Committee on Climate Change

Independent advice to government on building a low-carbon economy and preparing for climate change

Building a zero-carbon economy – Call for Evidence

Background

On 15 October 2018 the governments of the UK, Scotland and Wales asked the Committee on Climate Change (CCC) to provide advice on the UK and Devolved Administrations' long-term targets for greenhouse gas emissions and the UK's transition to a net zero-carbon economy. Specifically: when the UK should reach net zero emissions of carbon dioxide and/or greenhouse gases as a contribution to global ambition under the Paris Agreement; if that target should be set now; the implications for emissions in 2050; how such reductions can be achieved; and the costs and benefits involved in comparison to existing targets.

The advice has been requested by the end of March 2019.

The UK's long-term emissions target is currently for at least an 80% reduction in greenhouse gas emissions from 1990 to 2050. It covers all sectors, including international aviation and shipping and is measured on a 'territorial' basis (i.e. based on emissions arising in the UK). On a comparable basis, emissions in 2017 were estimated to be 38% below 1990 levels.

The current target was set in 2008 based on advice from the Committee. That advice considered that to avoid the worst impacts of climate change, the central expectation of global temperature rise should be limited "to, or close to, 2°C", while the probability of crossing "the extreme danger threshold of 4°C" should be reduced to an extremely low level. That meant global emissions would roughly have to halve by 2050. The 2008 advice made the assumption that the UK should not plan to have a higher level of per capita emissions in 2050 than the global average.

The long-term target guides the setting of carbon budgets (sequential five-year caps on emissions that currently extend to 2032 and require a reduction in emissions of 57% from 1990 to 2030). 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).

Any change to the long-term targets would therefore be expected to have significant implications, not just in the long-term but on current policies to drive the transition.

The CCC will advise based on a thorough consideration of the relevant evidence. We expect that to cover:

- The latest climate science, including as contained in the IPCC Special Report on 1.5°C.
- The terms of the Paris Agreement.
- Global pathways (including those reported by the IPCC) consistent with limiting global average temperature rise in line with the goals of the Paris Agreement.

- International circumstances, including existing plans and commitments to cut emissions in other countries, actions to deliver on those plans and opportunities for going further.
- An updated assessment of the current and potential options for deep emissions reductions in the UK and emissions removals from the atmosphere, including options for going beyond the current 80% target towards net zero.
- An appraisal of the costs, risks and opportunities from setting a tighter long-term target.
- The actions needed in the near term that would be consistent with achieving the long-term targets.

This Call for Evidence will contribute to that advice.

Responding to the Call for Evidence
We encourage responses that are brief and to the point (i.e. a maximum of 400 words per question, plus links to supporting evidence, answering only those questions where you have particular expertise), and may follow up for more detail where appropriate.

You do not need to answer all the questions, please answer only those questions where you have specific expertise and evidence to share. It would be useful if you could use the question and response form below and then e-mail your response to: communications@theccc.gsi.gov.uk using the subject line: 'Zero carbon economy – Call for evidence'. Alternatively, you can complete the question and answer form on the CCC website, available here.

If you would prefer to post your response, please send it to:

The Committee on Climate Change – Call for Evidence
7 Holbein Place
London
SW1W 8NR

The deadline for responses is 12 noon on Friday 7 December 2018.

Confidentiality and data protection
Responses will be published on our website after the response deadline, along with a list of names or organisations that responded to the Call for Evidence.

If you want information that you provide to be treated as confidential (and not automatically published) please say so clearly in writing when you send your response to the consultation. It would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information we will take full account of your explanation, but we cannot give an assurance that confidentiality can be maintained in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded by us as a confidentiality request.

All information provided in response to this consultation, including personal information, may be subject to publication or disclosure in accordance with the access to information legislation (primarily the Freedom of Information Act 2000, the Data Protection Act 1998 and the Environmental Information Regulations 2004).

Question and response 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 response to a maximum of 400 words per question.

