Committee on Climate Change

Independent advice to government on building a low-carbon economy and preparing for climate change

The Sixth Carbon Budget and Welsh emissions targets – Call for Evidence

Background to the UK's sixth carbon budget

The UK Government and Parliament have adopted the Committee on Climate Change's (CCC) recommendation to target net-zero emissions of greenhouse gases (GHGs) in the UK by 2050 (i.e. at least a 100% reduction in emissions from 1990).

The Climate Change Act (2008, 'the Act') requires the Committee to provide advice to the Government about the appropriate level for each carbon budget (sequential five-year caps on GHGs) on the path to the long-term target. To date, in line with advice from the Committee, five carbon budgets have been legislated covering the period out to 2032.

The Committee must provide advice on the level of the sixth carbon budget (covering the period from 2033-37) before the end of 2020. The Committee intends to publish its advice early, in September 2020. This advice will set the path to net-zero GHG emissions for the UK, as the first time a carbon budget is set in law following that commitment.

Both the 2050 target and the carbon budgets guide the setting of policies to cut emissions across the economy (for example, as set out most recently in the 2017 Clean Growth Strategy).

The Act also specifies other factors the Committee must consider in our advice on carbon budgets – the advice should be based on the path to the UK's long-term target objective, consistent with international commitments and take into account considerations such as social circumstances (including fuel poverty), competitiveness, energy security and the Government's fiscal position.

The CCC will advise based on these considerations and a thorough assessment of the relevant evidence. This Call for Evidence will contribute to that advice.

Background to the Welsh third carbon budget and interim targets

Under the Environment (Wales) Act 2016, there is a duty on Welsh Ministers to set a maximum total amount for net Welsh greenhouse gas emissions (Welsh carbon budgets). The first budgetary period is 2016-20, and the remaining budgetary periods are each succeeding period of five years, ending with 2046-50.

The Committee is due to provide advice to the Welsh Government on the level of the third Welsh carbon budget (covering 2026-30) in 2020, and to provide updated advice on the levels of the second carbon budget (2021-25) and the interim targets for 2030 and 2040. Section D of this Call for Evidence (covering questions on Scotland, Wales and Northern Ireland) includes a set of questions to inform the Committee's advice to the Welsh Government.

Question and answer form

When responding, please provide answers that are as specific and evidence-based as possible, providing data and references to the extent possible.

Please limit your answers to 400 words per question and provide supporting evidence (e.g. academic literature, market assessments, policy reports, etc.) along with your responses.

National Grid believes that the Government's commitment to a net zero emissions target by 2050 presents a huge opportunity for the UK to be world leading as we look to decarbonise our economy and energy systems.

The UK has made real progress in emissions reduction in the past decade, with much of this resulting from decarbonisation in the power sector. On the 1st January this year, National Grid announced that 2019 was Britain's cleanest year on record where, for the first time, the amount of zero carbon electricity used outstripped that from fossil fuels for a full twelve months. However, significant effort is needed right across the economy if we are to reach our net zero target. National Grid welcomes the opportunity to input to the Committee on Climate Change's Call for Evidence on its Sixth Carbon Budget, which will set out a pathway to meet the UK's net zero goal. Specifically, we believe that real change and progress is needed in the following key areas:

- **Delivering electrification at scale:** As the CCC set out in its 2019 report, electricity demand is expected to roughly double under a net zero scenario. The anticipated growth of offshore energy developments, such as the expected 75GW of offshore wind and required interconnection to mainland Europe, means we need strategically planned infrastructure to connect this clean energy to the network to ensure we do not create bottlenecks and that we minimise disruption for coastal communities. A policy and regulatory framework which enables the delivery of energy infrastructure ahead of need is essential.
- **Shifting to zero carbon transport and heating in a way that works for everyone:** Overcoming consumer range anxiety and removing early barriers to EV uptake will be key to facilitating the switch to zero carbon transport. We believe that a network of ultra-rapid EV charge points along the strategic road network, supported by appropriate electricity network infrastructure in addition to home, destination, local fast and fleet charging, will be vital. Decarbonising heat will also require real innovation. It looks likely that a mosaic of solutions will be needed to deliver zero carbon heat, dependent on specific circumstances. In addition to energy efficiency, our internal analysis suggests that an early move to hybrid heat pumps (comprising a heat pump and hydrogen-ready boiler) is currently the most practical solution to start the decarbonisation of heat.
- **Enabling decarbonisation of energy and industry:** Deploying CCUS is essential for decarbonising existing energy and industrial processes. The CCC's previous report rightly stated that CCUS is a necessity, not an option, if the UK wants to achieve net zero by 2050. CCUS can also deliver considerable socio-economic benefits by helping to create new jobs, improve quality of life, reduce energy costs for families and businesses, and support the economic viability of the UK's most heavily industrial clusters. National Grid has been developing CCUS projects for more than a decade. It is important to unlock the potential of the technology and secure the added value that it can bring to industrial centres, businesses, and societies around the world, starting in the Humber industrial cluster. This requires government commitment and a clear policy framework.
- **Ensuring the right skills for the future:** Emerging employment and skills gaps are one of the biggest obstacles to reaching net zero. Some of the skills challenges facing Britain include: loss of existing talent due to a baby boomer retirement crunch; competition for skilled workers from other sectors, such as finance and technology; limited pipeline of young people choosing science, technology, engineering and mathematics (STEM) qualifications; and lack of gender diversity. Research commissioned by National Grid showed that the energy industry needs to recruit for 400,000 jobs between now and 2050 to get the UK to net zero. It is critical that industry and government work together to ensure we are attracting new and diverse people into the industry and supporting current workers as part of a just transition.

The UK has a major opportunity to cement its position as a world leader on climate action. Importantly, this must be a fair transition, where the benefits are felt by everyone. This requires a different mind-set from industry, government, the regulator and consumers; all need to think, plan and deliver differently.

Understanding National Grid

National Grid performs a number of key roles that are essential in meeting the UK's energy needs, running the systems which keep Britain's energy moving, to power and heat our homes, businesses and communities.

This response represents the views of National Grid Gas plc (NGG) which owns and operates the high-pressure gas National Transmission System (NTS) in England, Scotland and Wales; National Grid Electricity Transmission plc (NGET) which owns the high voltage transmission system in England and Wales and National Grid Ventures (NGV), which owns and operates energy businesses in competitive markets in the UK and US, which include electricity interconnectors, the Grain LNG storage terminal and National Grid Metering. Following the business separation of the Electricity System Operator (ESO) from NGET, its views are not represented in this submission.

Please find below answers to a selection of questions in this Call for Evidence which are of greatest relevance to National Grid.

A. Climate science and international circumstances

Question 1: The climate science considered in the CCC's 2019 Net Zero report, based on the IPCC Special Report on Global Warming of 1.5°C, will form the basis of this advice. What additional evidence on climate science, aside from the most recent IPCC Special Reports on Land and the Oceans and Cryosphere, should the CCC consider in setting the level of the sixth carbon budget?

ANSWER: n/a

Question 2: How relevant are estimates of the remaining global cumulative CO_2 budgets (consistent with the Paris Agreement long-term temperature goal) for constraining UK cumulative emissions on the pathway to reaching net-zero GHGs by 2050?

ANSWER: n/a

Question 3: How should emerging updated international commitments to reduce emissions by 2030 impact on the level of the sixth carbon budget for the UK? Are there other actions the UK should be taking alongside setting the sixth carbon budget, and taking the actions necessary to meet it, to support the global effort to implement the Paris Agreement?

ANSWER: n/a

Question 4: What is the international signalling value of a revised and strengthened UK NDC (for the period around 2030) as part of a package of action which includes setting the level of the sixth carbon budget?

ANSWER: n/a

B. The path to the 2050 target

Question 5: How big a role can consumer, individual or household behaviour play in delivering emissions reductions? How can this be credibly assessed and incentivised?

ANSWER: n/a

Question 6: What are the most important uncertainties that policy needs to take into account in thinking about achieving Net Zero? How can government develop a strategy that helps to retain robustness to those uncertainties, for example low-regrets options and approaches that maintain optionality?

ANSWER: n/a

Question 7: The fourth and fifth carbon budgets (covering the periods of 2023-27 and 2028-32 respectively) have been set on the basis of the previous long-term target (at least 80% reduction in GHGs by 2050, relative to 1990 levels). Should the CCC revisit the level of these budgets in light of the net-zero target?

ANSWER: n/a

Question 8: What evidence do you have of the co-benefits of acting on climate change compatible with achieving Net Zero by 2050? What do these co-benefits mean for which emissions abatement should be prioritised and why?

ANSWER: n/a

C. Delivering carbon budgets

Question 9: Carbon targets are only credible if they are accompanied by policy action. We set out a range of delivery challenges/priorities for the 2050 net-zero target in our Net Zero advice. What else is important for the period out to 2030/2035?

ANSWER: n/a

Question 10: How should the Committee take into account targets/ambitions of UK local areas, cities, etc. in its advice on the sixth carbon budget?

ANSWER: n/a

Question 11: Can impacts on competitiveness, the fiscal balance, fuel poverty and security of supply be managed regardless of the level of a budget, depending on how

policy is designed and funded? What are the critical elements of policy design (including funding and delivery) which can help to manage these impacts?

ANSWER: n/a

Question 12: How can a just transition to Net Zero be delivered that fairly shares the costs and benefits between different income groups, industries and parts of the UK, and protects vulnerable workers and consumers?

ANSWER:

National Grid believes in a vibrant future that is clean, green and thrives with nobody left behind. This is a future that we know requires significant change and immediate action. We know from our extensive stakeholder engagement during the development of our RIIO-T2 business plan submissions, that a fair decarbonisation is a priority for consumers. The forthcoming Net Zero Review by HM Treasury will play an important role in allocating resources fairly and ensuring that nobody is left behind. We believe that delivering a just transition will involve:

- **Ensuring fairness in infrastructure provision** – in keeping with the Government's agenda to "level up" the Midlands and the North with other parts of the country, a just transition should ensure that no region is left behind regarding their infrastructure needs. For example, in Yorkshire, there are 103 public funded charging points per 51,825 people – while London has 497 publicly funded charging points per 17,682 people[1]. Without the appropriate Government intervention, a solely market-led approach, could result in unequal distribution of charging infrastructure across the UK. National Grid has been developing a solution for a national ultra-rapid EV charging backbone that would serve 99% of drivers, which is discussed further in the transport-related questions.
- **Ensuring fairness in accessing net zero jobs** – emerging employment and skills gaps are one of the biggest obstacles to reaching Net Zero. Britain needs a Net Zero Workforce to enable it to achieve its ambitions. Our *Building the Net Zero Energy Workforce* report, highlights the types of jobs that will be needed. This will include civil, mechanical and electrical engineers, data analysts, machine learning experts and skilled tradespeople. And new roles linked to electric vehicles, hydrogen, and carbon capture technology will emerge. To achieve a just transition, it's crucial to retain and retrain existing employees.
- **Ensuring fairness for different income groups** – through the transition, it is imperative that vulnerable consumers are not left behind – and this may mean reassessing the practice of putting the costs of energy transition on bills. Any cost impacts of the transition shouldn't drive more people into energy poverty and support should be available to help them through the transition. We're proud at National Grid to have made the largest private sector investment in energy efficiency through our £150m Warm Homes Fund to assist vulnerable consumers, and such support and incentives will be even more important on the journey to net zero.

D. Scotland, Wales and Northern Ireland

[1] HSBC survey data, published in "*Lack of chargers delays switch to electric cars", The Times, 26 March 2018*

Question 13: What specific circumstances need to be considered when recommending an emissions pathway or emissions reduction targets for Scotland, Wales and/or Northern Ireland, and how could these be reflected in our advice on the UK-wide sixth carbon budget?

ANSWER: n/a

Question 14: The Environment (Wales) Act 2016 includes a requirement that its targets and carbon budgets are set with regard to:

- The most recent report under section 8 on the State of Natural Resources in relation to Wales;
- The most recent Future Trends report under section 11 of the Well-Being of Future Generations (Wales) Act 2015;
- The most recent report (if any) under section 23 of that Act (Future Generations report).

a) What evidence should the Committee draw on in assessing impacts on sustainable management of natural resources, as assessed in the state of natural resources report?

b) What evidence do you have of the impact of acting on climate change on well-being? What are the opportunities to improve people's well-being, or potential risks, associated with activities to reduce emissions in Wales?

c) What evidence regarding future trends as identified and analysed in the future trends report should the Committee draw on in assessing the impacts of the targets?

d) Question 12 asks how a just transition to Net Zero can be achieved across the UK. Do you have any evidence on how delivery mechanisms to help meet the UK and Welsh targets may affect workers and consumers in Wales, and how to ensure the costs and benefits of this transition are fairly distributed?

ANSWER: n/a

Question 15: Do you have any further evidence on the appropriate level of Wales' third carbon budget (2026-30) and interim targets for 2030 and 2040, on the path to a reduction of at least 95% by 2050?

ANSWER: n/a

Question 16: Do you have any evidence on the appropriate level of Scotland's interim emissions reduction targets in 2030 and 2040?

