Providing a pipeline of economic opportunities will help attract the skills needed. Engagement across schools, businesses, industry, the Professional Engineering Institutes (PEIs) and trade bodies will be necessary.

Skills for the present

An increased workforce is needed to deliver the 2035 target in the near-term and so attention must also be paid to the scale of present demands. Re-skilling will be key to expanding the existing workforce.[22] Reskilling programmes should be made available as well as programmes that encourage lifelong learning and those that grant micro-credentials. These programmes can help attract both specialised skills focused on engineering, as well as the range of skills needed for the engineering-adjacent services needed to manage the interface between the energy system and consumers. Managing this interface will also require a range of professional and vocational roles beyond engineering such as environmental scientists for planning and approval, software developers for flexibility applications and customer service for consumer engagement, among others. Smart programmes for reskilling are needed as a key priority.

The private sector needs to play a key and proactive role in attracting and employing the right people. Companies themselves have novel ways of attracting young people – visiting schools, running apprenticeships, training models, etc. However, there may be a role for government and policy to address the demand for skills. The public sector could play a more active role in assisting the workforce find new employers as well as in encouraging employers through a mix

of policy or various schemes to implement the range of opportunities to attract, train and retain workers. There should also be attractive pathways developed to access the expertise and experiences of a soon-to-be retiring expert workforce to share their knowledge and experience with the current, re-skilling and incoming workforce.

Finally, an additional way to address the skills shortfall could be to attract skilled workers from abroad, along with providing opportunities for the foreign students studying engineering in the UK. These strategies would help address demand in the short-term but are not necessarily sustainable in the long-term.

> A national campaign which is part of a coherent and coordinated skills strategy could help attract the young people needed for the goals of the net zero transition

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Key messages from the NEPC Working Group on decarbonising the electricity system

The roundtable highlighted some of the key challenges that need to be addressed in decarbonising the GB electricity system by 2035 in a secure and affordable way.

Based on this discussion, the NEPC Working Group on decarbonising the electricity system has identified a number of key messages. While these were informed by the discussion at the roundtable, the conclusions are made independently by the Working Group and are not a record of the opinions of the participants in the roundtable.

- **Major barriers to delivery must be addressed**: Constraints in the supply chain and the availability of manufacturing and construction services, capital investment and skilled workers all need to be immediately addressed to achieve large-scale expansion. Many utility companies face major shortages in all of these areas and across the entire project cycle.

- **Opportunity for engineering and manufacturing**: The speed and scale needed to decarbonise the electricity system is significant, but this is also an opportunity to expand the engineering, construction services and manufacturing sectors in the UK. This includes significant export opportunities beyond domestic demand over the long-term. Effective policies to address this challenge can build the skills, manufacturing capabilities and supply chains, contributing to economic growth and energy security for the long-term.

- **Transformation requires programmes, not projects**: Decarbonisation demands a transformational shift across the energy system. This will only be possible if procurement is treated as a major programme of work with multi-year portfolios instead of as separate individual projects. This needs to be a part of an approach that provides a visible pipeline of work over decades to enable the decarbonisation of the electricity system by 2035 and to facilitate the continued electrification of heating and transport to achieve net zero emissions by 2050. This will help provide security and stability for investment to take place, encouraging expansion of manufacturing capabilities, supply chains and the skills needed.

Use of consistent design principles and standardisation of technologies, designs and solutions can help manage long lead times, introduce efficiencies, and bring down costs

- **Policy certainty to help position the UK as internationally competitive**: A major barrier to investment in the UK is policy uncertainty. Greater clarity and tangible government commitment is needed to enable the visible pipeline of opportunities that will encourage and attract the investment and other resources needed. Infrastructure strategy should be depoliticised in the UK, within an apolitical framework, supported by a delivery roadmap for the energy transition ideally with reliable cross-party support and commitment to decarbonisation.

- **Standardisation**: Use of consistent design principles and standardisation of technologies, designs and solutions can help manage long lead times, introduce efficiencies, and bring down costs. Standardisation of procurement processes, equipment, and manufacturing across the supply chains will make it easier for planners and regulators to review programmes, while also streamlining the training programmes needed for a skilled workforce.

- **Short- and long-term approaches for engineering skills**: There has been a plethora of work on how to close the skills gap. All measures will be needed at pace and scale but would benefit from a coherent and focused strategy to ensure efforts are deployed effectively for timely delivery. This should include: effectively communicating the energy transition as a major ambition for the UK, economic incentives and job security for young people, rethinking apprenticeships, bursaries for engineering graduates, re-skilling programmes for those already at work including programmes on lifelong learning and those that grant micro-credentials, harnessing knowledge and skills from established industry leaders, experienced engineers and technicians who are towards the end of their careers, and attracting skilled foreign workers to meet pressing short-term needs.

- **Skills needed beyond engineering**: The people managing the future system of distributed assets in a decarbonised electricity system will not only be engineers or energy specialists but will span across adjacent sectors like the environment and the digital sector among others. The skills needed will also span across professional and vocational roles. Training and re-skilling programmes need to provide for the skills and workforce needed to manage the interface between the energy industry and consumers that enables consumer participation in decarbonisation and a just transition for all.

Roundtables and briefings in the series

This is roundtable 5 of a series. The full series of roundtables and reports is listed below:

Roundtable 1	**Decisions now for a future system: Making design and construction decisions for the electricity system of 2035 and 2050**
Roundtable 2	**Local, regional and national: What interests, opportunities and challenges exist at these levels? How does each contribute to net zero?**
Roundtable 3	**Consumers, flexibility and efficiency: How can consumption contribute to the decarbonisation of the electricity system?**
Roundtable 4	**Governing transformation, transforming governance: Managing ambiguity, interconnection and digitalisation**
Roundtable 5	**Delivering electricity decarbonisation by 2035: What do we need across industry capacity, procurement and skills?**

Participant list

Dervilla Mitchell FREng, (Chair), Deputy Chair, Arup Group

Lydia Amarquaye, Professional Development and Education Policy Advisor, Institution of Mechanical Engineers

Rachel Armstrong, Director for Industrial Decarbonisation & Emissions Trading, DESNZ

Peter Bingham, Director of System Planning, Engineering & Technology, Ofgem

Eric Brown, Executive Adviser, Energy Systems Catapult

Luis Castro, Head of Delivery, Energy Portfolio Office, DESNZ

Elspeth Finch FREng, CEO, Indigo & Limited

Ian Funnell FREng, Chair, National Nuclear Laboratory

Dr Martin Grant FREng, Non-Executive Director, various

Russell Hall, Chief Engineer for Net Zero, High Value Manufacturing Catapults

Dr Simon Harrison FREng, Group Head of Strategy, Mott MacDonald

Martin Högel, Partner and Director, Operations and Energy Practices, Boston Consulting Group

Professor Roger Kemp FREng, Emeritus Professor of Engineering, Lancaster University

Matthew Knight, Head of Market and Government Affairs, Siemens Energy

Helen Lister, Energy Transition and Decarbonisation Practice Lead, Infrastructure and Projects Authority

Julian Leslie, Head of Networks and Chief Engineer, National Grid ESO

Professor John Loughhead FREng, Industrial Professor of Clean Energy, University of Birmingham

James Partington, Director of Policy and Impact, Institution of Mechanical Engineers

Professor Keith Ridgway FREng, Senior Executive Manufacturing, University of Strathclyde

Matthew Rooney, Head of Engineering Policy Unit, Institution of Mechanical Engineers

Dr David Wright FREng, Group Chief Engineer and Chief Risk Officer, National Grid ESO

Members of the NEPC Working Group on decarbonising the electricity system

This roundtable series is being convened by the National Engineering Policy Centre (NEPC).

The working group includes 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.

Dr Simon Harrison FREng (Chair), Group Head of Strategy, Mott MacDonald

Eric Brown Executive Adviser, Energy Systems Catapult

Tim Chapman FREng, Partner and Director, Boston Consulting Group

Peter Dearman FREng, Independent Consultant, Dearman Engineering

Robert Friel Managing Director, Apteno Consulting

Professor Tim Green FREng, Professor of Power Engineering, Imperial College London

Professor Nick Jenkins FREng, Professor of Renewable Energy, Cardiff University

Professor Roger Kemp MBE FREng, Emeritus Professor of Engineering, Lancaster University

Dr Catherine McClay OBE FREng, Director Energy Operations, ENOWA, NEOM

Graham Oakes Expert in Local, Community and Municipal Energy

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Royal Academy of Engineering
Prince Philip House
3 Carlton House Terrace
London SW1Y 5DG

Tel 020 7766 0600 www.raeng.org.uk
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