Part 1: Climate Science

Question 1 (Climate Science): The IPCC's Fifth Assessment Report and the Special Report on 1.5°C will form an important part of the Committee's assessment of climate risks and global emissions pathways consistent with climate objectives. What further evidence should the Committee consider in this area?
ANSWER:

Question 2 (CO_2 and GHGs): Carbon dioxide and other greenhouse gas gases have different effects and lifetimes in the atmosphere, which may become more important as emissions approach net-zero. In setting a net-zero target, how should the different gases be treated?
ANSWER:

Part 2: International Action

Question 3 (Effort share): What evidence should be considered in assessing the UK's appropriate contribution to global temperature goals? Within this, how should this contribution reflect the UK's broader carbon footprint (i.e. 'consumption' emissions accounting, including emissions embodied in imports to the UK) alongside 'territorial' emissions arising in the UK?
ANSWER:

Question 4 (International collaboration): Beyond setting and meeting its own targets, how can the UK best support efforts to cut emissions elsewhere in the world through international collaboration (e.g. emissions trading schemes and other initiatives with partner countries, technology transfer, capacity building, climate finance)? What efforts are effective currently?
ANSWER:

Question 5 (Carbon credits): Is an effective global market in carbon credits likely to develop that can support action in developing countries? Subject to these developments, should credit purchase be required/expected/allowed in the UK's long-term targets?
ANSWER:

Part 3: Reducing emissions

Question 6 (Hard-to-reduce sectors): Previous CCC analysis has identified aviation, agriculture and industry as sectors where it will be particularly hard to reduce emissions to close to zero, potentially alongside some hard-to-treat buildings. Through both low-carbon technologies and behaviour change, how can emissions be reduced to close to zero in these sectors? What risks are there that broader technological developments or social trends act to increase emissions that are hard to eliminate?

ANSWER: Decarbonisation of energy intensive industries (EIIs) can be partially achieved by switching to renewable fuel sources, and by investing in energy efficiency. However, for industries which produce CO_2 as part of their manufacturing process, such as cement, steel and chemicals, CCS is the only available way to remove these emissions. The BEIS Industrial Decarbonisation action plans published in 2017 concluded that CCS could provide up to 37% of total emissions reduction across eight energy intensive sectors[1]. Europe's Energy Intensive Industries recently highlighted CCS as one of six key solutions for meeting a net-zero target. CO_2 capture for industry can cost between €22-164/tCO_2 depending of the purity of the CO_2 stream. For processes such as ammonia production where CO_2 is a by-product, capture can be very cheap. Where CO_2 is in flue gas at low concentrations, the capture process can be much more expensive.

Innovation is taking place today to begin to address industrial emissions; Tata's new HIsarna technology can reduce emissions from the smelting process by 20%; this rises to 80% when coupled with carbon capture[2]. The LEILAC project being developed by European cement companies uses technology which re-engineers existing processes to allow direct separation of CO_2 from other flue gases, reducing significantly the cost of capture[3].

In addition to direct capture of industrial process emissions, switching hydrocarbon feedstocks with low-carbon hydrogen has the potential to significantly reduce industrial emissions. As the Committee on Climate Change pointed out in its recent report on hydrogen, existing projects capturing CO_2 from the hydrogen production process result in 60-85% CO_2 savings. This is because the emissions from the exhaust of the Steam Methane Reformer are not captured. However, Autothermal Reforming of methane can reach around 95% capture as it removes the need for an SMR.

Both CCS and low-carbon hydrogen can be deployed in industrial "clusters" to enable multiple industrial plants to benefit from economies of scale. The Energy Systems Catapult

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/651230/chemicals-decarbonisation-action-plan.pdf
[2] https://www.tatasteeleurope.com/en/news/news/2017/breakthrough-steelmaking-technology-to-dramatically-reduce-CO2-emissions-enters-final-testing
[3] https://www.project-leilac.eu/the-core-technology

Question 6 (Hard-to-reduce sectors): Previous CCC analysis has identified aviation, agriculture and industry as sectors where it will be particularly hard to reduce emissions to close to zero, potentially alongside some hard-to-treat buildings. Through both low-carbon technologies and behaviour change, how can emissions be reduced to close to zero in these sectors? What risks are there that broader technological developments or social trends act to increase emissions that are hard to eliminate?

recently concluded that CCS power generation can form part of the lowest cost pathway to power sector decarbonisation[4]. Power generation with CCS could also enable the development of clusters by providing a large source of captured CO_2 whilst generating valuable clean firm power.

