The Fifth Carbon Budget - Call for Evidence

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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.

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Questions for consideration:

A. Climate Science and International Circumstances

Climate science and international circumstances are important criteria in setting carbon budgets.

- The science indicates the impacts associated with different levels of climate change and the limit on emissions globally if these risks are to be contained.
- International circumstances inform the prospects of future action to reduce emissions globally, potential requirements of the UK to contribute to those actions, and prospects for low-carbon technology development and carbon pricing.
- The EU places obligations on Member States to reduce emissions to contribute to reductions in the bloc as a whole. These imply a minimum level of effort for the UK's carbon budgets.

The Committee intends to draw primarily on the work of the IPCC, as published in the Fifth Assessment Report, in assessing the implications of climate science for the budget advice

The Committee's advice is based on a climate objective to limit central estimates of temperature rise to as close to 2°C as possible, with a very low chance of exceeding 4°C by 2100 (henceforth referred to as "the climate objective"). This is broadly similar to the UNFCCC climate objective, and that of the EU.

In order to achieve this objective, global emissions would have to peak around 2020, before decreasing to roughly half of recent levels by 2050 and falling further thereafter.

The UNFCCC is working toward a global deal consistent with such reductions. Individual parties are submitting pledges for effort beyond 2020, with the details of the agreement to be discussed in Paris late in 2015.

The EU has agreed a package that requires a reduction in emissions of at least 40% on 1990 levels by 2030, on the way to an 80-95% reduction by 2050. The UK Government supported this package, while arguing for an increase to 50% in the context of a global deal.

The US and China have jointly made pledges for the period beyond 2020. The US has pledged a reduction of 26-28% by 2025 versus 2005, requiring a doubling of the rate of carbon reduction compared to 2005-2020 and on a trajectory to economy-wide cuts of the order of 80% by 2050. China has pledged to peak CO_2 emissions around 2030, and to make best efforts to do so earlier.

Question 1 *The IPCC's Fifth Assessment Report will form the basis 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?*

Question 2 *To what extent are the UN talks in Paris likely to have implications for the Committee's advice beyond the pledges and positions announced in advance of the talks?*

Question 3 *Based on the available evidence, does the EU 2030 package reflect the best path to its stated 2050 ambition? How might this package change, specifically its targeted emissions reduction, either before the end of Paris or after Paris?*

Question 4 *How does the UK's legislated 2050 target affect its ability to support international efforts to reduce emissions, including its position in negotiations? Does the level of UK carbon budgets have any additional impact (over-and-above the 2050 target) for the UK in international discussions?*

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B. The cost-effective path to the 2050 target

The carbon budgets need to set a path that is achievable from today without being over-optimistic about what is achievable in later periods to prepare for the 2050 target.

The Committee has previously set out scenarios for 2030 that balance effort before 2030 with potential opportunities from 2030 to 2050. The scenarios aim to include ways of reducing emissions that are likely to be relatively low cost and actions that will develop options that may need to be deployed at scale by 2050.

These scenarios, reviewed in detail in the Committee's report *The Fourth Carbon Budget Review – the cost-effective path to the 2050 target*, include substantial investment in low-carbon power generation, roll-out of low-carbon heat (heat pumps and district heating), development of the markets for ultra-low emissions vehicles and a combination of energy efficiency measures and fuel switching in industrial sectors.

The scenarios also reflect detailed assessments of what is practically deliverable, and the Committee monitors progress towards them as part of its statutory duties. The *2014 Progress Report to Parliament* indicated that current policy would not be enough to meet the fourth carbon budget, but that the 'policy gap' could be closed at affordable cost.

The set of policy options required to close the gap include:

- Strengthening the EU Emissions Trading System.
- Setting a clear objective for Electricity Market Reform (EMR) beyond 2020.
- Focusing on low-cost residential energy efficiency.
- Simplifying policies targeting commercial energy efficiency.
- Tackling financial and non-financial barriers to low-carbon heat.
- Pushing for strong EU targets for new vehicle efficiency in 2030.