ANSWER: n/a

Question 17: In what particular respects do devolved and UK decision making need to be coordinated? How can devolved and UK decision making be coordinated effectively to achieve the best outcomes for the UK as a whole?

ANSWER: n/a

E. Sector-specific questions

Question 18 (Surface transport): As laid out in Chapter 5 of the Net Zero Technical Report (see page 149), the CCC's Further Ambition scenario for transport assumed 10% of car miles could be shifted to walking, cycling and public transport by 2050 (corresponding to over 30% of trips in total):

a) What percentage of trips nationwide could be avoided (e.g. through car sharing, working from home etc.) or shifted to walking, cycling (including e-bikes) and public transport by 2030/35 and by 2050? What proportion of total UK car mileage does this correspond to?

b) What policies, measures or investment could incentivise this transition?

ANSWER: n/a

Question 19 (Surface transport): What could the potential impact of autonomous vehicles be on transport demand?

ANSWER: n/a

Question 20 (Surface transport): The CCC recommended in our Net Zero advice that the phase out of conventional car sales should occur by 2035 at the latest. What are the barriers to phasing out sales of conventional vehicles by 2030? How could these be addressed? Are the supply chains well placed to scale up? What might be the adverse consequences of a phase-out of conventional vehicles by 2030 and how could these be mitigated?

ANSWER:

An important barrier to the phasing out sales of conventional vehicles by 2030, will be consumer confidence and access to sufficient electric vehicle charging points.
The UK's EV charging infrastructure should be driven by consumer needs, not technology. Around 80% of charging in the UK today is carried out at home, however over 30% of people in the UK don't have a driveway where they could install a charger. Away from home, investment in EV chargers has been mostly focussed on 22-50kW 'rapid' chargers. However, only about 3% of charging is carried out on these chargers, due to the time it takes to charge a vehicle (45min-3hours from empty to full), with many consumers viewing the charging times as a major disincentive to adoption due to the added disruption to a daily routine.

To successfully decarbonise both domestic and fleet vehicles, the UK will require widespread coverage of easily accessible charging points which can charge a vehicle at a speed appropriate to the time a consumer will spend at a location, which doesn't create any additional disruption to their daily routine. This will require a mix of slow home and

work charging points and ultra-rapid on route charging points along the strategic road network.

While positive work is taking place on both home and work EV charging, there is a need to accelerate the delivery of an ultra-rapid (150-300kW) EV charging backbone across the UK. This network would ensure people and businesses have the confidence to buy an EV and allow all drivers to undertake out of pattern and long-distance journeys.

It is evident that a market only led approach, without the appropriate Government intervention to deliver sufficient underlying electricity network infrastructure to support the delivery of ultra-rapid charging points will result in an infrastructure postcode lottery and an unequal distribution of sufficiently fast EV charging points across the UK.

With appropriate support, the Government could unlock private investment for ultra-rapid charging points and ensure the mass take-up of electric vehicles, for both consumers and business, no matter where you are in the UK. National Grid has identified 54 ultra-rapid EV charging sites along the strategic road network, where an upgraded electricity network connection would allow 99% of EV drivers in England and Wales to be within 50 miles of an ultra-rapid charging hub, with the ability to charge their car in the time it takes to buy a cup of coffee. With the right support, this strategic network will provide a convenient and cost-efficient solution to overcome consumer concerns. Unlocking the required private sector investment and delivering a long-term electric vehicle infrastructure roadmap will help shape the UK's electric vehicle market.

Question 21 (Surface transport): In our Net Zero advice, the CCC identified three potential options to switch to zero emission HGVs – hydrogen, electrification with very fast chargers and electrification with overhead wires on motorways. What evidence and steps would be required to enable an operator to switch their fleets to one of these options? How could this transition be facilitated?

ANSWER:

Fleet businesses will need to be encouraged to switch to cleaner alternatives to diesel. Freight operators who are looking to invest in switching their fleet vehicles will require certainty in both policy direction in technology choice and infrastructure, to make the often-large investments required. A long-term transport decarbonisation infrastructure roadmap supported by clear policy direction would help provide some confidence to fleet operators. A key barrier to be removed will be ensuring there is sufficient network capacity (gas or electric) to drive the delivery the mix of hydrogen or high-powered electric vehicle chargers to support roll out of commercial fleet vehicles.

While there are many studies which single-out either a hydrogen or electrification solution as the most efficient way to decarbonise HGVs, it is likely that successful decarbonisation will require a blend of solutions which includes both hydrogen and electrification. A feasible scenario could see HGVs utilising a catenary traction current along the strategic road network, with a hybrid propulsion via hydrogen or biomethane for off network range and to overcome challenges where catenary is unable to be deployed.

Question 22 (Industry): What policy mechanisms should be implemented to support decarbonisation of the sectors below? Please provide evidence to support this over alternative mechanisms.

a) Manufacturing sectors at risk of carbon leakage
b) Manufacturing sectors not at risk of carbon leakage
c) Fossil fuel production sectors
d) Off-road mobile machinery

ANSWER: n/a

Question 23 (Industry): What would you highlight as international examples of good policy/practice on decarbonisation of manufacturing and fossil fuel supply emissions? Is there evidence to suggest that these policies or practices created economic opportunities (e.g. increased market shares, job creation) for the manufacturing and fossil fuel supply sectors?

ANSWER: n/a

Question 24 (Industry): How can the UK achieve a just transition in the fossil fuel supply sectors?

ANSWER:

On the journey to decreasing our reliance on unabated fossil fuels, it is important to recognise, as we transition to low carbon alternatives, that many thousands of people's livelihoods depend on the fossil fuel sector. Therefore, the transition needs to be fair to the many thousands of employees in the sector. Their skillset needs to be considered and not left behind. As highlighted in our recently published *Building the Net Zero Energy Workforce* report , the energy transition brings exciting opportunities to leverage the unique skillsets available within the energy sector. For example, National Grid is working on a specific regional project in the Humber, together with Equinor and Drax, to create a net zero industrial cluster. This will leverage the skillset of the fossil-fuel dominant industry there and has the capacity to protect 55,000 jobs.

It is important to understand the key enabling role of the fossil supply industry, and to ensure the safe and reliable transition away from these enabling resources to deliver the right infrastructure for the UK's net zero needs. Strong government leadership, as evidenced by March 2019 Spring Statement announcement of a Future Homes Standard mandating the end of fossil fuel heating systems in new homes, must be appropriately supported by training programmes and opportunities for those whose livelihoods are supported by installation and maintenance of gas heating. The CCC states that 68% of today's gas demand is likely to remain into 2050, largely to support the production of hydrogen. Transitioning these traditionally fossil fuel sector skills to target low carbon alternatives, may prove invaluable to achieve our 2050 UK targets.

For this transition to be just, the whole-life value of the infrastructure must incorporate an agreed cost of carbon, as well as supporting the enabling workforce to transition to the delivery of low carbon alternatives. Carbon pricing will help businesses make long-term decisions consistent with a net zero transition. The right investments are key to ensuring the economic multipliers are enjoyed by all. These decisions will then also inform

community-level planning of any reskilling requirements, to ensure the impact on workers is planned and just, and that they're not left behind in the range of opportunities offered by the energy transition.

Question 25 (Industry): In our Net Zero advice, the CCC identified a range of resource efficiency measures that can reduce emissions (see Chapter 4 of the Net Zero Technical Report, page 115), but found little evidence relating to the costs/savings of these measures. What evidence is there on the costs/savings of these and other resource efficiency measures (ideally on a £/tCO2e basis)?

ANSWER: n/a

Question 26 (Buildings): For the majority of the housing stock in the CCC's Net Zero Further Ambition scenario, 2050 is assumed to be a realistic timeframe for full roll-out of energy efficiency and low-carbon heating.

a) What evidence can you point to about the potential for decarbonising heat in buildings more quickly?

b) What evidence do you have about the role behaviour change could play in driving forward more extensive decarbonisation of the building stock more quickly? What are the costs/levels of abatement that might be associated with a behaviour-led transition?

ANSWER:

a) With approximately 80% of existing homes still occupied in 2050[2], we believe that energy efficiency should be the highest policy priority in the short term – for both new-build homes and existing stock, which should be improved to EPC rating Class C or higher. Energy efficiency and smart homes will play a crucial role in making a net zero system affordable for everyone through reducing the scale of the decarbonisation challenge and unlocking decarbonisation options.

We also see a need for a public engagement strategy and plan, which makes the case for the energy transition, to be developed and implemented. This should be supplemented by the implementation of policies that drive improvements in existing home efficiency standards in conjunction with domestic consumers being able to access advice and information on how home energy efficiency can be improved. Energy efficiency should have the highest priority and measures should be taken as soon as possible.

b) The transition to low carbon heat will require changes to most homes, making consumer acceptance a critical success factor. Whatever the future of heat, it needs to be clean, affordable, reliable and convenient for consumers. National Grid is keen to ensure that decarbonisation of heat is delivered in a way that works best for consumers and has commissioned a piece of consumer research to help gather the required evidence base to inform policy development.

The research kicked off in January with consumer focus groups held in Hull and Taunton – and initial findings from these workshops suggest:

[2] Domestic UK Retrofit Challenge: Current performance and barriers leading into the Green Deal http://cic.org.uk/admin/resources/buro-happold-.pdf

• There are doubts that the 2050 net zero target is achievable;
• There are concerns about the cost of achieving net zero, with government support highlighted as being essential;
• Those that had taken personal steps to reduce emissions had done so primarily to save money, and a “nice” consequence was protecting the environment;
• Many were surprised to learn of the contribution of heat to UK emissions and thought transport was the major contributor;
• Many want the transition to be fair, with no community being left behind.

This research project is scheduled for completion in April 2020 and we would welcome the opportunity to share our findings with the CCC.

Question 27 (Buildings): Do we currently have the right skills in place to enable widespread retrofit and build of low-carbon buildings? If not, where are skills lacking and what are the gaps in the current training framework? To what extent are existing skill sets readily transferable to low-carbon skills requirements?

ANSWER: n/a

Question 28 (Buildings): How can local/regional and national decision making be coordinated effectively to achieve the best outcomes for the UK as a whole? Can you point to any case studies which illustrate successful local or regional governance models for decision making in heat decarbonisation?

ANSWER: n/a

Question 29 (Power): Think of a possible future power system without Government backed Contracts-for-Difference. What business models and/or policy instruments could be used to continue to decarbonise UK power emissions to close to zero by 2050, whilst minimising costs?

ANSWER:

The ability to continue decarbonising UK power emissions to close to zero by 2050, whilst also minimising costs, will require supportive policy and regulatory frameworks which:

- **Facilitates and enables anticipatory investments for coastal connections.** For example, our electricity transmission business has identified £1bn of anticipatory investment that can facilitate net zero over the RIIO-2 period (2021-2026), such as the connection of offshore wind on the east coast – which could also make a significant contribution to decarbonising UK power emissions. Realising this potential will require regulatory frameworks to facilitate and enable anticipatory investment which are fundamental to ensuring we minimise disruption, especially to coastal communities, and mitigate infrastructure bottlenecks and constraints. It is important to recognise the future transmission infrastructure needs for large scale offshore wind generation in the North Sea. This includes an enabling framework that would allow us to invest in multi-purpose interconnectors – which continue to provide the benefits of market connections between the UK and Belgium/Netherlands, while also providing more efficient offshore connections for

offshore wind generation. This will result in benefits for consumers in terms of reduced cost, disruption and visual amenity, and reduced onshore grid reinforcement.

- **Boost investor confidence in interconnectors by providing a clear and stable policy and regulatory landscape.** One of the key pathways to decarbonisation is through investment in electricity interconnectors with continental Europe – providing access to low or zero carbon sources of generation and selling our surplus energy. Electricity interconnectors are super-highways that transport energy from where it is generated to where it is needed most. This means that the UK can import cheaper, zero carbon energy (offshore wind, Norwegian hydro, French nuclear) when required and provide savings for consumers. The Clean Growth Strategy pledges the government will work to ensure significant private investment in new electricity interconnectors. In order to achieve this investment, the UK must maintain a clear and stable policy and regulatory landscape to increase investor confidence. This includes appropriate UK/EU trading arrangements, expanded application of cap and floor regulation, fair and equitable access for interconnectors to capacity markets directly or through the generator-led model and appropriate carbon pricing (at least as ambitious as the EU ETS).

Question 30 (Power): In Chapter 2 of the Net Zero Technical Report we presented an illustrative power scenario for 2050 (see pages 40-41 in particular):

a) Which low-carbon technologies could play a greater/lesser role in the 2050 generation mix? What about in a generation mix in 2030/35?

b) Power from weather-dependent renewables is highly variable on both daily and seasonal scales. Modelling by Imperial College which informed the illustrative 2050 scenario suggested an important role for interconnection, battery storage and flexible demand in a future low-carbon power system:

   i. What other technologies could play a role here?

   ii. What evidence do you have for how much demand side flexibility might be realised?

ANSWER: n/a

Question 31 (Hydrogen): The Committee has recommended the Government support the delivery of at least one large-scale low-carbon hydrogen production facility in the 2020s. Beyond this initial facility, what mechanisms can be used to efficiently incentivise the production and use of low-carbon hydrogen? What are the most likely early applications for hydrogen?

ANSWER:

Mechanisms to efficiently incentivise the production and use of low-carbon hydrogen

The nascent technology and market for hydrogen points to a need for Government funding to help create a viable and investable business model. Such a funding mechanism would involve a combination of upfront capital and ongoing revenue support. Mechanisms which should be considered to incentivise production include:

- Funding for innovation projects and trials at scale in order to inform policy decisions in the early 2020s.
- Working with the gas industry to amend the Gas Safety Management Regulation (GSMR) to include a higher percentage limit of hydrogen, as this is a vital component in allowing gas networks to play a role in decarbonisation. The amendment could enable gas networks to transport greater quantities to those customers who are able and willing to accept it.

Other support, such as an obligation scheme on gas suppliers, could be planned to encourage the large-scale deployment of hydrogen once sufficient infrastructure is in place.

Early applications for hydrogen
Early applications for hydrogen could include: use in the Gas National Transmission System (NTS) in the transition stages, demand from transport, industry and power. For transport, this could involve hydrogen produced via electrolysis at re-fuelling stations for light transport, buses and heavy goods vehicles, or could be distributed from central production in early deployment. For industry and power generation, hydrogen produced at larger scale could be utilised as a blend or to fully convert these end users to hydrogen – this is especially relevant to industry who already produce or utilise hydrogen as a part of their processes. These initial users of hydrogen would have a steady demand, where small fluctuations in demand could be met by small-scale hydrogen storage tanks or pipe linepack.

Following these initial applications, a likely next stage of hydrogen utilisation could include demand from larger industrial and power generation clusters. Finally, a low-regrets early hydrogen application could include a hydrogen blend in the distribution networks for domestic heating demand, as current gas boilers are suitable for up to a 20% blend of hydrogen. This demand could potentially be met by hydrogen produced from larger scale methane reforming sites that have access to a supply of natural gas and geological carbon storage and hydrogen storage.

Question 32 (Aviation and Shipping): In September 2019 the Committee published advice to Government on international aviation and shipping and Net Zero. The Committee recognises that the primary policy approach for reducing emissions in these sectors should be set at the international level (e.g. through the International Civil Aviation Organisation and International Maritime Organisation). However, there is still a role for supplementary domestic policies to complement the international approach, provided these do not lead to concerns about competitiveness or carbon leakage. What are the domestic measures the UK could take to reduce aviation and shipping emissions over the period to 2030/35 and longer-term to 2050, which would not create significant competitiveness or carbon leakage risks? How much could these reduce emissions?

ANSWER: n/a

Question 33 (Agriculture and Land use): In Chapter 7 of the Net Zero Technical Report we presented our Further Ambition scenario for agriculture and land use (see page 199). The scenario requires measures to release land currently used for food production for other uses, whilst maintaining current per-capita food production. This is achieved through:

- A 20% reduction in consumption of red meat and dairy

- A 20% reduction in food waste by 2025
- Moving 10% of horticulture indoors
- An increase in agriculture productivity:
  - Crop yields rising from the current average of 8 tonnes/hectare for wheat (and equivalent rates for other crops) to 10 tonnes/hectare
  - Livestock stocking density increasing from just over 1 livestock unit (LU)/hectare to 1.5 LU/hectare

Can this increase in productivity be delivered in a sustainable manner?

Do you agree that these are the right measures and with the broad level of ambition indicated? Are there additional measures you would suggest?

ANSWER: n/a

Question 34 (Agriculture and Land use): Land spared through the measures set out in question 33 is used in our Further Ambition scenario for: afforestation (30,000 hectares/year), bioenergy crops (23,000 hectares/year), agro-forestry and hedgerows (~10% of agricultural land) and peatland restoration (50% of upland peat, 25% lowland peat). We also assume the take-up of low-carbon farming practices for soils and livestock. Do you agree that these are the key measures and with the broad level of ambition of each? Are there additional measures you would suggest?

ANSWER: n/a

Question 35 (Greenhouse gas removals): What relevant evidence exists regarding constraints on the rate at which the deployment of engineered GHG removals in the UK (such as bioenergy with carbon capture and storage or direct air capture) could scale-up by 2035?

ANSWER:

UK CCS deployment has been prevented by the lack of a clear investment and funding framework that adequately addresses risks and gives developers the confidence to invest. This is particularly the case with respect to CCS Transport and Storage (T&S) infrastructure.

Considering the full CCS chain, T&S infrastructure should take priority in the construction timeline to ensure confidence for industrial emitters who are looking to invest in capture technology. To achieve the government's CCS ambitions the development of T&S infrastructure – which could take between 6 to 8 years - must begin in earnest in 2020. The commercial incentive to develop CCS T&S infrastructure is currently not sufficient. There is no business model and the timescales to develop these frameworks will overlap with the government's ambitions for CCS deployment. The government should therefore establish a clear business model and supportive early funding framework for CCS that incentivises accelerated development and construction of a strategic T&S network. This would be best achieved by a Regulated Asset Base (RAB) business model for CCS T&S, which would encourage the required private sector investment and capabilities with a focus on value for customers and wider society.

With weak carbon markets offering little incentive for first movers, the government will likely be required to take a more proactive leading role. We do not believe that CCS in the UK will progress without initial government funding to assist with the development phase. There are already a few funding opportunities, but these offer very limited CCS T&S support. T&S developers will have to directly face risks in a 'first-of-a-kind' deployment and the unique challenge of CCS T&S 'capacity right sizing'. It is difficult to see accelerated private investment in CCS T&S without government grants or loans to aid the front-end activities.

In addition, investors will have to account for low probability, high-impact risks, such as cross-chain risks, stranded asset risks, and carbon dioxide leakage. Considering those risks, there is unlikely to be accelerated growth in CCUS within the UK without the government holding a proportion of these risks alongside the private sector.

Question 36 (Greenhouse gas removals): Is there evidence regarding near-term expected learning curves for the cost of engineered GHG removal through technologies such as bioenergy with carbon capture and storage or direct air capture of CO_2?

ANSWER: n/a

Question 37 (Infrastructure): What will be the key factors that will determine whether decarbonisation of heat in a particular area will require investment in the electricity distribution network, the gas distribution network or a heat network?

ANSWER:

The optimal pathway for the decarbonisation of heat is still unclear. Therefore, we should maintain technology neutrality and avoid closing off any future options with the decisions we make today. There isn't a "one size fits all" solution, as different home environments will lead to different heating solutions. Some potential factors could be (but not limited to):

- • costs;
- • geographical location;
- • age, type and ownership of properties;
- • existing network connections; and
- • other conditions (for example, being in a conservation area)

We believe that there will be a mosaic of solutions, including both electricity and low carbon gas, resulting in the most cost effective and best way to meet the needs of consumers in different areas. As highlighted in our response to question 26, there needs to be a strong focus on energy efficiency to reduce the scale of the decarbonisation challenge. In addition, an early move to hybrid heat pumps – comprising of a heat pump and hydrogen-ready gas boiler – is currently the most practical solution to start the decarbonisation of heat.

Question 38 (Infrastructure): What scale of carbon capture and storage development is needed and what does that mean for development of CO_2 transport and storage infrastructure over the period to 2030?

ANSWER:

There are a number of CCS projects in the UK that are expected to be operational by 2030. As a result, all UK clusters should have accessibility to CO_2 Transport and Storage (T&S) by 2030, meaning that the development and construction of T&S infrastructure must commence in the early 2020s. This will be most effectively achieved through the development of a coordinated and standardised approach to CCS T&S infrastructure. Given the limited number of clusters, we think there should be consideration of the benefits of having a more coordinated approach to T&S infrastructure across clusters. For example, a single entity responsible for T&S could enable better management and mitigation of risks, including cross-chain risks, stranded asset risks, and carbon dioxide leakage, by supporting the standardisation of infrastructure design, operational and maintenance practices; have one set of resources applying their knowledge and experience to all of the T&S assets with a consistent set of training, and leverage any points of optimisation. Such a model would be quicker to design and deploy CCUS technology. Given the urgency to reduce carbon emissions, this would aid a faster rollout of CCUS in the UK and help reach the country's net zero targets.

Furthermore, it would address the need to design the initial CCS infrastructure to enable the rapid increase in the scale of deployment necessary to be consistent with net zero as the ultimate volumes needed are significantly larger than the initial volumes that these projects will put in place.

It could also consider the potential for UK to offer carbon storage to other countries as a way to offset UK emissions. The UK is well positioned internationally to offer CO_2 storage services, importing captured CO_2 for storage in offshore reservoirs. Depending on the growth of the CCUS market, and the decarbonisation pathway from European nations, the UK could be importing significant amounts of CO_2 for geologic storage, becoming a world leader in CCS.