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 <u>400 words</u> per question and provide supporting evidence (e.g. academic literature, market assessments, policy reports, etc.) along with your responses.

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: The decarbonisation of heating is likely to be one of the most significant areas for the achievement of co-benefits and there is a need for greater analysis of the differing value and distribution of co-benefits across different levels of deployment of heat pumps, hydrogen, energy efficiency and heat networks. Firstly, there is well established evidence on the co-benefits of more energy efficient buildings, which can create significant comfort and health benefits for individuals. Evidence suggests that cost effective energy efficiency measures could be implemented in the UK to reduce domestic energy demand by 25%, increasing to 50% if co-benefits and falling technology costs are incorporated[1].

Secondly, we believe there could be significant macro-economic benefits associated with decarbonising heat via electrification, which would not be realised if a hydrogen route was the focus. Currently the key method proposed to produce hydrogen (to be cost-effective compared to electrification) is steam methane reformation alongside carbon capture and storage. If hydrogen is produced at scale using steam methane reformation, this approach is likely to maintain and possibly increase UK reliance on imported natural gas which could have significant energy security and macro-economic impacts. While we are not aware that this particular issue (macro-economics of electrification versus hydrogen for heat) has been specifically studied, the focus on the macro-economic benefits of energy efficiency for the UK has been studied[2] and Cambridge Econometrics have also considered the macro-economic impacts of heat decarbonisation in Europe[3]. Because of the scale of UK heat demand, and the potential for benefits, this could be a particularly important area to explore further in relation to co-benefits.

[1] Rosenow, J., Guertler, P., Sorrell, S., Eyre, N. (2018) The remaining potential for energy savings in UK households. Energy Policy. 121(June), 542–552.

[2] Verco and Cambridge Econometrics (2014) Building the Future : The economic and fiscal impacts of making homes energy efficient. http://www.energybillrevolution.org/wp-content/uploads/2014/10/Building-the-Future-The-Economic-and-Fiscal-impacts-of-making-homes-energy-efficient.pdf

[3] www.camecon.com/news/improving-way-economic-consequences-cutting-carbon-emissions-modelled/

Many of the co-benefits of decarbonisation are likely to be realised at a local level through, for example, improved air quality, reduced health spending and improved productivity in the local economy. As such local institutions, including local and combined authorities, clinical commissioning groups and local enterprise partnerships, are key sources of information on both understanding and monitoring co-benefits. However, the localised nature of co-benefits has been under-represented in analysis to date. Andy Gouldson and colleagues provide a thorough review of the evidence of the economic and social benefits of decarbonisation in cities across the buildings, transport and waste sectors[4]. A better understanding of the spatial distribution of co-benefits should also take into account evidence that most decarbonisation scenarios have the potential for significant regional economic disparities in the UK[5].

It is also important to note that understanding and accurately measuring the co-benefits of various policy measures requires investment in robust ex-post assessments of interventions, which are often lacking. Finally, a number of academics and the IPCC have emphasised the importance of quantifying co-benefits as a means to overcome public acceptability concerns [6,7,8]. Analysis of co-benefits should therefore recognise both their importance in establishing the cost-effectiveness of various interventions but also in continuing to developing public support for rapid decarbonisation.

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: We support the priority associated with rapid low carbon heat and energy efficiency deployment as well as large scale trials of low carbon heating.

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: In making declarations of 'Climate Emergency', many local authorities across the country have established targets, almost all of these are more ambitious than those at the national level, most often aiming for net zero by 2030[9]. Government should engage with local authorities to understand their ambitions, provide access to expertise, promote and help with sharing best practice, and devolve power and resources to facilitate local

[4] Gouldson, A. et al. (2018) The Economic and Social Benefits of Low-Carbon Cities: A Systematic Review of the Evidence. London and Washington, DC.

[5] http://projects.exeter.ac.uk/igov/new-thinking-the-changing-role-of-cities-local-energy/.

[6] Somanathan, E. et al. in IPCC Climate Change 2014: Mitigation of Climate Change (eds Edenhofer, O. et al.) 1141–1205 (Cambridge Univ. Press, 2014).

[7] Jordan, A. J. et al. (2015) 'Emergence of polycentric climate governance and its future prospects', Nature Climate Change. Nature Publishing Group, 5(11), pp. 977–982. doi: 10.1038/nclimate2725.

[8] Ostrom, E. Polycentric systems for coping with collective action and global environmental change. Glob. Environ. Change 20, 550–557 (2010).

[9] Harvey-Scholes, C (2019) Climate Emergency Declarations Accelerating Decarbonisation? What 249 UK examples can tell us. http://projects.exeter.ac.uk/igov/new-thinking-climate-emergency-declarations-accelerating-decarbonisation/

authorities' achievement of these goals. A review should take place of the role of the National Planning Policy Framework in enabling local action and the extent to which it empowers local authorities to, for instance, develop renewable energy generation (including onshore wind) and enforce high standards of energy efficiency.

It is clear that no single approach to decarbonising the energy system can be applied nationwide, with each local area requiring a unique mix of technologies and networks. In addition local authorities clearly have a central role to play in facilitating the transformation of the transport system and the delivery of energy efficiency programmes. But despite some renewed focus on the importance of the local level in decarbonisation (for example through the BEIS Local Energy team or Industrial Strategy funding for smart, local energy system trials) there remains a significant mismatch between activity at this scale and governance structures to enable and monitor change. As discussed above many local authorities have made ambitious decarbonisation commitments in the last 18 months but there is currently no requirement for all local and/or combined authorities to have regard for the UK's net zero commitments in their activities, or to monitor decarbonisation locally despite their clear role in understanding what is locally viable and managing socio-economic benefits and impacts. In addition existing commitments vary extensively in scope (i.e. whether they relate to the authorities own emissions or that of the whole authority area) and methodologies for assessing progress. To address this we have proposed a new statutory duty on local authorities to develop a Local Transformation Plan (in line with a centrally agreed methodology), and the devolution of carbon budgets. We discuss these proposals in more detail in this blog[10] and would be happy to take part in more detailed discussions on how the local governance of decarbonisation many need to evolve. Additionally, pilots of Local Heat and Energy Efficiency Strategies (LHEES) in Scotland and of Local Area Energy Planning (LAEP) by the Energy Systems Catapult have indicated the importance of developing common methods of assessing and monitoring decarbonisation options as well as the limitations of such approaches if implemented on a 'voluntary' basis[11][12].

Since the abolition of both the national indicator set for local authorities and the Audit Commission there has been a lack of comprehensive, consistent data on which authorities can be compared. Whilst under the principles of localism the focus has been on 'comprehensive local reporting against local objectives with maximum transparency'[13] it is becoming increasingly clear that delivering on the UK's net zero commitments will require concerted and coordinated action across all sectors of the economy and scales of governance and there is a need to rethink the duties, incentives and support mechanisms in place for local authorities.

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: See our response to question 8 regarding macro-economic impacts which could also support fiscal issues.

[10] http://projects.exeter.ac.uk/igov/new-thinking-the-changing-role-of-cities-local-energy/

[11] Wade, F., Webb, J. and Creamer, E. (2019) Local Heat and Energy Efficiency Strategies: Phase 1 Pilots. Social Evaluation Report. Edinburgh.

[12] https://es.catapult.org.uk/news/local-area-energy-planning-key-to-minimising-decarbonisation-costs/

[13] https://publications.parliament.uk/pa/cm201012/cmselect/cmcomloc/763/763.pdf

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: We believe a significant piece of work should be undertaken to investigate the equity issues associated with heat decarbonisation. While some early research has taken place[14], a much deeper investigation which considers the impacts of capital and ongoing costs on different consumer groups is needed. Additionally there is a need for more granular understanding of the spatial impacts of decarbonisation, particularly in relation to managing the local economic and social impacts of transitioning away from carbon intensive fuels and/or industry. Some research has started to explore regional variation in terms of progress and impacts of decarbonisation[15,16,17] but there is significant scope for analysis and modelling of these impacts to be incorporated into a revised relationship between central and local government on decarbonisation.

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: 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?

[14] Frerk, M., Maclean, K. (2017) Heat Decarbonisation: Potential impacts on social equity and fuel poverty. London. http://www.nea.org.uk/wp-content/uploads/2017/09/Heat-Decarbonisation-Report-2017.pdf

[15] www.drax.com/energy-policy/energising-britain-progress-impacts-outlook-transforming-uk-energy-system/#chapter-1

[16] www.sustainabilitywestmidlands.org.uk/wp-content/uploads/Final-Insight04_Proof4-for-promotion.pdf

[17] Li, F. G. N., Pye, S. and Strachan, N. (2016) 'Regional winners and losers in future UK energy system transitions', Energy Strategy Reviews. Elsevier Ltd, 13–14, pp. 11–31. doi: 10.1016/j.esr.2016.08.002.

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: n/a

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: n/a

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:

a) We are not aware of any examples of rapid building transitions away from gas. Therefore we believe a significant governance and policy focus on this issue is needed which not just equitably delivers within-building measures but also delivers the electricity system capacity and coordination needed to support and drive building decarbonisation.
b) Although social change may support the transformation of the building stock we are skeptical that any sort of bottom-up transition for heat is possible without the support of strong policy and cost incentives, and other regulatory measures (in the form of bans on oil and potentially other fossil fuel heating systems). The current policy framework for heat decarbonisation (the RHI) which has numerous issues[18] , particularly the requirement for householders to provide upfront capital for technologies. Policy should shift towards enabling a wider range of the population to act through the use of upfront grants and financial packages, as happens in Scotland and Germany.

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: No. Heat decarbonisation implies a significant increase in the heating engineering workforce which appears to currently be contracting. The existing widespread use of combination boilers also means that expertise with system design, sizing and control, which is extremely important for heat pumps, is limited. A blog considering these issues and summarising existing research into the heating installer workforce was written by Richard Lowes and published by UKERC[19].

[18] Lowes, R., Woodman, B., Fitch-Roy, O. (2019) Policy change, power and the development of Great Britain's Renewable Heat Incentive. Energy Policy. 131(August), 410 to 421.

[19] http://www.ukerc.ac.uk/news/heating-engineers-skills-and-heat-decarbonisation.html

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: Please see our response to question 10 and a blog from Jess Britton on reforming the local governance of energy system change - http://projects.exeter.ac.uk/igov/new-thinking-governance-for-local-energy-transformations/. One specific area where local authority engagement will be vital is around heat networks. BEIS' existing Heat Networks Investment Programme is seeking to provide financial and other support in order to create a self-sustaining heat network market in the UK, however one of the key barriers to heat network development relates to offtake risk (i.e. that customers will connect once the network is built). Addressing this risk is likely to significantly reduce the cost of capital associated with developing these large infrastructure projects. Many other European countries (partly) deal with this risk by making provision for local heat zoning which allows for connection to heat networks to be mandated for all consumers in a specific area, provided the price and service standards of the network meet various criteria. Individual cities in Germany such as Hamburg have provision through the development of local 'climate protection laws' to implement such policies. A 2018 National Infrastructure Commission report on the costs of decarbonising heating highlighted the potential role for heat zoning[20] and there could be significant scope for the ability to set such zones to be linked to the development of local transformation plans as detailed in the blog above.

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: 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

[20] Element Energy and E4tech (2018) Cost analysis of future heat infrastructure options. Report for the National Infrastructure Commission. Cambridge, Element Energy. Available at: https://www.nic.org.uk/wp-content/uploads/Element-Energy-and-E4techCost-analysis-of-future-heat-infrastructure-Final.pdf.

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: We think the key use for hydrogen is likely to be associated with inter-seasonal balancing, that is hydrogen produced using excess electricity in summer and used to balance the power grid/heating in winter. We would support research in this area but are unsure how best this could be supported without strategic investment/control of gas storage facilities.

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: Given that current international measures to mitigate greenhouse gas emissions from aviation will not deliver major reductions[21], we believe that domestic and regional policy is crucial in order to reduce emissions. Policy focused on domestic flights or wider policy implemented in parallel with the EU would minimise carbon leakage. A summary of a range of available policy tools was recently reported by the Stay Grounded network[22].

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

[21] Larsson, J., Elofsson, A., Sterner, T., & Åkerman, J. (2019). International and national climate policies for aviation: a review. Climate Policy, 19(6), 787-799.

[22] Stay Grounded, (2019). Degrowth of Aviation. [Online] Available from: https://stay-grounded.org/report-degrowth-of-aviation/

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: This is a hugely complex question and it depends on if and how governance is reformed in order to deliver net zero and energy decarbonisation. However, investment needs across gas, electricity or heat networks will, in part, relate to the speed at which (and whether) energy efficiency, storage and electric vehicles are developed in a locality, emphasises the need for DNOs, GDNOs, local and combined authorities and other local actors to work together to short-, medium- and long-term priorities for decarbonisation. There is also a need to ensure network regulation provides clear decarbonisation incentives.

On district heat networks, it is likely that local authorities will be key actors in bringing these projects forward and providing a framework to incentivise local decision-makers to create long-term plans for the decarbonisation of heating (across demand reduction, electrification, hydrogen and heat networks) in their area is a key factor. Our research has highlighted that some policy-makers believe that an electrification of heat route could be based around the existing market structures but how a hydrogen type market could work

appears more uncertain[23]. There is significant uncertainty in relation to the management of network investment across gas and electricity if hybrid systems were delivered at scale.

As part of the 4th Phase of the UK energy research centre, Richard Lowes and Bridget Woodman of the Energy Policy Group are leading research around the optimal governance for infrastructure for net zero. This work is at an early stage but we would be more than happy to engage in person around these issues.

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: n/a

[23] This paper is currently under peer review but we can share it once published.