The Government has subsequently published various documents, including its formal response, as required under the Climate Change Act, and the National Infrastructure Plan. The Plan includes investments of around £100 billion in low-carbon power generation in the 2020s, in line with the scenarios from the EMR Delivery Plan that reach 100 gCO_2/kWh by 2030. It also has significant investments in offshore oil and gas and in the road network. This includes £15 billion of new spending on roads and around £50 billion on offshore oil and gas.

Question 5 ***In the area(s) of your expertise, what are the opportunities and challenges in reducing emissions to 2032, and at what cost? What may be required by 2032 to prepare for the 2050 target, recognising that this may require that emissions in some areas are reduced close to zero?***

The ETI's analysis of the UK's low carbon transition is based on rigorous whole-system analysis informed by our public and private sector members and our portfolio of technology development and knowledge building projects.

- Our analysis shows that the UK can implement an affordable low carbon transition by 2050, based on developing, commercialising and integrating a basket of low carbon technology options, which are currently largely known but under-developed.

- The incremental (annual) costs of carbon abatement could be 1 to 2% of GDP by 2050, with potential to achieve the lower end of this range within a strategically co-ordinated approach. By 2030 annual costs could be 0.5 to 0.8% of GDP.

- Action in the period to 2032 will be critical in preparing for and beginning the large-scale deployment of key technologies. In the next decade resources should be focused specifically on bringing a basket of the most promising options to genuine deployment readiness in the UK. A portfolio will limit inevitable implementation risks and should include: bioenergy, carbon capture and storage (CCS), new nuclear, offshore wind, gaseous systems, efficiency of vehicles and low carbon heat for buildings (ie heat pumps and District Heating Networks).

- By the early 2030s we will need to have largely decarbonised electricity production and to be rolling out large scale deployment of low carbon heat and transport solutions.

Key opportunities:

- The effective large-scale deployment of CCS and bioenergy are the two most important system-wide opportunities to contain abatement costs. Each can reduce low carbon UK energy system costs by circa 1% of GDP. The ability (or failure) to deploy them has a huge impact on future energy infrastructure requirements, on which key decisions will be needed by the mid 2020s. Other technology options are important but from an energy system perspective are more easily substituted.

- Delivering negative emissions from the 2030s onwards by combining bioenergy and CCS is a hugely valuable opportunity. This could unlock headroom for some continued use of fossil fuels where this makes economic sense, enabling a much broader portfolio of options for future heat and transport systems.

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Key challenges:

- Key infrastructure investment and design decisions will need to be taken by the period of the 5th carbon budget to enable low carbon heat and transport. This depends in turn on achieving clarity by the mid 2020s about our ability to deploy large-scale CCS and bioenergy, along with supporting concepts (e.g. heat networks, use of waste heat, system approaches to energy storage).

- In addition, the characteristics of many key options (e.g. dependence on very large-scale investment, policy support, network characteristics, system integration requirements) make a pure market approach to their development very challenging. The UK will need to develop effective policy instruments to enable and incentivise early deployment, upscaling and cost reduction of valuable options.

- Strategy for delivering the UK's low carbon transition will need to fit with changes in political structures and decision-making, such as a trend towards greater devolution of power to the constituent nations (and regions and cities) of the UK. This will affect the ability to deliver some of the large-scale potential technology options, but could also enable progress in more distributed energy options (some of the associated risks and benefits are explored in ETI's scenario analysis).

Reference:

ETI report: Options, choices, actions (UK scenarios for a low carbon energy system transition)

Question 6 ***What, if any, is the role of consumer, individual or household behaviour in delivering emissions reductions between now and 2032? And, separately, after 2032?***

People are central to the UK reducing its emissions, in particular in the large-scale adoption of very different technologies for consumer comfort and cleanliness (domestic heat and hot water) and mobility (light transport). But historic experience generally suggests that consumer expectations of the quality of their experience will continue to rise.

ETI's work on both low carbon transport and domestic heat options points clearly to the need to develop attractive, consumer propositions which deliver strong consumer value, control and functionality to secure mass market uptake. Consumers will value low carbon technologies far more and adopt them much more readily if they deliver improved services. Only a very small minority of consumers

will be willing to put up with less just to reduce emissions.

While the period to 2032 will require heavy focus on decarbonising large-scale electricity generation, the transition in more consumer-facing components of energy use will also need to be well underway. To meet carbon targets and to enable mass deployment in the 2030s and 2040s it will be vital to have begun the large scale transition of building heating, hot water and light transport systems. This will require large numbers of consumers to be adopting much lower emission cars and home energy solutions. While there may be a role for standards and some degree of mandation, attractive consumer propositions for cars and home energy will also be needed to drive uptake and achieve acceptance. New propositions (e.g. time of use charging) may also have implications for upstream networks.

By 2032 our analysis suggests that we will need to achieve significant uptake of hybrid vehicles and plug-in hybrid electric vehicles (PHEVs). Adoption of both will require significant change in consumers' purchasing decisions and their behaviour in vehicle use and refuelling. These solutions will need to fit with broader social changes in demand for mobility and how people live, work and socialise.

In low carbon heat, the process of replacing gas boiler based domestic heating will need to be well underway by 2032 (effectively 26 million homes need to be converted to low carbon heating over a 25 year period, equating to 1M homes per year, in sharp contrast with current uptake under the Green Deal). The two key technology options appear to be heat pumps and heat networks, which present challenges in terms of consumer disruption and appeal. Solutions will be more desirable or less disruptive if they are designed to align with owners desires to improve their properties. Our work with consumers also shows that households have a range of priorities in how they use heat and hot water in their homes. Technical solutions for buildings will need to appeal to and deliver functionality for a broad range of occupants, as people with very different priorities may occupy a building through its lifetime. Finally solutions will also need to be designed to fit with the needs and behaviour of vulnerable households, ensuring that health outcomes are not compromised, and that low carbon solutions command broad social support.

References:

ETI Report: An affordable transition to sustainable and secure energy for light vehicles in the UK

ETI Insights report: Decarbonising heat for UK homes

Question 7 ***Is there evidence to suggest that actions to further reduce emissions after 2032 are likely to be more or less challenging to achieve than actions in the period up to 2032?***

Much of the action required to reduce emissions before 2032 is 'upstream' in nature, with low direct impact on consumers, and supported by existing policies (in particular the focus on low carbon electricity generation supported by EMR). This makes the challenges of managing deployment relatively more predictable, although clearly major delivery challenges remain, including

- successfully developing momentum to cost-effectively deploy large-scale CCS in power (and industry) by 2030,
- delivering more efficient and lower cost offshore wind capacity, alongside sufficient back up flexibility in the electricity system
- delivering a new generation of large-scale nuclear power plants.

Alongside addressing these challenges in the period to 2032, we will at the same time need to invest in developing, preparing and proving a broader basket of technologies for longer term roll out and/or adoption by consumers at large scale during the 2030s and 40s. Change in the heat and transport sectors will affect consumers more directly, so we will need early demonstration and deployment activity to build confidence, learn lessons and develop attractive propositions. If we fail to prepare options which are genuinely 'deployment-ready' before 2032, progress will become increasingly difficult and expensive, in turn risking UK economic competitiveness, energy security, affordability and broader political support for decarbonisation in the 2030s and 40s.

Two particularly critical action areas to highlight are heat and bioenergy:

- We need to prepare for a mass market transition in home heating by undertaking full scale projects to test and prove concepts, technologies and propositions.
- To maximise the chance that the UK can rely on bioenergy to deliver a major contribution after 2032 we need to establish UK plantings of biomass at scale over the next 10 to 15 years (due to the risks around relying on the sustainability and availability of imported biomass).

Investing in deployment preparedness includes not only technical development, learning cycles and cost reduction from demonstration and early deployment, but also the development and testing of business models, market and regulatory frameworks and consumer propositions. A key challenge for the near term is therefore to put in place resources, incentives and policy support that is capable of stimulating and supporting this preparatory activity, alongside the investment in near

term emissions reduction measures.

After 2032 the rate of roll out and investment needed will accelerate – with a need for continued investment in low carbon power generation capacity, and a broader range of solutions for heat and transport including heat networks, building upgrades and retrofitting, low carbon vehicles and supporting refuelling infrastructures. The challenge at this stage will be to deliver supply chains and market and policy frameworks capable of supporting the scale of physical deployment, financial investment and consumer uptake required. Our ability to do this will be strongly conditioned by preparatory activity in the next 10 to 15 years.

References:

ETI report by Jo Coleman and Andrew Haslett (2015): Targets, technologies, infrastructure and investments – preparing the UK for the energy transition

ETI report: Options, choices, actions (UK scenarios for a low carbon energy system transition)

ETI insights report: Insights into the future UK Bioenergy Sector, gained using the ETI's Bioenergy Value Chain Model (BVCM)

Question 8 ***Are there alternatives for closing the 'policy gap' to the fourth carbon budget that could be more effective? What evidence supports that?***

Much of the policy debate about decarbonisation focuses on finding the most cost-effective ways to cut emissions. Often this results in a strong focus on simplified metrics such as the levelised cost of electricity to guide policy choices. The ETI's energy system analysis demonstrates clearly the shortcomings of simplified metrics and the importance of basing policy and resource allocation decisions on a full analysis of system-wide impact and value. For example, the high system value of CCS is not reflected in its LCOE.

In terms of the specific recommendations for closing the 'policy gap' to the fourth carbon budget, the ETI broadly supports those identified by the CCC in their 2014 progress report. However, there are a small number of key areas where ETI's system analysis highlights a need for additional and stronger policy focus:

Carbon capture and storage: a significantly stronger policy push will be needed to create the momentum and investor confidence required to deliver CCS in the power and industrial sectors at sufficient scale by the period of the 5th Carbon Budget. This includes implementing the commercialisation programme projects, early investment in storage appraisal, awarding further contracts for strategically valuable phase 2

projects before 2020 and creating clearer policy signals to bring forward a robust pipeline of projects. ETI's insights report referenced below and supporting material contains further detail.

Bioenergy: ETI analysis shows the enormous potential value of bioenergy to a cost-effective UK transition, with sustainable domestic biomass forming a major source of primary low carbon energy. By aligning energy, agricultural and land use policies intelligently the UK could stimulate the production of sustainable biomass with benefits for energy security, affordability as well as rural incomes. We recommend a renewed focus on stimulating domestic plantings as well as a comprehensive review of policies and evidence to incentivise sustainable production of biomass for energy.

In addition, given the huge potential value of negative emissions, there is a need for an early review of policies to create long-term visibility and confidence around the rewards for the carbon benefits that these value chains can deliver. Timely policy signals will create confidence and stimulate the necessary innovation and investment to make this a reality.

Heat: ETI's work on low carbon heat for UK homes points to the need for early action to develop a succession of pilot schemes at increasing scales to test the design approach, build evidence and create confidence and capability to deliver integrated local area system solutions. Early pilots will also be critical in learning lessons about how to create attractive consumer propositions and an enabling policy framework.

References:

ETI insights report: Building the UK carbon capture and storage sector by 2030 – scenarios and actions

ETI insights report: Insights into the future UK bioenergy sector, gained using the ETI's bioenergy value chain model

ETI insights report: Decarbonising heat in UK homes

Question 9 ***Are the investments envisaged in the National Infrastructure Plan consistent with meeting legislated carbon budgets and following the cost-effective path to the 2050 target? Would they have wider implications for global emissions and the UK's position in international climate negotiations?***

ETI's analysis suggests that the investments which currently feature in the National Infrastructure are not fully aligned with delivering a cost effective path to the 2050 emissions targets. While the plan features extensive investment in electricity infrastructure, it does not reflect comprehensive strategic thinking about the

infrastructure investments required to facilitate a cost-effective transition to a low carbon economy by 2050. Key omissions include:

- CCS infrastructure – the plan does feature CCS, but given the potential value of CCS to a low carbon transition there is a strong case for investments in pipelines and CO2 storage to feature more prominently within the plan, and there is case too for making explicit use of the UK guarantees scheme to give confidence to early investors in CCS.

- Early investment in heat networks – ETI's analysis points to the importance of heat networks as part of integrated local area solutions to decarbonise domestic heat. Early investments will be needed in full scale projects to test and prove concepts and learn how the UK can implement a mass market transition in home heating.

- Power plant siting – there are key strategic considerations in the siting of future powers plants (e.g. in relation to potential CCS infrastructure, or to maximise the opportunities to use waste heat in networks). These issues are not considered in the NIP.

- Hydrogen storage – ETI analysis points to potential for hydrogen storage to play a key role in energy system flexibility from 2030. Salt caverns could be used to store hydrogen at a number of potential sites. Early investment in developing and proving this concept will enable the UK to make better energy infrastructure investment and siting decisions in the 2030s.

References

ETI report: Optimising the location of CCS in the UK

ETI insights report: The role of hydrogen storage in a clean responsive power system

C. Budgets and action

The UK's statutory 2050 target requires actions across the economy to reduce emissions. Many of these actions will be driven by (UK and devolved) Government policy and implemented by businesses and consumers. There will be an important role for Local Authorities in successful delivery.

Although the carbon budgets do not require specific actions, they provide an important indication of the overall direction that policy will take in future. Once set, carbon budgets can only be changed if there has been a significant change in the relevant circumstances set out in the Climate Change Act.

Feedback from businesses as part of the Committee's 2013 Call for Evidence for the review of the fourth carbon budget was that stability is an important and valuable characteristic of carbon budgets.

Question 10 ***As a business, as a Local Authority, or as a consumer, how do carbon budgets affect your planning and decision-making?***

Question 11 ***What challenges and opportunities do carbon budgets bring, including in relation to your ability to compete internationally? What evidence do you have for this from your experience of carbon budgets to date?***

Question 12 ***What would you consider to be important characteristics of an effective carbon budget? What is the evidence for their importance?***

The CCC has adopted a generally sensible and pragmatic approach to setting the level of carbon budgets, providing early visibility of the emissions reductions required.

ETI's energy system analysis suggests in addition that advice to government on achieving carbon budgets should be set within the broader context of the longer term path to meeting 2050 targets, and the emissions reductions which will need to be delivered during subsequent periods. As outlined elsewhere in our evidence, action will be required in a number of areas during the 2020s to prepare the ground for the deployment and / or consumer adoption of new technologies, in subsequent carbon budget periods to deliver emissions reductions. Key areas include bioenergy (including UK biomass production), CCS (including in combination with bioenergy), new nuclear (including small modular reactors), offshore wind (including large turbines and floating platforms), gaseous systems, efficiency of vehicles and integrated smart systems for heat.

D. Other issues

The Climate Change Act requires that in designing the fifth carbon budget we consider impacts on competitiveness, fiscal circumstances, fuel poverty and security of energy supply, as well as differences in circumstances between UK nations. High-level conclusions on these from our advice on the fourth carbon budget were:

- **Competitiveness** risks for energy-intensive industries over the period to 2020 can be addressed under policies already announced by the Government. Incremental impacts of the fourth carbon budget are limited and manageable.

- **Fiscal impacts**. The order of magnitude of any fiscal impacts through the 2020s is likely to be small, and with adjusted VED banding and full auctioning of EU ETS allowances could be neutral or broadly positive.

- **Fuel poverty**. Energy policies are likely to have broadly neutral impacts on fuel poverty to 2020, with the impact of increases in electricity prices due to investment in low-carbon generation being offset by energy efficiency improvement delivered under the Energy Company Obligation. Incremental impacts through the 2020s are likely to be limited and manageable through a combination of further energy efficiency improvement, and possible income transfers or social tariffs.

- **Security of supply** risks due to increasing levels of intermittent power generation through the 2020s can be managed through a range of flexibility options including demand-side response, increased interconnection and flexible generation. Decarbonisation of the economy will reduce the reliance on fossil fuels through the 2020s and thus help mitigate any geopolitical risks of fuel supply interruption and price volatility.

- **Devolved administrations**. Significant abatement opportunities exist at the national level across all of the key options (i.e. renewable electricity, energy efficiency, low-carbon heat, more carbon-efficient vehicles, agriculture and land use).

Question 13 ***What evidence should the Committee draw on in assessing the (incremental) impacts of the fifth carbon budget on competitiveness, the fiscal balance, fuel poverty and security of supply?***

The CCC has produced very good evidence based analysis in its work to assess the impacts of carbon budgets on competitiveness, the fiscal balance, fuel poverty and security of supply.

Clearly these are very difficult issues to assess over time periods measured in decades, with impacts dependent on the detail of future policy measures as well as underlying movements in global energy prices. In addition to making full use of other sources of evidence and insight (e.g. the National Grid Future Energy Scenarios (FES) work, and work by National Energy Action, and others on fuel poverty) the ETI would suggest the following as sources of evidence and insight to inform the Committee's assessment of these issues.

National energy system modelling – such as that possible within the ETI's ESME tool – can help to give a broad evidence-based overview of the national cost impact of alternative pathways towards meeting carbon targets. Ultimately it is the overall economic cost of low carbon energy which drives the impact on national economic competitiveness. National energy system modelling provides the clearest basis for integrated analysis of the key determinants and choices which impact on whole system costs. For example, ETI's modelling demonstrates the very high potential value of bioenergy to a low carbon energy system, and its potential to underpin a range of energy vectors and transition pathways.

Scenario analysis – this can enable understanding of some the key drivers that will affect the distribution of costs of low carbon energy across society, and larger impacts on tax and fiscal policy. For example, ETI's analysis of the challenges in transitioning low carbon light transport has illustrated the potential impact on tax revenues and on vulnerable groups in society of the uptake of increasing electrification of light transport. Different scenarios for global markets can also be important in assessing energy security implications. For example, sustainable biomass could become a scarce traded commodity under some scenarios, highlighting the high potential option value of developing a significant domestic biomass production capability.

Distributional impacts analysis – there is a case for building a greater capability to model future broad distributional impacts associated with different energy system transition pathways, and different broad approaches in recovering the costs of policy support measures (e.g. via energy bills or taxation). ETI's analysis suggest that these are key considerations in designing policies and business propositions

for different groups in society in transport and domestic energy.

Key industrial sectors – there are a relatively small number of key industries with high emissions. Evidence can be sought from major energy users themselves, alongside further analysis of the impact on their competitiveness in the light of emerging market circumstances and the policy choices available for cutting emissions and managing the cost burden this imposes. International evidence is also likely to be informative. Finally analysis should take account of the regional economic impact and importance of key industrial sectors and clusters, enabling Committee evidence and policy choices to be informed by an understanding of the broader economic impact of alternatives.

Question 14 ***What new evidence exists on differences in circumstances between England, Wales, Scotland and Northern Ireland that should be reflected in the Committee's advice on the fifth carbon budget?***

As set out in previous answers, the ETI's analysis points to the high potential of bioenergy, and the potential importance of domestic biomass, to enabling a cost-effective low carbon transition. The ETI has carried out significant analysis of the which shows there is a clear geographic dimension to the potential shape of bioenergy value chains across the UK. This applies to the potential suitability of different parts of the UK for the production of different sources of biomass (perennial energy crops or forestry), as well as the potential location of conversion or CCS facilities,

The ETI has also recently completed an Ecosystem Land Use Modelling project to improve evidence around the emissions impacts of UK biomass production. While most past research has relied on modelling potential releases of GHGs, the ELUM project has directly measured emissions and soil carbon impacts for a range of land use transitions at commercial sites across the UK.

This, together with the ETI's Bioenergy Value Chain Modelling (BVCM) toolkit, is creating a richer picture of how the UK can create a sizeable, and demonstrably sustainable, biomass for energy production capability. Further insights from this work will be published later in 2015.

Reference

ETI insights report: Insights into the future UK bioenergy sector, gained using the

ETI's bioenergy value chain model

Question 15 ***Is there anything else not covered in your answers to previous questions that you would like to add?***

A key issue emerging from the ETI's analysis relates to the profile of investment and activity required to deliver a low carbon transition that meets carbon budgets and ultimately the 2050 targets. The build rates and capital investment required in the period to 2030 are challenging, but significantly lower than the accelerating rates of investment and deployment required in the 2030s and 40s. This underlies the ETI's emphasis on the importance of activity over the next decade to prepare genuinely deployment-ready technology options. Any delay in the investment required to deliver early progress in emissions reductions and to prepare key technology options is likely to result in additional deployment pressure, risk and ultimately higher costs in the 2030s and 40s.

Reference

ETI report by Jo Coleman and Andrew Haslett (2015): Targets, technologies, infrastructure and investments – preparing the UK for the energy transition