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.

1. ENA represents the companies that operate and maintain the gas and electricity grid network in the UK and Ireland. Serving over 30 million customers, they are responsible for the transmission and distribution network of "wires and pipes" that keep our lights on, our homes warm and our businesses running.
2. Our energy network companies are recognised worldwide for their strong track record of safely, reliably and securely providing the UK with the gas and electricity it needs in three key areas:

Trusted performance - The average gas customer will experience an unplanned interruption once every 140 years. For electricity customers, since 1990, there has been a 59% reduction in the number of customer interruptions, and an 84% reduction in length of customer interruptions[1]. The average GB premises experiences a power cut once every two years and the average length is now only 35 minutes[1].

Reduced costs and increased investment - Network costs are now 17% lower than they were at the time of privatisation[1] and are projected to remain flat, and in some areas fall, into the next decade[2]. These costs are the same or cheaper than in other major economies. The UK's energy networks have attracted some £100 billion of investment since 1990. They are forecasted to invest £45 billion between 2013 and 2023**Error! Bookmark not defined.**.

Delivering innovation - Network companies have spent a total of £99 million across 928 projects through the Network Innovation Allowance, and supported over 1,400 innovation projects since 2004. Independent research carried out by Pöyry has shown that innovation projects from the previous Low Carbon Networks Fund by local electricity Distribution Network Operators (DNOs) could deliver up to £1.7 billion of benefits by 2031[3].

3. This track record of our energy network companies is key to understanding the role they play in helping the UK Government achieve its net zero target by 2050 and ensuring no-one is left behind. Energy network companies are playing a leading role in driving and supporting the transition toward this cleaner, smarter and more decentralised energy system. All this while continuing to deliver secure, reliable energy, record levels of customer satisfaction and keeping network costs low for the public.
4. As regulated monopolies, energy network companies are publicly and directly accountable to the energy regulator Ofgem, UK Government and Parliament through a price control system. Network companies pride themselves on being neutral facilitators. They act as an important lever of public policy, helping to overcome barriers and opening up opportunities for all types of technologies and market participants. With stable, long-term and closely aligned policy and regulatory frameworks, they can continue to perform this important role.
5. ENA welcomes the opportunity to respond to this CCC Call for Evidence. In our response we have focused on the areas where we believe we can contribute the greatest insights. As we are unable to include in this response all of the examples of support and value provided by energy network companies, we encourage you to also refer to individual company submissions.

[1] Ofgem: tougher price controls for energy networks
[2] Ofgem: current network price controls (RIIO-1)
[3] ENA: UK's electricity networks set out new opportunities for energy innovators to help deliver £1.7 billion of benefits, 2018

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:

- People across the UK accept the seriousness of climate change. A YouGov poll of 1,566 adults carried out in January 2020 found 67% of people believe the threat is as real as scientists have outlined[4]. A similar poll by Public First of around 2,000 adults found 47% of people consider climate change to be the single most important issue at this time[5]. Therefore, while increasing public awareness and support is vital, the focus must also be on providing people with opportunities to help reduce emissions. People can play a bigger role in reducing demand for energy, using it more efficiently and supporting shifts to cleaner energy.

[4] YouGov poll: do you think concerns about climate change have or have not been exaggerated?
[5] Public First: public attitudes to decarbonised gas, 2019 (link TBC)

- Major steps toward a more decentralised energy system have given the public better access to secure and affordable low-carbon energy, as well as more control over how and when they use energy. A growing number of people are prosumers, both producing and consuming energy. Since 2007 over 30GW has been connected to local electricity networks in Great Britain[6], with around 100 green gas plants (producing biomethane from waste) also connected locally.

- A smarter energy system is enabling people to be more active participants in our energy system. ENA's industry-wide Open Networks Project is leading vital work in this area, including bringing electricity network companies together to enable new local markets for flexibility services. In 2019, a total of almost 1GW of tenders for these services held across the UK, giving households and businesses the opportunity to earn new revenue streams. More recently, we have seen households benefit from a smart tariff offered by Octopus Energy's which rewarded people for using a surplus of renewable energy during an especially windy period[7]. A logical next step is to reward electric vehicle owners with smart charging tariffs.

- Smart meters have also been a catalyst for engaging people in the transition and offer big potential to reduce demand for energy and in turn emissions. National Grid's 2019 Future Energy Scenario estimates a significant roll-out of smart meters and smart appliances could reduce electricity demand by 20% by the late 2030s and 13.5% by 2050, equivalent to 1.6GW of peak electricity demand. Residential battery systems, heat storage and smart electric charging could help further reduce demand – over 75% of electric vehicles could be charged this way by 2050[8].

To drive the further mass behavioural change which is needed, we believe the two principles of accessibility and attractiveness are essential. Accessibility means a fair approach in which changes are easy-to-understand, everyone has a choice and no-one is left behind[9]. Legislation requiring all new boilers to be 'hydrogen ready' would future proof end-user systems in advance of a roll-out to 100% hydrogen in certain regions or nationally. Attractiveness is vital and largely determined by price and convenience. Decarbonisation pathways where there is minimal or no need for behavioural change, such as with a switch to hydrogen, are important in this regard not least in that they provide a route for reduced emissions for those less able or willing to change. For instance, Public First's polling found the public is positive about using new green gases for heat and transport providing it is convenient and comes at the right cost. Energy network company innovation trials such as Electric Nation, Flexible Power and the Freedom Project have also demonstrated the importance of information, choice and incentives in driving change.

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:

- The importance of a stable, long-term policy environment cannot be underestimated. With a new UK Government in place, it must ensure political will, prioritise achieving

[6] Digest of UK Energy Statistics
[7] Thousands paid to use extra renewable electricity on the windy weekend, 9 December 2019, The Guardian
[8] National Grid Future Energy Scenarios, 2019
[9] Future for All report, Citizens Advice, July 2019

net zero and put the robust policy framework in place which enables the private sector to invest. The industry is awaiting the publication of the Energy White Paper, a National Infrastructure Strategy and a HM Treasury strategy for decarbonisation – leading to some uncertainty. A changing or volatile political environment would cause further uncertainty, and undermine and slow progress.

- Tackling climate change naturally presents some uncertainty due to technology change and requires striking the balance between short and long-term costs and benefits. However, we know from the landmark Stern Review that the benefits of strong and early action far outweigh the economic costs of not acting[10]. Further, the technologies needed to achieve net zero are proven and available today, and this provides confidence in progressing a range of solutions[11].

- To manage inherent uncertainty, the UK Government must develop and implement policies which embody the following key principles:

    - Set out a clear road map for heat decarbonisation to enable long term heat policy decisions in the mid-2020s. This should encompass a commitment to green gas generation through the RHI or a similar mechanism, which should be put in place as soon as possible and ensure there is no hiatus in support from the current end date of the scheme in March 2021.

    - Prioritise the implementation of inexpensive, commercially-competitive and low regret options across all areas of the economy. If particular policy action will be needed irrespective of long-term plans, then this carries low risk. For instance, a 'fabric first' approach to energy efficiency is needed for households, regardless of the heat solution or solutions adopted over time. Similarly, we know carbon, capture, usage and storage technology is needed to achieve net zero so taking steps to fully enable this is key[11].

    - Address uncertainty as to cross-chain solutions, so that wind developers know their electricity can access the market and that captured CO_2 in power, industry and hydrogen production have networks available for its transport and vice versa.

    - Maintain a range of solutions as policy and technology develops, typically known as 'optionality' or 'system optimisation'. This provides flexibility to respond to consumer choice, the needs of different locations and regions, and to meet energy needs cost-efficiently as circumstances change over time. The Iron Mains Replacement Programme provides such optionality in that by 2032 the vast proportion of the gas distribution networks will be replaced polyethylene pipe and be able to distribute hydrogen to households and businesses. Continuing the funding of this would add up to 7% of headroom by 2052 which could allow for the roll of out low carbon gasses in the gas networks without noticeable impact on bills[12]. Mandating hydrogen-ready boilers would maintain this option.
    - Facilitate a programme of large-scale trials to better evaluate solutions, understand consumer preferences, spur innovation and drive down costs, and inform long-term plans. We have seen the benefits of this in falling global wind and solar prices. Trials should be considered across the whole energy system, such as the mass use of heat pumps and hybrid heating systems, smart

[10] Summary: The economics of climate change, the Stern Review, 2006
[11] Committee on Climate Change: The UK's contribution to stopping global warming, 2019
[12] H21 : North of England report, NGN 2018

solutions to support electric vehicle charging and the use of 100% biomethane or hydrogen networks – or a blend of these.

Account for the co-benefits of energy and climate policy measures, such as reduced air pollution, which makes measures more attractive even if they entail high carbon emission reduction costs. In the longer term, we may also see benefits from positive 'spillover effects' in behavioural change[13].

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:

- We commend the UK Government for meeting the first and second carbon budgets, and being on track to outperform the third carbon budget.

- Serious attention needs to be placed on the fourth and fifth carbon budgets given we are off track to meet them[14]. Thousands of the world's leading climate scientists (via the IPPC) explicitly called for urgent and unprecedented changes through to 2030 to limit catastrophic effects from climate change[15]. Failing to re-align the budgets to net zero will only allow for further complacency and not only risk the UK's contribution over this critical next decade, but our likelihood of meeting our 2050 target. We therefore urge the CCC to urgently revisit the level of these budgets and provide guidance to the UK Government quickly so they can act upon it.

- Having carefully considered but ambitious carbon budgets is essential in driving the necessary pace and scale of policy action. If the UK Government uses these targets to effectively guide their policy framework and mechanisms, this can facilitate much needed, timely investment from the private sector. This is best evidenced by energy networks companies, major investors in our energy system which play an integral role in the transition. As electricity network companies develop their business plans for the next regulatory price control period, 2023 to 2028, they are looking to government plans to ensure their own plans underpin progress and support targets. The gas network companies have recently submitted business plans for their next regulatory price control period, 2021 to 2026, all of which called for greater investment to deliver net zero. Supporting this ambition is ENA's Gas Decarbonisation Pathways Programme, a major industry initiative to build on the work that the networks have been undertaking to build a low cost, low carbon network and develop new technologies that make the most of biogas, bioSNG, hydrogen and smart hybrid heating systems[16].

- There are economic considerations of re-aligning the carbon budgets. However, as mentioned in Q6, we know from the landmark Stern Review that the benefits of strong and early action far outweigh the economic costs of not acting. Given re-aligned carbon budgets will be more ambitious than the current budgets, this will accelerate the timeline for action and deliver long-term economic benefits. Furthermore, we know from the CCC's own analysis that the cost of meeting net zero, if acted upon now, will

[13] Elf, Gatersleben & Christie (2019). Positive spillover effects.
[14] CCC online: Carbon budgets, how we monitor emissions targets
[15] Summary for policymakers of IPCC special report on global warming approved by governments, 2018
[16] ENA's Gas Decarbonisation Pathways Programme

be broadly the same as that estimated for the original 80% target – an annual cost of 1% to 2% of gross domestic product to 2050[11].

Re-aligned carbon budgets must reflect the latest policy analysis and recommendations by the CCC and other experts. This is especially important for technologies and solutions which were not accounted for in the original budgets or to the same extent, but which are essential to achieving net zero[11]. Specifically, this includes: extensive electrification particularly of transport and heating supported by a major expansion of renewable and other low-carbon power generation; development of a hydrogen economy; and development of carbon, capture, usage and storage technology not only for industry, but for hydrogen and electricity production.

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:

- A range of co-benefits can be delivered by acting on climate change and pursing a pathway to net zero by 2050. In developing policy frameworks and considering priorities, and weighing up costs, benefits and trade-offs, government and regulatory policy must consider these co-benefits. Three key policies which should be prioritised on this basis are:

    - Energy efficiency measures: At least 11,400 people die every year in the UK, on average, because they live in a cold home[17]. Given net zero can only be achieved if homes have much higher energy efficiency standards, it should be a priority to raise standards to Energy Performance Certificate (EPC) Band C for 2030, especially for fuel poor homes. The co-benefits include the potential to avoid deaths, but also ensure better health, less demand on the grid/s, lower energy bills and reduced air pollution (ie. for homes using oil / wood). It is time to find new ways to implement these measures and energy network companies stand ready to play a bigger role.

    - Smart electric vehicle charging: The shift to a smarter energy system is estimated to save the British public up to £8 billion annually by 2030 according to research by the National Infrastructure Commission (NIC)[18]. It is already offering households and businesses access to new revenue streams by participating the energy system. Building on this, introducing smart charging tariffs for electric vehicles could save owners money from charging-up when prices are cheapest, while potentially selling any excess battery power back to the grid (ie. vehicle-to-grid technology) to help keep network costs low.

    - Hydrogen and CCUS industries: Developing new industries for hydrogen or CCUS to help decarbonise industry, heat, power and transport presents wide-ranging co-benefits of local jobs, supply chain opportunities and the reinvigoration of industrial regions. The North West Hydrogen Alliance, involving gas network company Cadent, has estimated a regional hydrogen economy would deliver £17 billion in gross value added, including the creation of 6,000 jobs[19]. It has been estimated that by 2060, CCUS and the linked

[17] ENA blog: A fair energy future for all by National Energy Action's Matt Copeland, 2019
[18] NIC: Smart power, 2016
[19] North West Hydrogen Alliance website: A regional economy

economy could create over 225,000 jobs (direct and indirect)[20]. Developing such local capability and skills, can help preserve local industry while offering advantage globally.

- Air quality benefits: Gains can be achieved from EV take up for passenger vehicles and from biomethane and hydrogen from heavier transport (LGVs, HGVs, trains and shipping), with hydrogen emitting only water and biomethane CNG delivering particulate emissions savings of 96% compared with Euro VI diesel.

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:

- Over the next decade and through to 2035, we must progress policy action in the following areas:

  - Stability and effective co-ordination: Whether climate responsibilities remain with BEIS or are transferred to the Department for Energy and Climate Change[21], all departments in key areas such as environment, energy and transport, must work together to ensure stability, effective co-ordination and well-aligned policy and regulatory frameworks.

  - Support from HM Treasury: Outlining a clear funding strategy for net zero which is fair for everyone and leverages significant investment from the private sector. Where justified, this should include support for policy mechanisms key to developing early-stage technologies, driving innovation and kick-starting competitive markets.

  - An evolving regulatory framework: A new statutory duty on Ofgem**Error! Bookmark not defined.** would help ensure our world-class regulatory framework fully enables the smartest, most innovative and fairest path to net zero. More direction is also needed on 'future proofing' energy networks so companies can make transparent, timely and cost-efficient decisions to further support roll-out of vital infrastructure such as electric vehicles charging points.

  - Practical action on net zero heat: The UK Government's 2020 Heat Roadmap must embrace short-term solutions, minimise disruption to homes and businesses, and keep costs low for the public. More must be invested in innovation trials, including heat pumps, hydrogen and hybrid heating systems. Hydrogen-ready boilers should be mandated.

  - Boosting green gases on the grid: Once forthcoming innovation trials are successfully completed, it should be mandatory for hydrogen-ready boilers to replace existing gas boilers at the end of their life. A long-term policy mechanism is needed to boost the amount of green gas on the grid from 2021, beyond the end of the Renewable Heat Incentive. New or improved local

[20] Turner, Alabi, Low & Race (2019). Reframing the value case for carbon capture and storage
[21] Business Green: Number 10 planning to revive Department of Energy and Climate Change, 2019

systems for recycling food waste could boost the supply of green energy produced from waste, while reducing our environmental footprint.

- Decarbonising industrial clusters: At least one net zero industrial cluster should be live by 2025 to test carbon capture, usage and storage technology and hydrogen production at-scale. The right policies should enable more clusters to follow and eventually hydrogen zones to be established.

- Engaging the public: It is important that the public are at the heart of decision-making and that that they are engaged and supportive which would avoid potential "push-back".

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:

- Cities, towns and villages should be applauded for taking steps to set their own local emissions targets. Many local and city targets are significantly more ambitious than the UK climate targets. Location such as Bristol (2030), Edinburgh (2030), Glasgow (2030) and Manchester (2038) are finding ways to leverage the unique strengths and capabilities of their communities. The sixth carbon budget must therefore account for many of these cities, towns and villages, if they deliver on time, having already achieved net zero or carbon neutrality. Such decentralised planning should be supported and underpinned by a national framework, this would also ensure that local area plans are aligned and compatible with one another.

- Energy network companies are actively working with local authorities so that such ambitious plans, and in turn community needs, are fully reflected in their own business plans. They are incorporating more regional inputs than ever before, made possible in part through the development of Distribution Future Energy Scenarios developed by working closely with local stakeholders.

- Network companies are also exploring new ways to work with the communities they serve. By helping them build capacity, we can ensure they have the right skills, experience and support to deliver sustainable energy projects. Zero Carbon Communities[22], led by SP Energy Networks and partners, is the first of its kind to set out a detailed roadmap to help guide local communities toward Scotland's 2045 net zero target. It is being rolled out to communities in Edinburgh, Glasgow, Dumfries, Galloway, East Ayrshire and Fife.

- In planning for the sixth carbon budget, we must consider if policy and regulatory frameworks developed in the coming years could enable these communities to play an even bigger role in achieving net zero. Navigant's Pathway to Net Zero Report identified significant regional opportunities for delivering net zero transport, heat and industry from a balanced scenario of electricity and gas solutions. For instance, hydrogen clusters, and eventually zones, are better suited to parts of England and Scotland, while biomethane from anaerobic digestion and bio-synthetic gas will be a likely replacement for natural gas in the South West and parts of Wales[23].

[22] Zero Carbon Communities report, 2019
[23] Navigant: Pathways to net zero, decarbonising the gas networks in Great Britain, 2019

Thought should be given how to address rural communities which are not on mains gas and have single phase 11kV supplies feeding small villages and Hamlets.

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:

- As we work together to achieve net zero, we must ensure policies are designed and funded to maintain the integrity and fundamentals of our energy system, including security of supply, protection for vulnerable customers and competitiveness which keeps costs for bill-payers low.

- Secure, reliable supply is always a priority: Energy network companies have a strong track record of ensuring secure, reliable supply and this remains as important as ever. The average gas customer will experience an unplanned interruption once every 140 years. For electricity customers, since 1990, there has been a 59% reduction in the number of customer interruptions, and an 84% reduction in length of customer interruptions[1]. The average GB premises has a power cut once every two years and the average length is now 35 minutes[1].

- Data is increasingly key: It helps promote competition and open up new benefits for everyone. A focus on the role and potential of data is underpinning the move to a smarter and more decentralised energy system. Through ENA's industry-wide Open Networks Project, there has been a focus on improving data sharing between electricity and gas networks, as well as developing individual digitalisation strategies. ENA is also leading in the development of a digital systems map, a key recommendation of the UK Government's Energy Data Taskforce[24].

- Access to new markets: Ensure everyone has an opportunity to participate in emerging markets and benefit, such as flexibility services markets. Through Open Networks, energy network companies are driving increasing amounts of standardisation and alignment, while still fostering innovation – this will make it easier for market participants to pursue opportunities and facilitate faster processes such as connections.

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:

- The transition to net zero must be fair for everyone, including bill-payers, workers and our most vulnerable people. A just transition needs to consider the annual heating costs, upfront cost of low carbon heating equipment, how these will be paid for, as well

[24] Energy Data Taskforce: A strategy for a modern digitalised energy system, 2019

as ensure as little disruption as possible. The following are key to this:

- Train-up 'green workers' in the 2020s: New partnerships must create new opportunities and train-up millions of new green-collar workers in science, technology, engineering and maths (STEM) skills. As local and regional businesses which directly employ 36,000 people, energy network companies are committed to partnering with government and communities to help nurture the talent needed for the future.

- Continuing to support vulnerable customers: Gas and electricity network companies already work closely to ensure vulnerable customers are added to the Priority Services Register (PSR). This ensures they receive additional services during a supply interruption or in cold periods, such as alternative heating and cooking facilities and updates for friends and relatives. As of December, more than 7 million customers were registered on the PSR[25].

- Better targeted support for fuel poor homes: Improve the eligibility for the Fuel Poor Network Extension Scheme so homes can be more accurately and cost-efficiently connected to our increasingly green gas grid. An amendment to the Digital Economy Act would also provide data to better target support. The same homes must receive fully-funded boilers and heating systems via the Energy Company Obligation scheme.

Use of the network portion of the gas and electricity bill could support the just transition in a manner that enables large upfront costs to be spread over many years. The Iron Mains Risk Reduction Programme, set to be completed in 2032, proves the case for use of the RAB model. If continued after its scheduled end this could increase levels of network savings, adding up to 7% of headroom to the bill by 2052[26]. Use of this revenue could allow for the roll of out low carbon gasses in the gas networks without noticeable impact on bills.

D. Scotland, Wales and Northern Ireland

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:

Decarbonisation and progress towards achieving against the sixth carbon budget may have significant regional differences in the potential for – and cost of – different solutions, as well as local preferences.

Scotland's timeline is compressed with their earlier 2045 net zero target yet they will still need to for BEIS' long term, mid 2020s decision on heat decarbonisation before they can make decisions on how to decarbonise on gas grid homes. However, the characteristics of Scotland's gas network and its geography mean that it is poised to make a switch to hydrogen easier than other areas of the UK. Of note is Acorn, which has already carried out feasibility work for the storage of CO_2 from hydrogen production through reformation.

[25] ENA press release: 7 million milestone reached as Energy Networks Association urges the public to be winter ready

[26] H21 : North of England report, NGN 2018

Wind resources also provide significant opportunity for production from both curtailed and dedicated hydrogen electrolysis.

Thought should be given as to how to address rural communities which are not on mains gas and have single phase 11kV supplies feeding small villages and Hamlets. Within Wales there are large tracts where single phase 11kV supplies where heating is either oil or LPG.

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: At this time the Welsh Government is looking to install 50kW rapid dc charging for cars and light vans. High power dc chargers will need to be in place by 2025.

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: Dealing with HGVs should be addressed nationally as they would need to charged each night and en-route given their current vehicle range.

The UK Government and devolved administrations need to be working together to align policy plans and milestones along the path to net zero. This is especially key given Scotland and Wales have more ambitious targets than the UK, but they are dependent on the overarching policy framework and specific decisions made by the UK Government.

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:

- To support meeting the current target to phase-out the sale of conventional cars by 2040, or to bring this target forward, the following steps are vital. Many of these also apply to Q21 further below for heavy goods vehicles.

    - The UK Government's Road to Zero strategy has provided a strong foundation for policy but lacks comprehensive detail; a robust local and national transport plan is needed which goes beyond this and supports the transition of our transport system as a whole.

- Adopt the Electric Vehicle Energy Task Force[27] recommendations, particularly the need for effective local and national planning and coordination to enable efficient investment and the introduction of smart charging to benefit customers and help manage the grid. There must also be more innovation in vehicle-to-grid technology (V2G) to realise new revenue streams for customers in future and provide additional power to the grid.

- Sufficient certainty and time is needed to enable planning and investment. This is especially key for energy network companies which develop business plans according to the regulatory price control periods. Gas network companies and electricity transmission plans will commence from 2021, while electricity distribution companies are currently working with the regulator and stakeholders to develop plans that will begin in 2023.

- More direction is needed from the UK Government and the regulator on 'future proofing' energy networks. With this, network companies can make transparent, timely and cost-efficient decisions to further support the roll-out of infrastructure such as charging points for electric vehicles and green gas refuelling stations. Network companies are already using modern solutions such as flexibility to meet changing customer energy needs, but we must also step-up major investment, for example in substations and cables.

- There must be greater awareness, visibility and confidence raised in a wider range of low-emission transport options. For instance, while electric vehicles have been a positive, catalyst for change, there is much lower awareness and understanding of the opportunities, benefits and government support available for hydrogen fuel cell powered vehicles.

There must be continued decarbonisation of the electricity grid, to ensure that electric vehicles are powered by low-carbon electricity sources into the future. Similarly, the gas grid must be decarbonised so that green gases such as hydrogen, biomethane and bio-CNG can be used to run a greater number of vehicles and form a key part of a mix of solutions.

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:

- See above recommendations in response to Q20 which also apply here.

[27] Electric Vehicle Energy Task Force, 2020

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: n/a

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:

- Navigant's 'Pathways to Net Zero' report[28] found a balanced combination of low carbon gases and electricity (i.e. heat pumps) is the optimal way to decarbonise buildings (new builds and existing). The recommended pathway comprises four core elements, all of which are required to achieve net zero emissions and deliver least cost, least disruption and near-term change to help meet forthcoming carbon budgets.

    - Low carbon and renewable gases will be fully integrated into the GB energy system. By 2050, all gas end-users will be supplied with hydrogen and/or biomethane. Biomethane will be produced by anaerobic digestion and thermal gasification. Hydrogen will be produced by natural gas reforming, creating the basis for hydrogen clusters, and by electrolysis using renewable power (both dedicated and curtailed generation). Hydrogen-ready boilers will require a single, short visit from an engineer to convert the burners when streets or areas are switched over.

    - Electrification will occur across the demand sectors. Most road transport will be electrified, as well as short- distance shipping. There will be electrification of low-temperature industrial processes. According to our analysis, hybrid heat systems – an electric heat pump paired with a low carbon or renewable gas boiler – will be a key technology for decarbonising the buildings sector in a cost-optimal way.

    - Carbon capture, utilisation and storage (CCUS) will be needed to reduce emissions from hydrogen production and industrial processes. It will also provide "negative emissions" when combined with certain bioenergy technologies.

    - Energy efficiency will need to improve across GB, particularly in the buildings sector as a complement to electrification. Renovation measures such as loft insulation and high-performance glazing will be deployed to bring the majority of buildings up to a moderate level of energy efficiency.

Progress in each of these four core areas would enable faster progress on heat decarbonisation. Further to this, the Iron Mains Risk Reduction Programme (IMRRP) provides a successful tool that could be further utilised to drive change. The next regulatory period could expand IMRRP with new incentives on networks to reduce methane leakage to increase emissions savings.

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:

Gas and electricity networks have the skills base that could be transferred to deliver the required transition. Yet new staff will be required, with National Grid estimating 400,000 new recruits[29].

Gas networks foresee minimal re-training for gas engineers to be able to install and service hydrogen equipment following updates to Gas Safe accreditation. The H21 North

[28] Navigant Pathways to Net Zero: Decarbonising the gas networks in GB, 2019
[29] Building the Net Zero Energy Workforce, National Grid 2020

of England report showed that a widespread conversion of homes to hydrogen would require over 3,000 gas engineers for a number of years, with additional management staff, however with 128,000 Gas Safe registered engineers this would be achievable[30].

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:

- As the UK Government outlines a long-term national policy framework, it must be closely aligned with local and regional delivery. Rather than trying to slow or control the pace at which some local areas are moving, we must harness this as it will contribute to us meeting UK-wide carbon budgets and ultimately, achieving net zero.

- A number of steps should be taken to move toward this:

    1) Reviewing roles and responsibilities so all parties understand how decision-making is allocated between local, regional and national parties and opportunities to improve and strengthen this are identified.

    2) Giving local authorities more accountability, resources and support, to decide where best to invest and focus efforts. These actors know the unique challenges and opportunities which come with their local areas. This must take place alongside improvements to the planning system.

    3) Ensuring there are sufficient mechanisms for two-way flow of information and engagement between local authorities and key stakeholders. In the case of energy network companies, they work to understand local energy plans and directly support them, but also encourage local authorities to make better use of their advice and expertise.

- Examples of existing, coordinated local and regional decision-making provide vital learnings which must be considered in future plans. For instance, in Scotland local authorities lead area-based programmes for energy efficiency (HEEPS and EES) which are funded by the Scottish Government in areas with high levels of fuel poverty.

- The schemes are designed and delivered by councils with local authority delivery partners. The Scottish Government funds Energy Saving Trust to work with local authorities and housing associations to help them take a strategic approach to sustainable energy and ensure that the sector takes full advantage of the opportunities.

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?

[30] H21 North of England, NGN, 2019

ANSWER: n/a

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:

Navigant's 'Pathways to Net Zero' report[31] recommends multiple clusters are supported in their development during the 2020s. To deliver these requires mechanisms and business models to support hydrogen production aligned to the concurrent development of CCUS projects. We would be pleased to share our submission to the BEIS consultation on CCUS business models. The RTFO should also be expanded to include all forms of low carbon hydrogen production.

We also think it is important to commence a programme of large scale trials to evaluate options as well as consumer behaviour and perception. Trials could be whole system and energy system wide, encompassing 100% hydrogen networks but also 100% biomethane networks, blends of the two, evaluation of heat pumps, and use of hybrid heating systems, along with interactions with electric vehicle charging infrastructure.

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

[31] Navigant Pathways to Net Zero: Decarbonising the gas networks in GB, 2019

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: n/a

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 capacity of gas and electricity networks varies around the UK, with some areas with sufficient capacity to support growing demand from new heating technologies and solutions, and other areas with more limited capacity. This has traditionally been driven by factors such as population growth, area demographics and the urban or rural nature of a location.

- When considering if investment in infrastructure such as wires, pipes, substations and cables is needed as we transition to net zero, it is vital to take a whole systems view. Rather than looking only at changing demand driven by the decarbonisation of heat, we must also consider emerging trends and needs driven by other sectors such as transport.

- Robust data, government, industry and community engagement, and a full analysis of risks, costs and benefits are vital to understanding changing consumer needs and making the right strategic decisions. For example, in locations where electric vehicles are growing more quickly, access to and visibility of this data is key to delivering charging infrastructure underpinned by the electricity networks.

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:

CCUS infrastructure needs to be developed throughout the UK as to facilitate the growing demand for hydrogen as industrial clusters emerge and expand, notably in: Aberdeen (Aberdeen Vision, Project Acorn); Grangemouth (Aberdeen Vision); North West Energy and Hydrogen Cluster; Teeside; South Wales and Bristol; Southampton; and the Thames Estuary. Several projects are exploring offshore storage including Acorn in Scotland, HyNet in the North West and Teesside Collective in the North East. Other projects are also being developed, including in South Wales, for Greater London.