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?

2017 saw the production cost of renewables fall below that of fossil fuels for the first time[1]. Energy storage costs have also dramatically fallen in that time. Together, increasing global deployment of renewable generation and storage technologies is highlighting the potential to create energy systems which are net-zero carbon[2]. Recent research from BNEF gives specific consideration to the UK's energy mix, and adds to the technical literature demonstrating that a-near 100% renewable energy system is both technically feasible and economically viable[3]. As such, the CCC should aim to advise Government on transitioning to a net-zero carbon energy system. In the UK, this will likely consist of high renewables penetration with some residual fossil-fuelled generation paired with CCUS technology, at least initially (and assuming that the cost-effectiveness of CCUS over renewables is demonstrated). To this end, the CCC should develop a clear target for going net-zero carbon across the entire UK energy system.

Although fossil-fuel-CCS is generally considered to have an ongoing *transitional* role, we emphasise here that this role (as acknowledged by the Government in its *Clean Growth Strategy*[4], and by the CCC's 2018 *Progress Report*[5]) depends on the technology's ability to demonstrate its cost effectiveness against competing technologies in delivering net-zero carbon electricity alongside the ability to meet peak seasonal demands. Thus, attention must also be given to ensuring that there is a level playing field for competing

[1] Forbes (2018) Production Cost Of Renewable Energy Now 'Lower' Than Fossil Fuels https://www.forbes.com/sites/gauravsharma/2018/04/24/production-cost-of-renewable-energy-now-lower-than-fossil-fuels/#2f3d07ca379c

[2] ETC (2018) *Mission Possible* http://www.energy-transitions.org/sites/default/files/ETC_MissionPossible_FullReport.pdf

[3] BNEF (2018) *Flexibility Solutions for High Renewable Energy Systems* https://about.bnef.com/blog/flexibility-solutions-high-renewable-energy-systems/

see also LUT (2018) Can we get 100% of our energy from renewable sources? https://www.lut.fi/web/en/news/-/asset_publisher/lGh4SAywhcPu/content/can-we-get-100-of-our-energy-from-renewable-sources-new-article-gathers-the-evidence-to-address-the-sceptics and Brown (2018) Response to 'Burden of proof: A comprehensive review of the feasibility of 100% renewable-electricity systems' *Renewable and Sustainable Energy Reviews* 92, 834 – 847.

[4] *Clean Growth Strategy* (2017) pg.53; 69; in particular CCUS deployment is 'subject to costs coming down sufficiently' (pg.71) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf

[5] CCC (2018) *Reducing UK emissions – 2018 Progress Report to Parliament,* pg. 45 https://www.theccc.org.uk/wp-content/uploads/2018/06/CCC-2018-Progress-Report-to-Parliament.pdf

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?

technologies, and that, ultimately, the priority is reaching net-zero carbon emissions across our energy system with the utmost urgency and at the lowest possible cost[6].

As well as the IPCC's work, the CCC should take into account recent reports from the ETI[7], IEA[8] and the CCC[9] itself. These emphasise the crucial role that sustainable bioenergy has in contributing to the UK's legally-binding carbon targets. Specifically, both the ETI and CCC argue that sustainably grown biomass has the potential to become a critical resource for the UK's energy system, given the myriad possibilities for combustion (biomass power/heat), conversion to low-carbon gases (anaerobic digestion), conversion to liquid fuels (transport) and Energy from Waste (EfW). The ETI and CCC also highlight the potential value of Carbon Capture Usage and Storage (CCUS) in abating emissions, particularly those from industrial processes.

Elsewhere, consideration is offered to Bioenergy with CCS (BECCS), due to its ability to deliver 'net negative' emissions. Namely, the ETI estimate that by 2050 the annual abatement costs would be roughly 50% higher without bioenergy, or 100% higher without CCS. Thus, without either of these solutions, achieving 2050 targets would likely be impossible, requiring prohibitively expensive carbon prices that risk pushing industry offshore. Instead, negative emissions from BECCS allow the 2050 target to be met as part of a cost-effective pathway whilst also complementing technologies such as large-scale hydrogen via gasification with CCS.

Also of particular value, is the IEA's *Renewables 2018* report which details development pathways for renewable and clean technologies. This source suggests that bioenergy, which accounted for half of all renewable energy consumption in 2017, will lead growth in renewables over the next 5 years to 2023. Within this, the IEA project ~15% growth in biofuels, working to decarbonise difficult-to-treat areas of transport such as aviation and shipping; and EfW, particularly through the use of agricultural residues.

By using the IPCC's AR & SR1.5 alongside market- and technology-centric materials such as the IEA and ETI reports, the CCC will equip themselves with the necessary information to set realisable goals in relation to UK-based emission pathways.

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?

[6] For an example of a competing, non-CCUS pathway, see *Clean Growth Strategy* (2017) pg.56 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf

[7] ETI: Options, Choices, Actions (2018) https://d2umxnkyjne36n.cloudfront.net/insightReports/Options-Choices-Actions-Updated-Low-Res.pdf?mtime=20181003113219

[8] IEA: Renewables (2018) https://www.iea.org/renewables2018/

[9] CCC: Biomass in a low-carbon economy (2018) https://www.theccc.org.uk/wp-content/uploads/2018/11/Biomass-in-a-low-carbon-economy-CCC-2018.pdf

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?

Although it is difficult to determine the precise residence time of CO_2, it is estimated by the IPCC to persist for around 500 years[10]. As such, the need to immediately and dramatically reduce CO_2 emissions is a well-founded target of our global response to climate change – a response in which the UK will play a crucial part. Last month, the ESC released a report arguing that delaying commercial scale deployment of CCUS increases risk and the costs of a UK energy transition to a low carbon economy[11]. The new electricity system analysis underpinning this modelling indicates that the UK will likely need low carbon baseload generation to meet our energy demands. Therefore, it is imperative that the CO_2 from these sources is captured through the deployment of CCUS technology. In addition, rates of national CO_2 emissions reduction can be expedited through the deployment of BECCS (see Question 1.1).

Whilst CH_4 has a much shorter residence time (around 8 years), it has 28 times the global warming potential (GWP) of CO_2[12]. Some of the most significant contributors to atmospheric CH_4 in the UK are that released agriculture, landfill waste sites and that lost to gas network leakage. Possible solutions include:

- Anaerobic Digestion (AD), which serves to reduce atmospheric CH_4 by utilising methanogenic slurries and wastes in order to create renewable biogas.
- Investment in and deployment of EfW, which creates energy from waste otherwise sent to landfill (where its degradation produces potent atmospheric CH_4)
- Capture and use of landfill gas
- Investment in and deployment of H_2 production[13] (e.g. biomass gasification)
- Investment in non-methane renewable gases
- Investment in renewable gas alternatives such as Bio-SNG and Bio-LPG

Consideration should also be given to fluorinated (F-) gases, which have a global warming potential 23,000 times greater than that of CO_2[14]. F-gases are used in several areas of industry, including as an insulating gas in high voltage switchgear (in particular, SF_6, Sulphur Hexafluoride). Appropriate management of electrical systems and grid networks can dramatically reduce volumes of fugitive F-gases and research into viable, low-/non-GWP alternatives should also be considered by Government.

Part 2: International Action

[10] IPCC 4th AR Working Group I: The Physical Science Basis http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10.html

[11] Specifically, the ESC warns that carbon abatement costs could double by before 2050. See: ETI: CCUS (2018) https://www.eti.co.uk/news/delaying-commercial-scale-deployment-of-ccus-increases-risk-and-the-costs-of-a-uk-energy-transition-to-low-carbon

[12] GHG Protocol: Global Warming Potential Values https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf

[13] CCC (2018) *Hydrogen in a low-carbon economy* https://www.theccc.org.uk/wp-content/uploads/2018/11/Hydrogen-in-a-low-carbon-economy.pdf

[14] European Commission (2018) Fluorinated Greenhouse Gases https://ec.europa.eu/clima/policies/f-gas_en

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?

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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?

- Support for EU ETS/strong carbon price. A strong carbon price not only boosts the market viability of renewable energy generation against cheaper, fossil-fuelled generation, but also sends a clear signal in the UK and beyond as to the value of renewable energy. This is confirmed in recent analysis, which estimated that the UK Carbon Price Support policy alone resulted in a 73% reduction of coal generation between 2012 and 2016[15]. Another recent report assessed the future of carbon pricing in the UK and suggests a steadily rising, economy-wide carbon tax formed independently of the EU ETS in 2021[16].They also advocate border carbon adjustments which would encourage significant carbon reductions abroad by ensuring that companies which export carbon-intensive products into the UK are also subject to carbon taxation equivalent to domestic industries. This answers both areas of Question 4, indicating the proven efficacy of a strong carbon price and arguing for its 'ratcheting' in order to drive both domestic and international carbon reductions.
- Developing the UK's CO_2 storage facilities/assets (the UK has available geological storage equivalent to the other EU 27 countries combined, in the order of 70 billion tonnes). Therefore, it has the opportunity to import CO_2 and provide a storage service to other countries that do not have access to storage.

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?

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Part 3: Reducing emissions

[15] Aurora (2017) The Carbon Price Thaw: Post-freeze future of the GB carbon price https://www.auroraer.com/wp-content/uploads/2017/10/GM-CPS-final_publication_Nonsubscribers.pdf

[16] Policy Exchange (2018) The Future of Carbon Pricing: Implementing an independent carbon tax with dividends in the UK https://policyexchange.org.uk/publication/the-future-of-carbon-pricing-implementing-an-independent-carbon-tax-with-dividends-in-the-uk/

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?

Aviation is the most challenging area of transport to decarbonise. However, there are others which present very significant obstacles, for example marine and haulage, where electrification is too distant an option and therefore, interim measures may be required. Biofuels and renewable fuels of non-biological origin (RFNBOs) present the most likely long-term solution for aviation, although there are aspirations to electrify short haul flights e.g. Norway's target to electrify 100% of short-haul flights by 2040[17]. Biofuels and RFNBOs may also prove the optimal solution for heavy haulage and marine. In addition, aviation may be addressed using synthetic fuels, e.g. those produced via combining hydrogen and CO_2 which has been captured by negative emissions technologies. Of course, if electrification is the elected approach, it goes without saying that large scale electrification requires an equivalent increase in the amount of renewable electricity generation.

In agriculture, significant emission reductions can be achieved through:

- The use of agricultural resides in EfW
- The use of agricultural waste as a feedstock for Anaerobic Digestion (AD)
- Use of on-site biofuels (e.g. in agricultural machinery)
- Use of on-site biogas-fuelled CHPs

In industry, significant emission reductions can be achieved through:

- Electrification (in particular, reductions in the cost of zero-carbon electricity[18])
- Biofuels
- On-site AD (e.g. CHPs)
- Biomass power and heat (combined with CCUS to achieve net-negative emissions)

Across these sectors, but for industry and agriculture in particular, access to low cost, zero-carbon electricity is a key enabler for electrification-based decarbonisation. To that end, it is essential that the power sector rises to support cross-sector decarbonisation through driving cost reductions in the deployment and integration of zero-carbon electricity generation and flexibility. The REA therefore supports enabling and strengthening market signals for investing in smart on-site renewable generation (e.g. battery storage, solar or wind generation) alongside smart technologies such as battery storage and demand side response.

To address the later part of this question, risks are evident in, for example, the increased affordability of air travel for the purpose of leisure, which has increased its accessibility and thereby produced an 'uptick' in associated emissions. In the context of the technologies listed above, however, it is expected that a general trend of technological improvements and increasing pressure to decarbonise cross-sector will *reduce* emissions overall.

[17] Guardian (2018) Norway aims for all short-haul flights to be 100% electric by 2040 https://www.theguardian.com/world/2018/jan/18/norway-aims-for-all-short-haul-flights-to-be-100-electric-by-2040

[18] McKinsey & Company (2018) *Decarbonisation of Industrial Sectors: The next frontier* https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Sustainability%20and%20Resource%20Productivity/Our%20Insights/How%20industry%20can%20move%20toward%20a%20low%20carbon%20future/Decarbonization-of-industrial-sectors-The-next-frontier.ashx

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?

Carbon Dioxide Removal (CDR) is essential to meeting our legally binding carbon targets and central to keeping global warming within 1.5C[19,20,21]. CDR methods include the management of land, such as peatland restoration, afforestation and the use of CCS technologies. Beyond sustainable land management (discussed in this recent report from the CCC[22]), examples of CCS deployment include use with bioenergy (delivering negative emissions), or capturing emissions from residual fossil-fuelled sources, e.g. gas. In addition CCUS is likely to be required for the production of hydrogen, as noted by the CCC[23].On the REA's view, pairing fossil-fuel-CCUS is a transitional measure which should only be considered if it delivers a least cost pathway to a net-zero carbon energy system.

Recent literature gives considerable credence to Bioenergy with CCS (BECCS), due to its ability to deliver net negative emissions. Namely, the ETI estimate that by 2050 the annual abatement costs would be roughly 50% higher without bioenergy, or 100% higher without CCS[24]. BECCS is a versatile technology that can be paired across several bioenergy technologies, such as AD, biofuel production (e.g. bio-ethanol), biomass power and biomass heat. At present, there are no effective incentives for capturing CO_2 emissions from either bioenergy or fossil fuel use. Many bioenergy technologies give rise to almost pure streams of CO_2, which could be more cost-effectively captured than CO_2 streams from fossil fuel combustion. Examples include from large scale fermentation, AD and biomethane injection. Indeed, many of the financial incentives for bioenergy generally are falling away, and this should be reversed. Mechanisms should also be considered to reward those providing net-negative, rather than simply net-zero emissions as currently, no such incentives exist. However, emphasis should be on the 'low hanging fruit', such as capturing CO_2 from fossil-fuel sources before turning to technologies such as BECCS. This is because bioenergy currently delivers CO_2 savings relative to fossil fuel combustion.

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?

2017 saw the production cost of renewables fall below that of fossil fuels for the first time[25]. Energy storage costs have also dramatically fallen in that time. Together, increasing global

[19] CCC: Biomass in a low-carbon economy (2018) https://www.theccc.org.uk/wp-content/uploads/2018/11/Biomass-in-a-low-carbon-economy-CCC-2018.pdf

[20] IPCC SR1.5 (2018) http://www.ipcc.ch/report/sr15/

[21] IEA: Renewables (2018) https://www.iea.org/renewables2018/

[22] CCC: Land use: Reducing emissions and preparing for climate change https://www.theccc.org.uk/publication/land-use-reducing-emissions-and-preparing-for-climate-change/

[23] CCC (2018) *Hydrogen in a low-carbon economy* https://www.theccc.org.uk/wp-content/uploads/2018/11/Hydrogen-in-a-low-carbon-economy.pdf

[24] ETI: Options, Choices, Actions (2018) https://d2umxnkyjne36n.cloudfront.net/insightReports/Options-Choices-Actions-Updated-Low-Res.pdf?mtime=20181003113219

[25] Forbes (2018) Production Cost Of Renewable Energy Now 'Lower' Than Fossil Fuels https://www.forbes.com/sites/gauravsharma/2018/04/24/production-cost-of-renewable-energy-now-lower-than-fossil-fuels/#2f3d07ca379c

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?

deployment of renewable generation and storage technologies is highlighting the potential to create energy systems which are net-zero carbon[26]. As such, the CCC should aim to advise Government on transitioning to a net-zero carbon energy system. In the UK, this will likely consist of high renewables penetration with some residual fossil-fuelled generation paired with CCUS technology, at least initially (and assuming that the cost-effectiveness of CCUS over renewables is demonstrated). To this end, the CCC should develop a clear target for going net-zero carbon across the entire UK energy system.

Although fossil-fuel-CCS is generally considered to have an ongoing *transitional* role, we emphasise here that this role (as acknowledged by the Government in its *Clean Growth Strategy*[27], and by the CCC's 2018 *Progress Report*[28]) depends on the technology's ability to demonstrate its cost effectiveness against competing technologies in delivering net-zero carbon electricity alongside the ability to meet peak seasonal demands. Thus, attention must also be given to ensuring that there is a level playing field for competing technologies, and that, ultimately, the priority is reaching net-zero carbon emissions across our energy system with the utmost urgency and at the lowest possible cost[29].

Lessons can again be learned from current research which offers a detailed account of a net-zero global energy system, including battery storage and power-to-gas[30,31]. Closer to home, a recent BNEF report explores possible UK pathways with high levels of renewables penetration, demand-side response and flexible generation technologies[32]. As such, a tight net-zero emissions target for the UK should be clearly set out with high deployment levels of renewables as well as the development of storage and balancing technologies.

For further information, please also see response to Question 1.

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?

[26] ETC (2018) *Mission Possible* http://www.energy-transitions.org/sites/default/files/ETC_MissionPossible_FullReport.pdf

[27] *Clean Growth Strategy* (2017) pg.53; 69; in particular CCUS deployment is 'subject to costs coming down sufficiently' (pg.71) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf

[28] CCC (2018) *Reducing UK emissions – 2018 Progress Report to Parliament,* pg. 45 https://www.theccc.org.uk/wp-content/uploads/2018/06/CCC-2018-Progress-Report-to-Parliament.pdf

[29] For an example of a competing, non-CCUS pathway, see *Clean Growth Strategy* (2017) pg.56 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf

[30] LUT (2017) *Global Energy System Based on 100% Renewable Energy – Power Sector* http://energywatchgroup.org/wp-content/uploads/2017/11/Full-Study-100-Renewable-Energy-Worldwide-Power-Sector.pdf

[31] RMI (2014) *Reinventing Fire* https://rmi.org/insight/reinventing-fire/

[32] BNEF (2018) Flexibility Solutions for High Renewable Energy Systems https://about.bnef.com/blog/flexibility-solutions-high-renewable-energy-systems/

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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?

- Transport is the highest single source of emissions in UK, accounting for 26% of all emissions[33]. This figure continues to increase. One easily-implemented action delivering instant CO_2 reductions would be the introduction of E10, petrol with a 10% bioethanol blend. This should be introduced in the UK as a matter of urgency.
- A clear strategy for the decarbonisation of heat is necessary. As the CCC has stated, the UK's heating will need to be nearly completely decarbonised by 2050 if we are to meet our emission reduction goals[34]. Despite this, there is currently no clarity on how particular technologies will be supported in the future following the closure of the Renewable Heat Incentive (RHI) in 2020.
- Policy clarity is needed on how other areas previously subsidised by Government, such as renewable electricity generation under the Feed-in Tariffs (FiT) scheme can be transitioned to market-based arrangements that work to accelerate the development of a smart, flexible, zero-carbon energy system. The Government's proposals to end FiT export payments without anything to take their place creates serious obstacles to the deployment of renewable energy generation and its supporting technologies. The lack of mechanism to remunerate renewable electricity generators who generate more than they themselves use whilst encouraging those generators to export their excess energy to the grid, means that they will either be giving energy away to the grid for free or for much less than it is worth. This is an unsustainable model. As such, the REA is calling for either the retention of an export tariff or its immediate replacement with an alternate form of market-based mechanism which encourages smart, flexible zero-carbon electricity generation moving forward.
- Flexibility is a key enabler to integrating renewable electricity generation into the grid. The transition to a low-carbon energy system powered by renewables can only happen with energy storage and associated smart technologies such as Demand Side Response (DSR). Government, the ESO and the DNOs must continue to unlock barriers to the sector and increase the speed of regulatory change to enable these, such as through the introduction of new balancing services markets. The 15 remaining points on the BEIS/Ofgem Smart Systems and Flexibility Plan must also be implemented.

Part 4: Costs, risks and opportunities

[33] BEIS (2018) 2016 UK Greenhouse Gas Emissions https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/679334/2016_Final_Emissions_Statistics_one_page_summary.pdf

[34] CCC: UK must act now to secure zero carbon from heat by 2050 https://www.carbonbrief.org/ccc-uk-must-act-now-secure-zero-carbon-heat-2050

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?

The risks of either being under-ambitious when setting targets or in failing to achieve those already set by Government are unequivocally catastrophic. Current assumptions about technological limits must not be a reason to constrain setting ambitious targets to meet the Paris Agreement goals.

The opportunities presented by increasing investment into renewable energy and clean technologies, are manifold. Analysis conducted by the REA indicated that the renewable energy sector directly employed nearly 128,000 in 2016/17[35], highlighting the value of renewables to the UK's economy. This number will only grow if the UK increases investment in renewable technology and ensures that those areas requiring subsidies are appropriately supported, complemented by a strong carbon price.

As stated in Question 4, the UK has available geological storage equivalent to the other EU 27 countries combined, in the order of 70 billion tonnes. As such, it has the opportunity to import CO_2 and provide a storage service to other countries that do not have access to storage. Thus, even relatively recent technologies such as CCS present enormous opportunity for the UK's economy and will greatly enhance its trajectory to net-zero emissions.

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?

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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?

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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?

- There must be a clear and unequivocal government commitment for ambitious action which achieves a net-zero target.
- The REA call on Government to urgently switch their framing of Ultra Low Emission Vehicles (ULEVs) to Zero Emission Vehicles. ULEVs, like plug-in hybrids, are not

[35] REview (2018) pg.11 http://www.nnebooks.co.uk/REA/REA%20REview%202018/index.html#10

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?

consistent with meeting current emission targets, let alone net-zero.

- The Government's *Road to Zero* strategy included a 'Transport Energy Model' showing electrification as the lowest CO_2 form of road transport in all sectors when aligned with a decarbonised power sector. This being said, these conclusions are dependent on a decarbonised power sector and the same findings give competitive performance values for hydrogen-powered vehicles[36]. Electrification is likely to be the enduring solution for many modes of transport, but it will take time to achieve this. In the interim liquid and gaseous biofuels will play an important role. As such, the CCC should consider all available options in terms of renewable transport fuels, including renewable gases such as H_2 and bio-LPG.
- Whilst it is essential that Government expedites EV deployment so as to have no ICE cars left on the road by 2050, hard-to-treat areas such as heavy haulage may require hybrid models.
- The most recent Budget from Government (Autumn 2018) indicated the termination of Enhanced Capital Allowances (ECAs) alongside no new support for renewable power or heat. The provision of renewable subsidies, either directly or through indirect means such as a market mechanism or strong carbon price (see Q4) will be necessary for increasing investor certainty and renewable market growth.
- In the near term, reforms to network charging needs to be designed and implemented in a way that supports the steady deployment of flexible energy resources[37].

[36] *The Road to Zero* (2018) pgs. 118 – 123 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

[37] See Ofgem's recent proposals in its *Targeted Charging Review* (2018) which seek to remove the remaining grid charge benefits for small, embedded generation. https://www.ofgem.gov.uk/publications-and-updates/targeted-charging-review-minded-decision-and-draft-impact-assessment