Continued targeted funding for innovation, plus an incentive for industrial CO_2 capture will be vital for technologies such as these to be deployed at scale.

Question 7 (Greenhouse gas removals): Not all sources of emissions can be reduced to zero. How far can greenhouse gas removal from the atmosphere, in the UK or internationally, be used to offset any remaining emissions, both prior to 2050 and beyond?

ANSWER: GHG removal will be essential to meeting net-zero due to the need to offset difficult or very expensive to abate emissions. As recent evidence demonstrates, the extent to which negative emission are needed is highly dependent on the ability to remove emissions from sectors such as aviation and agriculture which require not just technical but behavioural shifts. In the IPCC's P1 scenario GHG removal can be achieved globally through "natural" solutions (reforestation and afforestation) alone - but this requires a tremendous change globally in diet, population and energy use. The remaining pathways rely on bioenergy with CCS (BECCS) to achieve negative emissions[5].

In a recent report assessing the UK's ability to meet net-zero by 2050, WWF and Vivid Economics highlights the need for BECCS and also recommends urgent scale-up of research into Direct Air Capture (DAC) as a top priority for the UK, given that availability of biomass across the global economy is subject to sustainability constraints[6]. DAC is currently in early pilot stage of development.

The Committee on Climate Change's recent work demonstrates that as far as possible, use of biomass should be focused on construction and BECCS to achieve maximum emissions reduction. BECCS can encompass power generation, fuel and hydrogen production from biomass. The amount of BECCS that is feasible is dependent on availability of sustainable biomass, and is estimated to be in the range of 65 MtCO2e/yr[7].

[4] Add reference when available next week
[5] http://www.ipcc.ch/report/sr15/
[66] https://www.wwf.org.uk/sites/default/files/2018-11/NetZeroReportART.pdf
[7] https://www.theccc.org.uk/wp-content/uploads/2018/11/Biomass-in-a-low-carbon-economy-CCC-2018.pdf

Question 7 (Greenhouse gas removals): Not all sources of emissions can be reduced to zero. How far can greenhouse gas removal from the atmosphere, in the UK or internationally, be used to offset any remaining emissions, both prior to 2050 and beyond?

CO_2 captured via CCUS processes can be utilised in a variety of applications, including being combined with Hydrogen to create synthetic fuels. When this CO_2 has been captured by negative emissions technology such as BECCS or DACCS, this could produce a low carbon or carbon neutral fuel which can be used to decarbonise sectors such as aviation.

Targeted support will be needed to incentivise BECCS and DAC in different sectors of the economy. Government is currently undergoing a review as to how Greenhouse Gas Removal (GGR) may be incentivised[8] however, there is currently a lack of strategy on deployment of GGRs, including timing for implementation if they are to be used at scale by 2050. Implementing BECCS at scale will require a significant lead time but can be paired alongside CCUS infrastructure development. In order for an investment decision to be made and to meet the governments aims of having CCUS infrastructure in place by the 2030's early decisions on CCUS infrastructure are already time critical.

In order to enable the deployment of Greenhouse Gas Removal technologies such as BECCS some consideration as to how negative emissions will be rewarded needs to be made. At present there is no mechanism or incentive to reduce emissions past zero, and therefore GGRs (which have been shown to be vital to meet climate targets) cannot and will not be deployed at scale.

Question 8 (Technology and Innovation): How will global deployment of low-carbon technologies drive innovation and cost reduction? Could a tighter long-term emissions target for the UK, supported by targeted innovation policies, drive significantly increased innovation in technologies to reduce or remove emissions?

ANSWER: Commercial-scale deployment of low-carbon technologies is critical to reducing costs. As CCS requires development of transport and storage infrastructure, it is not something which can be "bought in" as with more modular technologies and therefore, waiting for CCS to be developed elsewhere will not drive cost reduction in the UK. However, there is a rationale for incentivising innovation in capture technologies in the UK which have potential for export. Developing CCS in the UK as rapidly as possible will allow maximum potential to develop solutions which can help other countries to decarbonise.

In the Clean Growth Strategy the Government committed £100m to innovation in CCUS technologies, some of which has been allocated to various competitions for CCU, CCS and hydrogen production. This is incredibly welcome but needs to be accompanied by an ambitious, commercial scale deployment programme if these solutions are to have a

[8] https://www.gov.uk/government/publications/clean-growth-strategy

Question 8 (Technology and Innovation): How will global deployment of low-carbon technologies drive innovation and cost reduction? Could a tighter long-term emissions target for the UK, supported by targeted innovation policies, drive significantly increased innovation in technologies to reduce or remove emissions?

practical application in the timeframe within which the UK will be required to meet a net-zero emissions target.

Setting clear expectations through tighter long-term emissions targets could drive behaviour change, provided the right support mechanisms are in place. The decision to phase out coal is an example of where clear policy has driven behaviour change- this required a high-level ambition (phase out by 2025), a market mechanism (Carbon Price Floor) and a targeted set of policy instruments (CfDs and Capacity Market). Similarly clear signals are needed to drive investment of low carbon technologies including CCS and GGR.

Question 9 (Behaviour change): How far can people's behaviours and decisions change over time in a way that will reduce emissions, within a supportive policy environment and sustained global effort to tackle climate change?

ANSWER:

Question 10 (Policy): Including the role for government policy, how can the required changes be delivered to meet a net-zero target (or tightened 2050 targets) in the UK?

ANSWER:
CCS is unique in its ability to provide a decarbonisation solution across power, heat and transport (via low-carbon hydrogen production), industry and Greenhouse Gas Removal. As the CCUS Cost Challenge Taskforce demonstrated, to meet the Committee on Climate Change's estimate of up to 180MTCO_2 being stored per year by 2050 would require a rapid ramp-up in deployment from 2035[9]. This is reliant on a sensible industrial deployment strategy to build an industry and supply chain capable of rapid scale-up. This will require clear and consistent policy signals and sustained engagement from government and industry over the next two decades. The delivery of projects in the 2020s is critical to CCS remaining an option for the UK to meet its climate change targets.

Furthermore, the investment mechanisms for development of CO_2 transport and storage infrastructure, industrial capture, CCS projects in the power sector and Greenhouse Gas Removal will need to be decided upon in 2019 to enable investors to take decisions in the early 2020s. A cross-government review of investment mechanisms is currently underway; there must be no delay to public consultation on these mechanisms by Q1-2 2019.

[9] https://www.gov.uk/government/publications/delivering-clean-growth-ccus-cost-challenge-taskforce-report

Question 10 (Policy): Including the role for government policy, how can the required changes be delivered to meet a net-zero target (or tightened 2050 targets) in the UK?

Designated funding is needed immediately to enable CCS cluster design and FEED studies for projects. The Industrial Strategy Challenge Fund is a potential source of such funding. The CCSA estimates that this would amount to £7-12m per CCUS cluster for pre-FEED and £50m for FEED.

In order to ensure effective coordination between clusters and between the different elements of the CCS chain (multiple capture projects and T&S) a CCS delivery or oversight body should be set up. This was a key recommendation of both the Parliamentary Advisory Group on CCS and the more recent CCUS Cost Challenge Taskforce.

Finally, there is a near-term opportunity to bring down cost and delivery time of CCUS projects by repurposing existing assets, such as pipelines, establishing base infrastructure. However these assets are at risk of infrastructure decommissioning decisions. The CCUS Cost Challenge Taskforce recommended that industry and government move quickly to identify oil and gas infrastructure at risk of being decommissioned in the next 5-10 years which could be retained as “strategic assets” for CCS use.

Part 4: Costs, risks and opportunities

Question 11 (Costs, risks and opportunities): How would the costs, risks and economic opportunities associated with cutting emissions change should tighter UK targets be set, especially where these are set at the limits of known technological achievability?

ANSWER:

Question 12 (Avoided climate costs): What evidence is there of differences in climate impacts in the UK from holding the increase in global average temperature to well below 2°C or to 1.5°C?

ANSWER:

Part 5: Devolved Administrations

Question 13 (Devolved Administrations): What differences in circumstances between England, Wales, Scotland and Northern Ireland should be reflected in the Committee’s advice on long-term targets for the Devolved Administrations?

ANSWER:

Part 6: CCC Work Plan

Question 14 (Work plan): The areas of evidence the Committee intend to cover are included in the 'Background' section. Are there any other important aspects that should be covered in the Committee's work plan?
ANSWER: