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: There is significant evidence of the health co-benefits of significantly more energy efficient buildings and dwellings so that thermal comfort (and less damp/mould) is achieved with lower energy inputs – see below and (Telfar-Barnard et al. 2019; Chapman et al. 2009; Chisholm et al. 2019). However construction methods must ensure that air tight buildings (to reduce heat loss) are properly ventilated (to prevent the recurrence of damp and other low air quality issues) (De Groot and Leardini 2010; Schieweck et al. 2018). Changes to the building code to mandate standards such as PASSIV/E should be a priority in this regard and this may also address the emerging issue of summer over-heating in retrofitted insulated buildings (Mylona and Davies 2015).

• Radically improving the energy efficiency of the building stock will also mean a substantial reduction in the energy required for heating/cooling, especially in morning an winter peak periods when the demand for electric/heat pump heating will be greatest (Love et al. 2017; Anderson, Rushby, and Jack 2018). This in turn will mean LV distribution networks may avoid peak period re-inforcement costs (see below) and also reduce the costs of integrating large scale renewables into the grid (which, apart from pumped hydro, are not dispatchable during peak demand periods).

• Similarly a switch in the light vehicle fleet to EV or hydrogen is likely to have a significant positive health co-benefit with respect to air quality in urban areas and the need for other active transport modes (Chapman et al. 2018; Dirks, Salmond, and Talbot 2018; Barnes, Chatterton, and Longhurst 2019).

C. Delivering carbon budgets

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

ANSWER: n/a

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

ANSWER: n/a

Question 11: Can impacts on competitiveness, the fiscal balance, fuel poverty and security of supply be managed regardless of the level of a budget, depending on how policy is designed and funded? What are the critical elements of policy design (including funding and delivery) which can help to manage these impacts?

ANSWER: n/a

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

ANSWER: 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: a) It is well known that per capita energy consumption scales (non-linearly) with the occupancy level of dwellings (Longhi 2015; Huebner et al. 2016). Put simply, single-person households use proportionately more energy due to the 'shared' nature of space heating as well as (in many cases) cooking, lighting, laundry, entertainment etc. Politically unpalatable though it may seem, one potentially fast-acting solution would be incentivise increased household occupancy (co-living) through housing provision, sub-letting tax allowances, social care, planning and any other policy mechanisms to reverse the current trend towards increased solo living (ONS: Families and household in the UK:2019). A similar argument is well known in the spatial economics literature with respect to the trend towards (and normative projection of) suburban development comprising low density large footprint housing (Lee and Lee 2014).

b) It is unclear exactly what 'a behaviour-led transition' refers to in this context but with respect to the household/consumer sector there is evidence that voluntary behaviour change incentivisation and/or information provision has relatively limited effects (Abrahamse et al. 2005; Shove 2010; Barr 2006). Further:

1. Residential space heating: it seems unlikely that behaviour change could produce substantial decarbonisation without triggering substantial and costly (in terms of both additional emitted GHG and £) health consequences (Huebner et al. 2015; 2018). Considerable work in New Zealand, which has a relatively poor housing stock in a broadly similar climate suggests that the optimum route is through reduced energy input enabling increased energy services (heat/cool) through substantial upgrades to the energy efficiency of the building stock (Chapman et al. 2009; Telfar-Barnard et al. 2019) rather than via behaviour change and this is confirmed by UK research (Huebner et al. 2018; Adan and Fuerst 2016).

2. Residential cooling: The prospects for cooling may be more amenable to behaviour change although the risks of over-heating as a consequence of increased insulation to reduce winter energy inputs is an emerging concern in temperate climates (Lomas and Porritt 2017). There is evidence suggesting reductions in energy demand at 'peak cool' can be achieved through changes to household practices (de Vet and Head 2019; Moore et al. 2016; Sherriff et al. 2019), including reconfiguration of what is considered 'normal' in terms of thermal comfort, clothing and air flow (see also Japan's Cool Biz programme - http://www.demand.ac.uk/wpcontent/uploads/2018/04/demand-insight-17-V3.pdf). However where deep retrofits have installed insulation and HVAC, 'normal' UK practices of window-opening and curtain/blind opening need to be reversed for best effect.

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:
ii. Current research suggests that the amount of residential demand side flexibility that can be realised depends on the time of day (to some extent) season and the energy using practices of the households. It's value to the system therefore depends on the value of the degree of flexibility available at a given time. Empirical research suggests that we can expect to realise at most 5-15% residential electricity demand flexibility during evening peak periods where behaviour-only interventions are used and that there is substantial variation between households and across studies (Frederiks,
Stenner, and Hobman 2015; Srivastava, Van Passel, and Laes 2018).

Recent reviews have shown that there is also large variation (0% - 30%) between studies aimed at reducing energy demand over time (sustained rather than flexibility) even where similar interventions are tested (Abrahamse et al. 2005; Andor and Fels 2018; Nicolson and Moon 2019).

We should expect the lower end of these ranges on a population-wide basis as many of the studies contributing to this evidence base are biased self-selecting samples of consumers who are more likely to respond to incentives (Anderson et al. 2020; Frederiks et al. 2016; Srivastava, Van Passel, and Laes 2018). We know that consumers are particularly price insensitive in this period although there are indications that this varies by social group (White and Sintov 2019). As far as we are aware there has not been a systematic review of the evidence for residential demand side flexibility at different times of day and seasons and we recommend that a rapid evidence review on this topic should be commissioned.

Finally, we should not expect consumers to make 'rational' choices about responding to price incentives to reduce or shift electricity demand (Nicolson and Moon 2019). We should also not presume consumers can (or will) make choices about appropriate tariffs. Recent work has shown that even when provided with full information in a task that required no greater then primary school level maths, only 44% of a representative sample of GB bill payers selected the 'best' ToU tariff for a presented consumption pattern (Moira Nicolson 2018 Table 13). Crucially, 'lower' social grades did even worse (39%). This raises serious questions about the 'energy justice' consequences of relying on price incentives to flex demand as Ofgem's recent working paper notes at some length (Ofgem 2019).

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: 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: With respect to residential space heating, the effect of heat pumps on the temporal profile of residential electricity demand is not well researched. It is assumed that there will be overall decreases in energy input for similar energy services (heat/cool) due to appliance efficiencies. However recent simulation of temporal loads (Eggimann, Hall, and Eyre 2019) based on analysis of observed demand patterns in the UK (Love et al. 2017) shows that substantially increased (up to 200%) local peak load may ensue (see also (Anderson, Rushby, and Jack 2018) for a comparative UK and New Zealand view with similar insights). This is likely to require either the decoupling of energy input from the timing of the energy service (shifting e.g. via thermal stores) and/or the integration of other forms of storage (e.g. V2G or local batteries) and/or network re-enforcement to prevent failure of at-capacity (or constrained) local distribution networks. It seems clear therefore that the investment required will depend on the temporal usage patterns of the energy consumers in that area together with the socio-technical infrastructure in place. To some extent it will also depend on the low-emissions infrastructure vision of those energy users (Stephenson et al. 2015; Artelle et al. 2018).

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