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: Climate science cannot be considered in isolation from social science when dealing with climate change the main consequences of which are economic. For example, the capital stock plays a key role in explaining UK CO2 emissions since 1860 as it affects the efficiency with which fuels are used. As capital embodies the vintage of technology at its construction and is long lived, any cost-effective transition to zero carbon must be gradual. The ban on internal combustion cars from 2035 reflects the costs of stranded assets in production being otiose before their economic life expires as against such vehicles being scrapped unnecessarily early, assuming none will be allowed to be used post 2025. See https://voxeu.org/article/driving-uks-capita-carbon-dioxide-emissions-below-1860-levels for a non-technical discussion.

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: Global cumulative CO2 budgets are only moderately relevant for constraining the UK's emissions on the pathway to net zero. This arises because equitable mitigation necessitates that some countries (richer countries, countries with greater cumulative GHG emissions) reduce their future emissions more rapidly than others. Emissions budgets consistent with different conceptions of equitable mitigation have been estimated in the literature (https://doi.org/10.1038/nclimate3186), though research on climate ethics present diverse perspectives (see Morrow, "Values in climate policy"). Global CO2 budgets must be distributed across countries, and the UK ought to reduce emissions more rapidly than many other countries to allow those to mitigate more slowly. This is consistent with widely accepted norms of common but differentiated responsibilities in climate policy and sustainable development.

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: How the timelines for other countries' international commitments map onto the UK's sixth carbon budget depends on other countries using different target years and accounting cycles when setting their own targets. Setting common reporting requirements, including but not limited to reference timelines, would support transparency and reciprocity in international climate policy and the effective implementation of the Paris Agreement. Reciprocity remains important in climate policy, as national governments will likely only set ambitious targets if they understand their counterparts are taking roughly equivalent actions. If other countries in their updated commitments pledge to move quicker on GHG mitigation, then a stringent sixth carbon budget (along with a stringent 2020 INDC) could facilitate building a broader coalition of ambitious countries.

Three other issues are important for effectively implementing the Paris Agreement. First, many developing countries have communicated conditional Paris targets, that depend on outside financial support from Annex 1 countries for their full implementation. The UK could strengthen global implementation through the provision of increased climate finance for projects in developing countries. Second, the effective implementation of the Paris Agreement relies on increased global ambition in GHG mitigation in the next round of INDCs. The UK's sixth carbon budget falls within this second round of targets under the Paris Agreement, so can play a key role in structuring the first years of the UK's renewed target. Third, effective implementation depends on clarity and transparency in policy targets. Existing research has shown that the Paris INDCs were not uniformly transparent, hindering their comparability and potentially misleading observers (https://doi.org/10.1007/s10584-019-02494-7). To remedy this, the UK could coordinate closely with other countries before submitting its 2020 INDC to agree to common reporting requirements among a subset of leading countries on topics such as baselines, target years, and scope of emissions covered.

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: The UK, along with all other countries, is expected to submit an updated NDC ahead of COP26 in Glasgow for the period after the current, EU negotiated, NDC expires (2030). This is part of the ratchet process. The submission should not be conceptualized in terms of signalling. Instead, the UK NDC should be understood as a set of public commitments, made to national and international stakeholders.

It is of paramount importance that the UK NDC articulates a clear, quantifiable, and accountable economy wide GHG emissions reduction target. The NDC can go much further than this however. A credible net zero NDC would communicate what the relative contributions of direct decarbonization/mitigation will be compared to CO2 removal: how much will the UK's GHG emissions excluding land use change/etc. fall compared to how much will be offset through carbon dioxide removal. The NDC would benefit from moving beyond a headline target to outlining specific policy measures (carbon pricing, direct regulation, tax incentive, subsidy removal, zoning and transport infrastructure, etc.) the UK government intends to implement to reach the NDC goal.

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?

The NDC could also communicate the government's aims with respect to national adaptation planning, the provision of climate finance to developing countries, direct training and technical assistance to build climate policy capacity in developing countries, research and development spending on clean energy technologies, means for commercializing, diffusing, or exporting green technologies, etc. The UK can also use the flexibility of the NDC system to articulate positions across a range of important, emerging issues in climate policy, such as on research and development of negative emissions technologies, direct air capture, solar geoengineering, transboundary migration caused by climate change, and preferential market access for trade from countries with effective climate policies.

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: Is this an attempt to switch responsibility from production to consumption based emphasis? Targeting consumption emissions rather than production has the unwanted consequence of removing key incentives for emitting industries or exporting countries to improve their performance, as these would not be counted against them (e.g., if NDCs used a consumption basis). Border carbon taxes have a role to play in improving both exporters and importers performance. Similarly, allocating emissions from transport and packaging to (say) the food sector would again alleviate those intermediate sectors of the responsibility to invest to reduce what are in fact their emissions by attributing them to retail outlets or consumers. Conversely, the purchasing clout of large retail chains can pressure suppliers to improve, as (e.g.) Walmart is doing https://corporate.walmart.com/2016grr/enhancing-sustainability/reducing-energy-intensity-and-emissions

Raising VAT on household fuel consumption to the standard level combined with using the increased revenue to offset fuel poverty in poorer households (on benefits, earning but below tax thresholds) as with the winter fuel allowance. Increasing petrol and diesel fuel taxes as the prices of the raw material falls so the pump price does not fall. Consumer-oriented decarbonisation could lower territorial emissions by up to a quarter, but this will necessitate a diverse range of demand-side policy instruments (Moran et al. 2018). Additional reductions could be achieved upstream (abroad) in relevant product supply chains. Nevertheless, the responsibility to reduce emissions remains squarely with institutions. See: Moran, D., et al., 2018. `Quantifying the potential for consumer-oriented policy to reduce European and foreign carbon emissions'. *Climate Policy*, pp.1-11.

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:
Uncertainties abound over:

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?

1) Nuclear costs, especially large power stations and potentially larger role for SMRs that could be subject to a lower-rate version of Moore's law
2) CCS costs which will depend on which route is adopted, all initially worth exploring
3) Electrolysis costs if hydrogen is to play an important role, combined with a major conversion of UK household gas equipment from methane to hydrogen, reversing the 1969 policy.
4) Unanticipated sources contributing to rising electricity demand
5) The widespread adoption of storage technologies as a solution to renewables intermittency
6) The necessary policies to tackle the challenge of building sector decarbonisation

The (un)willingness of governments to make the necessary capital investments to aid with all of the above, paired with the likelihood of an insufficiently low carbon price for the foreseeable future and underfunding of research into key areas. Electric car technology relies on lithium-ion batteries which is expensive and polluting on disposal, but the UK seems to be failing to build on our initial lead in graphene technology to consider carbon nanotubes embedded in Faraday cages as electric storage in new types of vehicle.

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: Obviously-policy simulations that showed how to achieve 80% reductions are irrelevant if 100% is required. See e.g., DF Hendry (2020) `First in, First out: Econometric Modelling of UK Annual CO2 Emissions, 1860—2017', Economics Discussion Paper **2020-W02**, Nuffield College, Oxford. Achieving net zero for air transport, agriculture, construction and waste management looks problematic and entails extraction of CO2, a seriously under-researched topic.

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:

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:

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:

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: Carbon pricing revenues can be recycled strategically to mitigate the outsized distributional consequences on lower- and middle-income households (Klenert *et al*. 2018). Competitiveness concerns may be better addressed through the adoption of border carbon adjustments, with the applicable carbon price levied on relevant imported goods and refunded upon relevant exports. The levy should increase on goods from countries failing to achieve GHG reductions and reduced as GHG reductions are achieved.

However, these remedies do not mean that general budgets for climate mitigation should be cut, since some sectors – residential and commercial buildings especially – very likely require substantial public investment to be consistent with net zero targets.

Klenert, D., Mattauch, L., Combet, E., Edenhofer, O., Hepburn, C., Rafaty, R. and Stern, N., 2018. Making carbon pricing work for citizens. *Nature Climate Change*, *8*(8), pp.669-677.

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:

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:

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:

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:

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

ANSWER:

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:

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:

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

ANSWER:

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:

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:

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:

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:

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

ANSWER: Early retirement of world-wide coal mines, coal plants, and oil and gas fields will be required over the next two decades. This can be expedited through supply-side cancellation or revocation of relevant fossil fuel production permits, paired with compensation to laid-off workers and state investment in replacement green energy infrastructure. The net present value of resultant savings from avoided air pollution and health-related damages can exceed the costs of compensating laid-off fossil fuel workers for early supply-side closures by two orders of magnitude, as studies on the German coal phase-out have shown (Rafaty et al. 2020). Similar interventions to expedite early closure of upstream oil and gas operations may be justified with reference to evidence from natural capital accounting that quantifies the third-party costs of fossil fuel production. State-led efforts in this domain may be cost-effective relative to the near-term mitigation delays and supply-side policy loopholes generated by the present focus on (demand-side) carbon pricing.

Rafaty, R., Srivastav, S., Hoops, B. (2020, forthcoming). Revoking Coal Mining Permits: An Economic and Legal Analysis. *Climate Policy*.

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:

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:

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:

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:

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: A return to intelligently designed feed-in tariffs (expanded to included storage technologies), paired perhaps with capital grants covering part of the cost of new high-capacity installations (e.g. offshore wind in the North Sea) and associated transmission & distribution infrastructure, could expedite power sector decarbonisation greatly. To help contain costs, the tariff rates should be linked to the installation costs for each energy source as well as the 'locational value' of each installation. On the importance of ensuring that policy measures adequately account for the locational value of heterogeneous renewable energy sources, and the resultant improvements to system flexibility, see a recent report
- http://www.ieee.org/ns/periodicals/PES/Articles/PE_MarApr2019_Burger.pdf - and its media coverage https://www.greentechmedia.com/articles/read/distributed-energy-value-properly. Also see our answer to Q6.

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:

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:

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:

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:

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:

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:

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:

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:

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: