ICE submission to the BEIS Committee on decarbonisation of the power sector

July 2022

Overview

This response from the Institution of Civil Engineers (ICE) has been informed by experts on the ICE's Decarbonisation and Low Carbon Energy Community Advisory Boards.

Submission

1. **Is the proposed future electricity mix, as announced in the Energy Security Strategy, the most efficient and cost-effective way to deliver power sector decarbonisation by 2035? Are there any further policy details and/or legislation required by the end of this Parliament to achieve these goals?**

The greatest risk to security of supply is overinvestment in one single source of low carbon energy generation. There needs to be a blended approach to decarbonised generation, which is generally reflected in the Energy Security Strategy.

Digital technology aside, the toolbox of power generation technology we have now is, by and large, the one we will have used by 2035. While there is room for incremental development, there is relatively limited opportunity to develop new initiatives that could be deployed at scale. Taking this as read provides an indication as to what the supporting energy system might end up looking like.

The Energy Security Strategy discusses the expansion of renewable energy sources, which is positive, but also seems to suggest that continued oil and gas exploration is compatible with net zero. This is not in keeping with other reports and makes the target of net zero by 2050 look questionable.

It is also questionable whether the commitment to new nuclear reactors included in the strategy is deliverable. Nuclear will doubtless need to provide a huge contribution to grid decarbonisation, but these programmes need to be accelerated in the very near future for them to be achievable, as experience suggests that nuclear power stations take at least ten years to build.

The scale and cost of the required nuclear build is challenging; a requirement for 40GW of nuclear has been suggested, but Hinkley Point C alone represents 3.2GW of capacity. The cost of each GW of nuclear is approximately £10 billion, potentially representing a £400 billion expense if the costs of nuclear are not brought down.

To achieve the pace of change that is necessary for the Net Zero Strategy as well as energy security, there is a need for more urgent action on energy efficiency in homes to bring down energy costs and investment in energy schemes that can be up and running more quickly, such as onshore wind.

Analysis shows that the UK will need to build 12-16GW of new generation capacity each year between now and 2035 to hit decarbonisation targets – the equivalent of building Ireland's entire energy system each year.[1] The average build rate

[1] Atkins (2022) Unprecedented build rate required to decarbonise UK's energy system by 2035

for 2017-2021 was 3.2GW. The pace of new build required and complexity of the challenge means plans to decarbonise power by 2035 are under threat.

This means that action needs to happen now. There is no longer time for two more years of strategies or plans.

2. Beyond current Government ambitions, how else can energy demand be reduced and how much of an impact will this make on reaching power supply targets? What action is required to ensure consumers engage with and are protected during the power sector transformation?

Demand solutions are not only required short-term about the current energy security crisis; there also needs to be a much stronger emphasis on the demand side to meet the longer-term net-zero targets.

As noted by the CCC, "*the Net Zero Strategy sets a pathway to deliver the necessary emissions reductions but takes an approach that does not include significant ambition to reduce consumer demand for high-carbon activities*". Behavioural change is not at the core of government strategies in the way that it should be.

Decarbonising the power sector by 2035 is already a huge challenge. This challenge is made even harder by considering additional power demand from heating and transport. The Net Zero Strategy assumes that demand will increase, suggesting the public can continue living as they do now by simply switching to low carbon energy sources.

Energy consumption needs to be reduced. This will require some significant behavioural changes to reduce the pressure on the need to produce greenhouse gas removals.

From a demand reduction perspective, there needs to be more focus on insulation and energy efficiency. This was noticeably absent from the Energy Security Strategy and the Net Zero Strategy.

The public need to be involved and part of the decision-making process to be more comfortable with these changes. There is a big piece needed that is currently missing around public acceptance of some of the changes needed to meet net zero and ingraining them in day-to-day activities to accelerate change. Mechanisms are needed to help drive the required behaviour changes.

There also needs to be a regulatory perspective to reducing demand, forcing a behaviour change in the consumer to reduce emissions. The proposal in the Energy Security Strategy to reduce electricity prices is good and will be key to incentivising consumers to make more sustainable choices, such as switching from natural gas boilers to electric heat pumps, but more is likely to still be needed.

The concept of 'throttling' is in use with broadband, where households that exceed a certain daily usage threshold have their connection restricted for the remainder of the day. A similar concept could be considered for energy use.

This would greatly impact the demand profile and significantly reduce emissions, though it would require dialogue and development with the public. More consideration would of course need to be given to the knock-on implications of a policy like this, not least to those who live in rented housing with poor energy efficiency or who cannot afford the latest energy-efficient technology. If a pricing structure is based on use against allowance, this would allow those who can afford it to continue polluting, so consideration could be given to direct some of the funds back into energy efficiency improvements for lower-income households.

3. **What are the key challenges faced by each generation technology (e.g., nuclear (traditional, small and advanced modular, and fusion), offshore and onshore wind, solar, hydrogen, tidal, biomass, and gas combined heat and power) regarding both their deployment and scaling up within the current policy framework? What can be done to overcome these challenges? What generation capacity is required and what role will each technology play?**

Energy mix

Trying to establish what the exact electricity generation mix will look like in 2035 or beyond is unlikely to be a productive exercise given the vastness of the challenge. There must be a broad acceptance that whatever we build by 2035 will not be exactly what we had set out to do.

Alongside trying to reduce energy demand, we must build as much as we can of everything we can - primarily nuclear and offshore wind - and build faster than ever before. While debates can become mired in detail about how much wind power we need, or whether we do need Sizewell C, there is evidence showing we simply need to build as quickly as possible.

As a historical comparison, this might be likened to the UK undergoing a second industrial revolution, but with this one taking place over not much more than a decade.

There is no realistic scenario for decarbonising energy in the UK without a huge contribution from nuclear and offshore wind. Within this model, managing the intermittency of offshore wind requires either more nuclear capacity, or CCGT (combined cycle gas turbines) with CCUS (carbon capture utilisation and storage), or both. These are the only two proven low-carbon technologies that could be switched on at such magnitude to account for the intermittency of renewables.

Summarised, the government must first recognise how much must be built so it can tell engineers what they are aiming at. In turn, those engineers can explain the programmes and projects required to achieve those aims.

Systems approach

It is important to recognise that all the elements of our society that we are trying to decarbonise are connected. Nothing works in isolation, our infrastructure is becoming increasingly interdependent, and systems exist within systems. A systems approach is essential for considering how all aspects are connected in implementing this strategy and joining all the dots.

The common links between different sectors need to be found so that solutions can be applied across the board to answer the cross-cutting questions, such as those relating to skills and regulation. There will be examples where particular policies fall between government departments and would benefit from better cross-departmental working.

Rapid decarbonisation of electricity supply will provide a platform for the decarbonisation of other sectors such as heating and transport, but for optimum outcomes, the sector strategies must be aligned. For example, policy on electric vehicles is separated between those responsible for the roll-out of charging infrastructure, those encouraging switch-over, and those dealing with the impacts of increased demand on the energy system.

Change needs to happen for several sectors simultaneously, and changes in one sector may potentially negatively impact another sector. The thinking needs to be joined up enough to make sure that unintended consequences are not driven into other areas.

4. What are the challenges for the current grid infrastructure in delivering the proposed energy mix by 2035 and how can these be overcome in a cost-effective manner? What role does digitisation of the grid infrastructure play and developing a smart electricity network? Are current regulators enabling this transition and flexibility within the system? What role will storage play? Please consider this question from generation source to in the home.

Storage will be essential for balancing renewables against demand – and we need to utilise current, emerging, and new technologies.

The large-scale energy storage option currently available is pumped-storage hydroelectricity, where water is pumped from a lower elevation reservoir to one at a higher elevation. The system uses cheaper off-peak electric power to run the pumps and more than recoups against this cost at peak times when the gravity-fed stored water produces electricity by driving turbines. The downside is that more energy is generally required than produced; this would be more so in many Welsh locations. This would be mitigated to some degree in Scotland, where pumped storage facilities could receive significant mountain run-off water.

Currently, the government does not yet have the required policy or mechanism to finance pump storage initiatives. It would need to work on something such as a Contracts for Difference and/or Capacity Market scheme as an enabler.

The most plausible future for storage systems includes hydrogen and air and battery storage. But, like pumped storage, these systems need government intervention in terms of capacity payment because there is an understandable unwillingness to invest in these large-scale infrastructure schemes when they would only be used when the wind is not blowing sufficiently. However, as well as developing hydrogen at scale for storage, it is also likely to be an important component at a national level for low carbon domestic heating systems.

Another option is liquid air storage. This converts air into a liquid for underground storage that, when requirement demands, can be released to drive turbines. In June 2020, BEIS awarded Highview Power a £10 million grant to build a 50MW liquid air energy storage facility (with a minimum of 250MWh) at Trafford Energy Park, Greater Manchester. In addition, development consent was granted earlier this year for Thurrock Power's large-scale facility that would see it build a 150MW battery on land adjacent to Thurrock's Tilbury substation in Essex.

5. What key milestones and indicators are needed to scrutinise and measure progress in delivering the UK's power sector targets? Should new reporting requirements be required and what role should Ofgem, or the proposed new energy systems regulator, play?

Regulator duties

Almost half of the UK's infrastructure, chiefly water and energy, is financed and delivered by the private sector and paid for by consumers under the Regulated Asset Base (RAB) model.[2]

This model of regulation has generated significant investment and improved performance over the past decades. However, it is increasingly facing new challenges that it was not intended to address, not least in achieving the 2050 net zero target.

Over time, regulators have had to balance important factors, such as climate change, against a primary duty to protect the interests of consumers. This has led to difficulties when prioritising long-term strategic investments, which would impose costs on consumers in the short term. Given the increasingly complex long-term solutions necessary to tackle net zero and other challenges, the regulation of economic infrastructure needs to be more flexible.[3]

[2] ICE (2018) State of the Nation 2018: Infrastructure Investment
[3] ICE (2020) Aligning Long-Term Government Policy and the Regulation of Utility Companies

There is no escaping the fact that the future investment needed to meet social, environmental and technological challenges will ultimately be funded by consumers. They need the confidence that their money is being spent on the right things in the right way, that they are not being taken advantage of, and that the benefits are being shared with them as well as with investors.

The regulators' duties vary considerably, with inconsistency in aspects such as resilience and security of supply. Crucially, none of the regulators has a direct duty to consider the government's long-term policy commitment to achieve net zero.

The government needs to outline clear, long-term, strategic policy objectives that allow better alignment between regulatory, industry, and policy activity. This would provide regulators, industry and consumers with greater clarity on long-term strategic priorities, providing the context for future price reviews and the investments required within and outside price control periods.

Future Systems Operator

The role of the Future Systems Operator will be crucial. This new body will oversee key roles in electricity and gas to facilitate net zero while maintaining a resilient and affordable system, and is independent of not only commercial energy interests but also from the day-to-day operational control of government.

This may have the potential to become the conductor that is needed to orchestrate the much-needed overarching plan. Essentially, it may allow for a podium that looks objectively at how the various elements of a system of systems interact with one another, and the consequences of individual decisions for the system as a whole.

It should also be recognised by government and regulators that new evidence could emerge that causes the 2050 net-zero target to be accelerated. The consequences this may have for infrastructure provision and delivery should be considered.

6. Does the UK have the right skills, industrial and labour capacity, and materials required to effectively deliver on the proposed energy security strategy by 2035, and if not, how can the supply chain be scaled up?

N/A

7. How should Government work with industry to ensure proposed projects are ready when needed and on-budget? Are there domestic or international examples of time- and cost-effective delivery of large-scale power generation schemes?

Although the UK's strategy is ahead of many other countries, there is also more that we could do to learn from other countries that have made significant progress on the path to net zero. Sweden is one such country that has made excellent progress in implementing carbon reduction plans.

8. Does the Government's strategy incentivise investment that enables decarbonisation of the power sector by 2035? Do current financing mechanisms allow for the required investment? What are the risks for taxpayers and/or consumers? Are there national security and investment considerations we should understand?

Incentivisation

Regulation, funding and tax incentives are essential and urgently required to move the decarbonisation of the power system forward as needed.

Government needs to be putting these elements in place to demonstrate its commitment and support for the low carbon energy mission and to financially encourage companies to progress with the scaling up and rollout of piloted projects. The next 12 months are critical.

The scaling up of the new technologies, such as CCUS and hydrogen, is expensive and needs government backing, funding and a regulatory mandate to use them.

The costs to the public of 'doing the right thing', for example, installing heat pumps, are currently prohibitive, so incentives need to be introduced. The explicit requirements of these need to be considered to meet the needs of the Net Zero Strategy, to ensure that the funds are available to the right people to be used in the right way, and to drive the appropriate behaviours. Many existing green loans for low carbon technologies are means-tested and not accessible for large parts of the population who cannot afford to make the required changes.

Front loading this funding now will produce jobs, boost the economy and enable savings to be made later.

Funding in the right way now, with a focus on green infrastructure, will mean cost-neutrality by 2050. This is illustrated in the balanced pathway in the CCC's Sixth Carbon Budget, which shows a large, sustained increase in investment, adding around £50 billion annually by 2030. Savings in fuel costs will then offset the investment cost in later years.

Comparisons have been drawn with the conversion from town gas to natural gas in the 1960s and 70s and the certainty that the Government provided to British Gas to make that investment. This level of certainty is not yet being provided for the current situation.

However, funding cannot be considered in isolation. As government funding is handed down to a local level, there is a need for specialist skills to be in place in utilising this funding. These skills need to be developed.

Private investment is also vital in driving innovation. Pioneering pilot projects can be held up as examples of successful innovation that, once proven, can provide the basis for new regulation.

Existing mechanisms

The financial sector has a vital role in delivering increased or redirected capital in support of net-zero-aligned objectives.

For the most part, the funding and financing mechanisms required to support the power sector's transition to net zero already exist, for example, the RAB model and Contracts for Difference auctions. The key will be adapting and iterating existing mechanisms so they can be deployed where appropriate and are tailored to net-zero outcomes. These mechanisms could also be considered for deploying carbon capture and storage technologies, hydrogen infrastructure and other renewable energy sources, such as tidal lagoons.

ICE has also recommended that energy storage and other emerging technologies receive enhanced government support, drawing on the successful impact of Contracts for Difference on the renewable energy market.[4]

Green Book guidance and monetising carbon

The carbon emissions impact of projects, policies and programmes needs to be monetised. The Net Zero Strategy acknowledges that the Green Book already mandates the consideration of climate and environmental impacts in spending and that policies must be developed and assessed against how well they deliver on the Government's long-term policy aims, such as net zero.

The Green Book guidance includes the following clarification: "*The creation of GHGs has a social cost based on its contribution to climate change. To estimate the social cost of an intervention it is necessary to include the costs of emitting*

[4] ICE (2020) State of the Nation 2020: Infrastructure and the 2050 Net Zero Target

GHGs. Energy efficiency has a direct social value, in addition to the value of a reduction in GHGs, as the energy saved itself has a direct benefit to society (similarly, activities that create extra demand for energy have a direct energy cost)."

The carbon values published by BEIS in September 2021 represent the monetary value that society places on one tonne of carbon dioxide equivalent (£/tCO2e). The values are used to estimate a monetary value of the greenhouse gas impact of policies, projects and programmes.

This monetisation of carbon is key to the success of delivery and needs to be more widely communicated. It is a fundamental issue to be dealt with as part of making carbon contractual. Mandating PAS2080, a global standard for managing infrastructure carbon, will also help move us in the right direction.

About ICE

Established in 1818 and with over 96,000 members worldwide, the Institution of Civil Engineers exists to deliver insights on infrastructure for societal benefit, using the professional engineering knowledge of our global membership.

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