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.

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: The papers cited and linked in my responses, and those only referred to in my responses, but cited and linked here.

[1] Birdsey R et al (2018) Climate, economic, and environmental impacts of … bioenergy. Environ. Res. Lett. 13, 050201 https://doi.org/10.1088/1748-9326/aab9d5

[2] Booth MS (2018) Not carbon neutral … Environ. Res. Lett. 13, 035001 https://doi.org/10.1088/1748-9326/aaac88

[3] European Academies Science Advisory Council (2018) Negative emission technologies? EASAC Policy Report 35 https://easac.eu/projects/details/negative-emission-technologies/

[4] Fuss S et al (2014) Betting on negative emissions. Nature Clim Change 4(10), 850–853 https://doi.org/10.1038/nclimate2392

[5] Galik CS (2020) A continuing need to revisit BECCS … Nature Clim Change 10(1), 2-3 https://doi.org/10.1038/s41558-019-0650-2

[6] Harangozo G et al (2018) How big is big enough? Sustain. Dev.26, 172–181 https://doi.org/10.1002/sd.1728

[7] Heck V et al (2018) Biomass-based negative emissions … Nature Clim Change 8, 151-155 https://doi.org/10.1038/s41558-017-0064-y

[8] Hickel J (2019) The contradiction of the sustainable development goals. Sustain. Dev. https://doi.org/10.1002/sd.1947

[9] Hickel J & Kallis G (2019) Is green growth possible? New Political Econ., https://doi.org/10.1080/13563467.2019.1598964

[10] Hilaire J et al (2019) Negative emissions and international climate goals … Clim.Change 157, 189–219 https://doi.org/10.1007/s10584-019-02516-4

[11] Jiborna M et al (2018) Decoupling or delusion? Measuring emissions … Glob. Environ. Change 49, 27–34 https://doi.org/10.1016/j.gloenvcha.2017.12.006

[12] Jones CD et al (2016) Simulating the Earth system response … Environ. Res. Lett. 11, 095012 https://doi.org/10.1088/1748-9326/11/9/095012

[13] Karstensen J et al (2018) Trends of the EU's territorial and consumption-based emissions … Clim.Change 151, 131–142 https://doi.org/10.1007/s10584-018-2296-x

[14] Kartha S et al (2018) Whose carbon is burnable? Clim.Change 150, 117–129 https://doi.org/10.1007/s10584-018-2209-z

[15] Larkin A et al (2017) What if negative emissions … Clim. Policy 18(6), 690-714 https://doi.org/10.1080/14693062.2017.1346498

[16] Minx, J. C. et al (2018) Negative emissions—part 1. Environ. Res. Lett. 13(6), 063001 https://doi.org/10.1088/1748-9326/aabf9b

[17] Smith P et al (2016) Biophysical and economic limits … Nature Clim. Change 6(1), 42-50 https://doi.org/10.1038/nclimate2870

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: Matthews HD et al (2018) Focus on cumulative emissions, global carbon budgets and the implications for climate mitigation targets. Environ. Res. Lett. 13, 010201 https://doi.org/10.1088/1748-9326/aa98c9 :

"There are a range of carbon budget estimates in the literature associated with global temperature targets (IPCC 2014, Friedlingstein et al 2014, Rogelj et al 2016b, Matthews et al 2017, Millar et al 2017). Some of this range reflects geophysical uncertainty associated with the climate response to CO2 emissions (i.e. the range of the transient climate and carbon cycle responses to emissions), though there is also an important contribution to carbon budget uncertainty that arises from human mitigation decisions and the contribution of non-CO2 emissions to future climate warming"

"the release of carbon from thawing permafrost has the potential to decrease total allowable CO2 emissions for the 2 ◦C temperature target by about … 8% of the total budget, though this effect may increase in importance for higher temperature targets. In addition … choices regarding the timing of CO2 emission reductions can affect carbon budgets, if delays in mitigation result in the overshoot of a carbon quota. … net carbon budgets following overshoot of and return to a warming target through artificial removal of CO2 from the atmosphere ('overshoot net carbon budgets') are generally smaller than carbon budgets consistent with achieving a warming target without overshoot (i.e. more CO2 needs to be removed than the actual amount by which the cumulative emissions budget is exceeded)." ("This effect has been quantified with one Earth system model only, and it is unclear if it applies to low emissions scenarios limiting global temperature to below 1.5 ◦C and 2 ◦C.")

"large uncertainties exist with regard to the size of the carbon budgets consistent with the 1.5 ◦C and 2 ◦C climate targets … This propagates onto significant uncertainties in the required emission reductions and associated costs."

"the timing of zero emissions is a relatively poor indicator of the likelihood of achieving a temperature target."

Lahn B (2020) A history of the global carbon budget WIREs Clim Change e636 https://doi.org/10.1002/wcc.636 : “the shift in positioning ... frames the carbon budget less as a knowable and quantifiable physical entity than as a research frontier consisting of a number of identifiable uncertainties and knowledge gaps (cf. Hulme, 2018) that can be decomposed”

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: Matthews et al (2018) (link at 2 above) “for industrialized countries who have contributed the majority of historical emissions, international equity considerations suggest that emissions should reach net zero 1–2 decades earlier than the rest of the world”.

The UK should aim for net zero, by 2030 or shortly thereafter.

CCC 2019 Net Zero report assumes compatibility of net zero with growth; p217: “Arguments for climate action in general still stand for a net-zero target. There are no grounds for thinking that it will have a significant impact on economic growth provided policy is designed appropriately.”

This view does not appear to be well founded.

[11] Jiborna et al (2018): “Over the last few decades several industrialized countries, among them the UK and Sweden, have reported substantial reductions in territorial carbon emissions in combination with sustained economic growth. This has been interpreted as a successful decoupling of economic growth from carbon emissions … the analysis [in this paper] does not support the claim that absolute decoupling has taken place in the UK and Sweden in this period”

[13] Karstensen et al (2018) p140: “The EU has been reducing territorial and consumption-based emissions, but some of this is arguably good fortune. A Kaya identify decomposition suggests that weaker EU economy is the dominant immediate factor for the reductions since 2008, and ... also suggests that a return to stronger economic growth since 2014 has help push emissions back up again. This suggests that if economic growth remains strong in the years ahead, then it will continue to put upward pressure on emissions”

The CCC view conflicts with respect for planetary boundaries (For a review of planetary boundary literature see Downing AS et al (2019) Matching scope, purpose ... Environ. Res. Lett. 14, 073005 https://doi.org/10.1088/1748-9326/ab22c9)

[9] Hickel & Kallis (2019): “there are no scientific grounds upon which we should not question growth, if our goal is to avoid dangerous climate change and ecological breakdown. Staying within planetary boundaries may require a de-growth of production and consumption in high-consuming nations”.

[8] Hickel (2019): “the only feasible pathway for Annex 1 nations to achieve their obligations under the Paris agreement is to scale down economic activity.”

[6] Harangozo et al (2018) provide a concise review of the literature in this area, specifically including degrowth

See also 5 below.

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: Harris PG and Lee T (2017) Compliance with climate change agreements: the constraints of consumption. International Environmental Agreements: Politics, Law and Economics 17, 779–794 https://doi.org/10.1007/s10784-017-9365-x :

"international efforts to address climate change will be unlikely to succeed ... if they do not tackle the political obstacles inherent in consumption-based economies and societies. This analysis may ... question the viability of capitalist economic growth models in a new age of climate change".

"The association between consumption and compliance (or lack of it) implies that the battle to mitigate the causes of climate change will have to be as much about consumption as anything else. Governments of the developing world may have to ask their citizens to do precisely the opposite of what those governments have been encouraging them to do recently—to become consumers just like people in the developed world. It goes without saying that taking such a step will be no less politically difficult, and possibly more so, than will be policies to discourage ongoing consumption in the West."

A strengthened UK NDC, covering both territorial and consumption-based emissions will support efforts to cut emissions elsewhere.

This is underlined by three contributions to the IPCC Fifth Assessment report.
• Fleurbaey M et al (2014) In: Cont of WGIII to IPCC AR5 at 283-350. https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter4.pdf , sect 4.4: "A disproportionate part of the GHG emissions arising from production are linked to the consumption of products by a relatively small portion of the world's population"
• Blanco G et al (2014) In: Cont of WGIII to IPCC AR5, at 351-412. https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter5.pdf Executive Summary: "There is an emerging gap between territorial, production-related emissions, and consumption-related emissions ... The gap shows that a considerable share of CO2 emissions from fossil fuels combustion in developing countries is released in the production of goods exported to developed countries."
• Agrawala S et al (2014) In: Cont of WGIII to IPCC AR5, at 1083-1140. https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter14.pdf 14.3.4.3: "With economic growth, households in less-developed regions are expected to 'westernize' their lifestyles, which will substantially increase per capita and global total carbon emissions."

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: Harris and Lee (2017) (link at 4 above):

"Without addressing consumption behaviors and the policy implications thereof, effectively

addressing climate change in the future will be extremely difficult, if not impossible."

"A premise in most societies, and an assumption of most governments, is that more consumption is good because it ''grows'' the economy. … this generates economic, social and political forces ... undermining states' compliance with internationally agreed GHG emissions limitations. Even progressive climate change policies for GHG mitigation may not achieve their targets because they are embedded within economic structures reliant on consumption and consumerism."

"Voters enjoy consumption ... This is precisely why government policies are so vital to achieving compliance with international environmental agreements … to address climate change: .... Many or most climate-related policies must attempt to counter preferred or habituated behaviors of most citizens—not to mention behaviors of politically influential businesses (e.g., petroleum and coal producers, automakers) and interest groups (e.g., labor organizations and their members)—that would be affected by those policies."

Ottelin J et al (2019) What can we learn from consumption-based carbon footprints ... Environ. Res. Lett. 14, 093001 https://doi.org/10.1088/1748-9326/ab2212 : Section 4.4 notes unique features which a consumption-based perspective can bring to policy discussions: a focus on responsibility for emissions, awareness of rebound effects and focus on sustainable consumption and lifestyles.

Peters GP et al (2020) Carbon dioxide emissions continue to grow … Nature Climate Change, 10(1), 3-6 https://doi.org/10.1038/s41558-019-0659-6 : "The failure to mitigate global emissions … suggests that the full bag of policy options is not being effectively deployed. Most policies tend to focus on supporting low-carbon alternatives, such as solar, wind or electric vehicles, but these technologies often add to existing demand and therefore do not displace fossil fuel to any great extent. Public policies need to place far more importance on directly cutting back the use of fossil fuels ... particularly the phasing out of ... conventional vehicles well before they reach their productive end-of-life."

The co-benefits noted at 8 below provide incentives for the necessary behaviour change. TCBA (see 9 below) would assist in assessing progress.

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: Oreskes N (2018) The scientific consensus on climate change … In: Lloyd EA and Winsberg E (Eds) Climate Modelling … 31-64. Palgrave Macmillan https://doi.org/10.1007/978-3-319-65058-6_2 p39 "Much of the recent and continuing debate in the scientific community involves the likely rate of future change. .... Virtually all professional climate scientists agree that human-induced climate change is underway, but debate continues on tempo and mode."

Parker W (2018) The significance of robust model predictions. In: Lloyd EA and Winsberg E (Eds) Climate Modelling … 273-296. Palgrave Macmillan https://doi.org/10.1007/978-3-319-65058-6_9 : "There is now a broad scientific consensus … that Earth's climate will be still warmer by the end of the twenty-first century ... Less clear are the quantitative details ..."

Baumberger C et al (2017) Building confidence in climate model projections …. WIREs Climate Change 8, e454 https://doi.org/10.1002/wcc.454 review the limits to confidence in projections arising from climate models – table in box 3 on their p14 is a useful summary

Workman M et al (2020) Decision making in contexts of deep uncertainty … Environmental Science and Policy 103, 77–84 https://doi.org/10.1016/j.envsci.2019.10.002 : "Modellers argue that … IAMs are not intended to make scientific predictions, but to embrace uncertainty through modelling the behaviour of a wide range of hypothetical scenarios … Yet to the extent that policymakers view IAM results as "objective science", it is natural ... [t]hat … they are used as scientific evidence in themselves rather than a way of discussing, assessing and organising scientific evidence. Examples of this can be seen in national-level policy setting, with the inclusion of 50–70 MtCO2 removals via BECCS in recent advice to the UK government on its 2050 net-zero target (CCC, 2019) … The dominance of BECCS in IAM outcomes and international and national policy discourse belies the claim that they are seen primarily as tools to explore hypothetical futures. Instead, we argue that this interpretation reflects a mindset that seeks to find optimal solutions to policy challenges: … a "predict-then-act" framework. The tendency for policy-makers to frame problems in a predict-then-act framework when using modelled outputs leads to the seemingly precise characterisation of imprecise possible futures, hindering the exploration of the full range of available measures to mitigate climate change."

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: yes

Le Quéré C. et al (2019) Nature Clim Change 9(3), 213-217 https://www.nature.com/articles/s41558-019-0419-7 at 217: "the emissions reductions observed … fall a long way short of the deep and rapid global decarbonisation of the energy system implied by the Paris Agreement temperature goals, especially given the increases in global CO2 emissions in 2017 and 2018, and the slowdown of decarbonisation ... since 2014 … Recent acceleration in the deployment on renewable energy ... will only translate into emissions reductions if accompanied by extensive measures to phase out the use of fossil fuels"

Matthews et al (2018): "Meeting the goals of the Paris climate agreement will clearly require immediate and considerable mitigation effort across all sectors of the global economy."

Jackson RB et al (2019) Persistent fossil fuel growth threatens the Paris Agreement and planetary health. Environ. Res. Lett. 14, 121001 https://doi.org/10.1088/1748-9326/ab57b3 : "Two under-appreciated trends suggest continued long-term growth in both oil and natural gas use is likely. Because per capita oil consumption in the US and Europe remains 5- to 20-fold higher than in China and India, increasing vehicle ownership and air travel in Asia are poised to increase global CO2 emissions from oil over the next decade or more. Liquified natural gas exports from Australia and the United States are surging, lowering natural gas prices in Asia and increasing global access to this fossil resource. To counterbalance increasing emissions,we need accelerated energy efficiency improvements and reduced consumption, rapid deployment of electric vehicles, carbon

capture and storage technologies, and a decarbonized electricity grid, with new renewable capacities replacing fossil fuels, not supplementing them."

CCC Net zero report May 2019: Box 3.3, p105 notes that consumption-based emissions in 2016 had only declined to 91% of their 1997 levels. Box 5.7, p163 notes "Consumption-based emissions were estimated to be around 70% higher than territorial-based emissions in 2016". The UK is thus failing to significantly reduce its consumption based emissions.

I discussed this in detail in my December 2018 submission to the CCC: https://www.theccc.org.uk/wp-content/uploads/2019/04/Brian-Drummond-response-to-Call-for-Evidence-2018.pdf

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: Lamb WF and Steinberger JK (2017) Human well-being and climate change mitigation. WIREs Clim Change 8, e485 https://doi.org/10.1002/wcc.485 provides a good overview of the literature in this area arguing for limiting consumption and noting:

"transitioning towards a low-consumption, zero-growth society would be consistent with stable or improved well-being … "the most appropriate frameworks for mitigation research describe well-being as … satiable (there is such a thing as 'enough' to live a good life) … both hedonic and eudaimonic well-being research support a threshold hypothesis for consumption: that many consuming activities can be substantially reduced or substituted through alternative forms of social provisioning without a concomitant impact on well-being."

See also: Jain P and Jain P (2019) Ensuring sustainable development by curbing consumerism: an eco-spiritual perspective. Sustain. Dev.27(3) https://doi.org/10.1002/sd.1935

CCC Net zero report May 2019 p8: "there is the prospect of real benefits to UK citizens: cleaner air, healthier diets, improved health ..."

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: [9] Hickel & Kallis (2019): "Of course, we need all of the technological innovations we can get, and we need to gear government policy toward driving these innovations, but this will not be enough .... The evidence ... indicates that in order for efficiency gains to be effective, we will need to scale down aggregate economic activity too. It is more plausible that we will be able to achieve the necessary reductions in resource use and emissions without growth than with growth. … As Gough (2017) notes, combatting climate change might require not only new clean and efficient energy technologies, but also a reduction and re-composition of consumption, with a shift from carbon-intensive to low or zero carbon sectors. Legislative limits, green taxes, shifts in public investment and working hour-reductions or new social security institutions such as a basic income all have a role to play in such a transition"

[32] Kander A et al (2015) National greenhouse-gas accounting for effective climate policy ... Nature Clim Change 5, 431–435 https://doi.org/10.1038/NCLIMATE2555 recommends technology-adjusted consumption-based accounting (TCBA) as an improvement on simple CBA. It notes that, UK TCBA emissions, although smaller than UK CBA emissions, are consistently greater UK production based emmissions.

[14] Kartha, Sivan et al (2018): “An emerging body of research … argues that policies focused on emissions alone may not be sufficient, and that achieving the ambitious climate goals to which countries have committed themselves will require complementary policies to curb fossil fuel extraction and address carbon lock-in.”

“cross-country evidence suggests that HDI and energy consumption increases in near lockstep until energy consumption levels of about 2 tons of oil equivalent per capita, which is a level considerably higher than average consumption in most developing countries today (Jess et al. 2011). If undertaken through fossil fuel use, achieving traditional development goals of higher life expectancy, access to basic needs and economic growth through traditional growth pathways are likely to absorb a large share of the remaining global carbon budget (Lamb and Rao 2015). For developing countries with limited technical and institutional capacities, the attractiveness of treading a well-worn path rather than a more experimental path should not be understated, especially in a context of the persistent reluctance of many wealthier countries to be early movers"

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: Afionis S et al (2017) Consumption-based carbon accounting: does it have a future? WIREs Climate Change 8, e438 https://doi.org/10.1002/wcc.438 : “this article concluded by outlining some options, relying on readily available policy instruments, such as emissions trading, that could directly or indirectly address the impacts of internationally traded emissions in a more practical and politically acceptable fashion”

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: n/a

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?

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: n/a

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: 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: On BECCS see 38 below.

Algunaibet IM et al (2019) Powering sustainable development within planetary boundaries. Energy Environ. Sci. 12, 1890-1900 https://doi.org/10.1039/c8ee03423k demonstrates that nuclear and gas (even with CCS) can play at most a very limited role due to the water usage planetary boundary constraint

There are other reasons to reduce the role of nuclear power.

Barnham K (2015) False solution ... Ecologist, 5 Feb https://theecologist.org/2015/feb/05/false-solution-nuclear-power-not-low-carbon provides a comprehensive analysis of research and meta-analyses on emissions associated with nuclear power and concludes “There is no consensus in the scientific literature as to the carbon footprint of existing nuclear reactors”.

Roche P (2013) Nuclear vs climate. Third World Resurgence 279/280, 43 https://www.twn.my/title2/resurgence/2013/279-280/cover11.htm considers nuclear power in the context of emissions targets. Roche notes the decade or longer construction time for nuclear plants and concludes that we don't have time to wait for an increased rollout of nuclear power.

UK Sustainable Development Commission (2006) Report: The role of nuclear power in a low carbon economy, at 20 http://www.sd-commission.org.uk/publications.php@id=344.html : "If the UK cannot meet its climate change commitments without nuclear power, then under the terms of the Framework Convention on Climate Change, we cannot deny others the same technology. The UK … must take account of the implications of this legal issue. … other countries who adopt nuclear power may have much lower safety standards than the UK, and this increases the risk of accidents (transboundary contamination) and radiation leaks from waste materials. Greater use of nuclear power also increases the risk of nuclear proliferation, which impacts on international security".

Royal Society (2011) Report: Fuel cycle stewardship … at 36, 45, 65 https://royalsociety.org/topics-policy/projects/nuclear-non-proliferation/report/ notes on nuclear waste (p36): "Based on the NDA's current planning assumptions, the first emplacement of ILW and HLW in a UK Geological Disposal Facility will be in 2040 and 2075, respectively" (p45) "the UK now has the world's largest civil stockpile of separated plutonium that is being stored without any long term plan to manage it" (p65): "The Government's recognition that the status quo of continuing to store [this] stockpile indefinitely is not ... acceptable".

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: n/a

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: [3] EASAC (2018): “NETs (in particular BECCS) ... should not be seen as offering a realistic pathway to meeting Paris Agreement targets. … we do not consider any NET as likely to offer the potential for CDR at the scales assumed in future climate scenarios”

[10] Hilaire et al (2019): “Planning for large-scale NET deployment while postponing near-term GHG abatement … could turn out to be an ineffective tool for reducing climate risk. The associated overshoot in GHG concentration (and perhaps temperature) would increase the risk of not meeting the PA targets and potentially lead to climate change irreversibility. … From a socio-economic perspective, NETs add another layer of risks by increasing competition for land, water, energy and financial resources.”

“The deployment of NETs is subject to a wide array of challenges, which can be technology specific. These include: NET upscaling, governance, political, policy, legal and

finance aspects, social acceptance, food security, technological limits, reservoir leakage, environmental impacts, and
climate and carbon cycle feedbacks."

[15] Larkin et al (2017): "This article … explicitly eschews widespread use of NETs ... because there are many major and potentially insurmountable obstacles to their successful uptake at scale"

[17] Smith et al (2016): "A failure of NETs to deliver expected mitigation in the future, due to any combination of biophysical and economic limits examined here, leaves us with no "Plan B". ... there is there is no NET, or combination of NETs, available now that could be implemented to meet the <2°C target without significant impact on either land, energy, water, nutrient, albedo or cost"

[16] Minx et al (2018): "Over the past decade, NETs have moved from the periphery towards the core in climate policy discussions. This change is in part due to the growing cognitive dissonance between increasing long-term ambition in international climate policy … and the very limited success in achieving short-term emission reductions across the globe … Climate policy needs to focus on limiting the dependence on NETs through aggressive mitigation … it seems crucial in the light of the prevailing uncertainties surrounding all NETs to keep the dependence on NETs for achieving the climate targets as small as possible"

The analysis in the following 2 papers is also relevant:

[4] Fuss et al (2014) and [12] Jones et al (2016).

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: n/a

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: Specifically on BECCS:

[15] Larkin et al (2017): "The absence of robust operating costs for a CCS power station, let alone BECCS ... raises concerns given that it is repeatedly found to be a key least-cost policy option in many scenarios." cf fig 2.5 on p78 of CCC net zero report.

[7] Heck, V. et al (2018) “Pending ongoing improvements in the definition and quantification of [planetary boundaries], relying on BECCS as a key decarbonisation strategy should be considered highly risky”

[5] Galik (2020): “for BECCS … the magnitude of the challenge is only slowly finding its way to the forefront of the dialogue. … First ... there must be agreement on the net GHG benefits of BECCS and how to account for them. Second there must be sufficient governance of the potential co-effects associated with scaling the technology, particularly elements of water consumption, biodiversity and food production. … If BECCS cannot achieve the mitigation it has been tasked with, something else must take up the slack. Although such strategies may be suboptimal from a modelling perspective, it is imperative that we confront them fully, given the challenges associated with otherwise preferred solutions such as BECCS.”

[2] Booth (2018): “in the UK, … the government provided £809 m … in subsidies to biomass electricity in 2015, the same year it announced it was terminating subsidies for offshore wind earlier than planned. Since residues would eventually release carbon to the atmosphere whether through burning or decomposition, any putative reduction in CO2 emissions actually depends on residues-fueled bioenergy displacing fossil fuels, but in the UK, it appears bioenergy may instead be displacing zero emissions technologies, while prolonging the life of coal plants that partially switch to subsidized wood burning.”

“Using the NEI to weight biogenic CO2 for inclusion in US and EU carbon trading programs and to qualify bioenergy for renewable energy subsidies would reduce emissions more effectively than continuing with the current assumption of zero emissions, though for wood pellets sourced from bolewood, counting direct emissions is a more ... accurate approach.”

[1] Birdsey, Richard et al (2018): “increasing bioenergy production and pellet exports often increase net emissions of GHGs for decades or longer, depending on source of feedstock and its alternate fate, time horizon of analysis, energy emissions associated with the supply chain and fuel substitution".