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.

Response from

The Mineral Products Association

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:
The MPA recognises the priority being given to a raised ambition towards a mid-century net zero ambition. MPA shares the Government's aspirations of combatting the causes and impacts of climate change on the environment, society and the economy. Strong progress has already been made in the minerals industry. For example, in the UK cement industry GHG emissions per tonne of Portland cement (or equivalent) have reduced by 29% since 1990 mainly through investment in modern plant technology, fuel switching and product reformulation. Over the same period however, imports have increased significantly. 25% of the cement consumed in the UK is now imported, meaning that some of the UK's environmental obligation has been exported. Absolute GHG emissions from UK cement production have reduced by 51%.
Over recent decades we have seen an increased number of examples in the built environment where the building fabric incorporated into the operational design is significant contributor to the energy efficiency of the building in use. Building energy efficiency, climate resilience and design for both use and end of life will be critical to the long-term sustainability of the climate and economy. As such when considering whether or not a net zero target can be achieved, MPA propose the CCC look at 5 key criteria for each sector of the economy. These are summarised below:

1. **The availability of cost-effective technology** relevant to emissions reduction delivery. Any increased ambition should be accompanied by a technology roadmap which incorporates the necessary policy support levers for R&D/innovation funding.
2. **Economic contribution:** It is vital that climate change ambitions do not jeopardise the competitiveness of UK businesses. Any increased ambition should be accompanied by an assessment of the cumulative burden of environmental policy costs, particularly on energy intensive industries. Where domestic competitiveness is impacted, foreign imports will fill the void. Ultimately, this will have a detrimental effect on tackling global climate change if goods are imported from countries with lower GHG reduction ambitions. This would clearly be contrary to the net zero policy objectives. Any increased ambition should be accompanied by an assessment confirming that there will not be an increase in the import of manufactured goods currently produced in the UK.
3. **Energy and climate change policy:** Consideration must be given to incentivising emissions reductions and energy efficiency improvements to meet the targets set. Any increased ambition should be accompanied by a statement that all the

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increased ambition will be met by domestic action and that none of it will be met by exporting the UK's environmental obligations (by importing more manufactured goods).

4. **Fuel availability and energy security:** Central to climate ambition is the type of industrial heating fuel and the technology in which it is used. Biomass fuels will be limited due to land access, so it is important that biomass is used before it is combusted. Biomass based products could replace plastics for many packaging purposes before being combusted in industrial plant fitted with carbon capture. Any increased ambition should be accompanied by a statement on how to maximise the availability of biomass-based fuels for industry.
5. **Interaction with the UK industrial strategy:** Mineral products are essential to construct and operate a low carbon economy, and to adapt to a changing climate. GHG reduction should take place without damaging foundation industries that are vital to the delivery of economic prosperity and low carbon living. The mineral products industry supplies low carbon solutions for construction, the built environment and other industries in all geographical regions of the UK. Any increased ambition should be accompanied by plan to increase the UK industrial manufacturing base, retain foundation industries and utilise the products from UK manufacturing to supply and service the low carbon economy.

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:
Different GHG's and their reduction will vary depending on the sector concerned. In cement and lime manufacture the main GHG emission is carbon dioxide (CO_2) and therefore that's where the focus of reduction needs to be. Other GHG's may play a greater role in other sectors (e.g. methane emissions from forestry activities for timber production and from landfilling of waste wood) and any targets set for their reduction should be made after consideration of the 5 criteria outlined in answer to question 1.

Throughout this response reference is only made to CO_2 as this is the main emission from cement and lime manufacture.

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:

1. Climate change is a global problem that must be tackled globally. Every country

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and sector needs to play a part. 'Consumption' emissions should be included in the UK's carbon accounting to recognise the significant decarbonisation already achieved by industry and to protect industry against carbon leakage.

2. When assessing the UK's contribution to global temperature goals the UK must disclose the true picture. The Climate Change Act currently only requires domestic sources of emissions to be reported but this conceals the UK's carbon footprint from consumption of imported goods. Any increased ambition to net zero should account for 'consumption' GHGs from the production of imports to the UK.
3. The cement and lime sectors have invested heavily to reduce CO_2 emissions and improve energy efficiency. This has resulted in a 51% reduction in absolute emissions in cement manufacture since 1990. If the UK is to set more ambitious targets than the rest of the world, effort should be shared across the UK economy, coupled with support for EIIs to protect them from carbon leakage. Otherwise the result will be the offshoring of UK industry. This not only moves the emissions problem elsewhere but is also very likely to increase overall emissions. As well as the additional transport emissions, production emissions may be higher in other countries. Offshoring is an irresponsible way for the UK to decarbonise. It puts UK jobs and skills at risk and it would also put at risk the security of supply of strategic materials that are required for a low carbon economy and to protect against the impacts of climate change. Further decarbonisation in EII's to meet an 80% carbon reduction target or higher will require breakthrough technologies such as CCUS. A move to deeper levels of decarbonisation therefore has to mean a shift in focus, both in terms of the level of decarbonisation required by other sectors of the economy and in terms of a policy shift to that which supports, through R&D/innovation funding, the development and deployment of breakthrough technologies in EII's.
4. EII's are already contributing proactively to the transition towards a low carbon economy and have taken considerable action towards decarbonisation. This is not only due to regulations such as EU ETS, but also a commercial necessity; high energy costs and demands mean that operating inefficiently will instantly make an EII uncompetitive.
5. EIIs have long taken responsibility for and worked to reduce impacts on the environment. For example, cement manufacturers have reduced the embodied CO_2 of bagged cement products by including a higher level of clinker substitute materials. It is now not possible to buy a bagged CEM I cement (CEM I cement has the highest embodied CO_2).
6. The MPA Greenhouse Gas Strategy shows how the UK cement sector can achieve an 80% reduction below 1990 emissions levels by 2050 within a supportive policy framework[1]. The following reports provide additional useful information:
    1. IEA cement roadmap[2]
    2. CEMBUREAU Building carbon neutrality in Europe paper[3]

[1] Greenhouse gas reduction strategy, 2013, MPA, https://cement.mineralproducts.org/documents/MPA_Cement_2050_Strategy.pdf

[2] "Technology Roadmap: Low-carbon transition in the cement industry", 2018, International Energy Agency, Cement Sustainability Initiative, https://www.iea.org/publications/freepublications/publication/TechnologyRoadmapLowCarbonTransitionintheCementIndustry.pdf

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3. A sustainable future for the EU cement and concrete industry[4].

7. Achieving net zero emissions will require a significantly greater effort but could be possible with BECCs, combined with development of low-carbon cements and inclusion of concrete re-carbonation in national GHG accounting. Further detail is provided in the answer to question 6.

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:
The UK should primarily focus on UK domestic reduction whilst not placing additional burden on our trading partners by expecting them to make GHG reductions whilst UK consumption continues unabated. CCC should measure the amount of international aid provided for climate change mitigation against the support provided to UK manufacturing industry for emissions reduction.
International initiatives undertaking work/research into breakthrough technologies such as CCUS should be supported as this knowledge sharing would help reduce the cost of technologies and speed up their deployment globally including in the UK. There is no point duplicating research effort where this can be shared and built upon instead. The sooner these technologies are developed and start to be deployed, the cheaper they become for everyone.

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:
GHG mitigation should take place at the point of lowest cost, the ability to purchase international credits in place of domestic action is an important flexibility. The key role of carbon credits for industry has been through EU allowances in the EU emissions trading scheme. For businesses with installations in different countries across the EU, the flexibility to choose where to invest in decarbonisation to offset emissions elsewhere is one of the huge benefits of the scheme.

In terms of carbon credits for investment in decarbonisation in developing countries, ideally

[3] "Building carbon neutrality in Europe", 2018, CEMBUREAU, https://lowcarboneconomy.cembureau.eu/wp-content/uploads/2018/10/CEMBUREAU-BUILDING-CARBON-NEUTRALITY-IN-EUROPE_WEB_PBP.pdf

[4] "A sustainable future for the European cement and concrete industry", 2018 ETH Zurich and EPFL, https://europeanclimate.org/wp-content/uploads/2018/10/AB_SP_Decarbonisation_report.pdf

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?

the focus for the UK should be on supporting the UK to decarbonise. There is much still to be done across many sectors of the UK economy and resources should be focussed on supporting UK decarbonisation e.g. in EII's and the jobs, skills and technologies that could be developed here to do that.

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:
MPA recognises that it is difficult, but not impossible, to reduce emissions to close to zero in both **industry** and **buildings**. Mineral products are essential to construct and operate a low carbon economy, and to adapt our buildings to a changing climate. With the right support and investment, the mineral products industry could achieve net zero - or even net negative - emissions by 2050.

INDUSTRY
The cement industry requires CCUS to reduce emissions to close to zero. Around 70% of the CO_2 emissions from cement production arise from the chemical process of breaking down the raw materials, rather than from fuel combustion. These process emissions of CO_2 cannot be reduced through options such as fuel switching but must be captured.

Manufacturers are developing cement and concrete products with even lower carbon content. MPA is leading the first BEIS Industrial Energy Efficiency Accelerator (IEEA) consortium which aims to produce, test and standardise new Portland cement produced using multiple additions, which emits 12.1% less CO_2 than standard cement manufacture.

Concrete re-carbonates over the course of its life and when crushed at the end of its life by absorbing and permanently storing CO_2 from the atmosphere. At least 13% of the CO_2 emitted during production is reabsorbed in this way, rising to over 42% with appropriate end-of-life processing to optimise carbon uptake. This significantly reduces the carbon impact of concrete but is not yet included in national GHG accounting.

The following combination of actions could enable the cement and concrete sector to achieve net zero or even net negative emissions.

1. **Industrial deployment of CCUS with biomass**. All scenarios in the IPCC's 1.5ºC report show that CCUS deployment is needed at scale. The CCC Biomass for a low carbon economy report highlighted the potential application of IBECCS (Industrial Bio-Energy Carbon Capture and Storage) in the cement sector. CCUS is fundamental to deep decarbonisation of the cement sector. Around 70% of the CO_2 emissions from cement manufacturing arise from the chemical process which takes place in the cement kiln to breakdown the raw limestone. These emissions cannot

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be reduced by options such as fuel switching but must be captured through CCUS. There are several barriers to overcome to enable wider CCUS deployment:

i. Location: The CCUS cost challenge task force report urged the Government to focus CCUS deployment on specific industrial clusters. The majority of cement and lime plants in the UK are located in isolated rural locations. At present this puts them further down the priority list for targeted Government support for the deployment of CCUS.
ii. Storage and transport of CO_2: Due to the isolated location of many cement sites, technology to transport the CO_2 from cement sites to a carbon storage or use site needs to be developed.
iii. Technical: Many UK cement manufacturers are involved in research and demonstration projects across Europe to develop carbon capture technologies ready for deployment.
iv. Financial: These research and demonstration projects require significant financial support. For example, around €90 million is required for two industrial scale demonstrations of oxyfuel technology at existing European plants.
v. Biomass fuel use: New policies that incentivise greater uptake of biomass fuels by industry in efficient direct heating processes are needed to replace current policies which divert biomass to power and residential users.

2. **Development of low carbon cement and concrete products**. Standards allow 27 different cement types to be used with varying levels of 'additions' which achieve the safety and quality performance for the wide range of concrete applications. Additions are materials (often but not always waste and by-products from other sectors such as ground granulated blast furnace slag (GGBS) from steel production and pulverised fly ash (PFA) from coal fired power generation) that replace the high carbon clinker component of cement. In the UK clinker has been reduced to 76% of the cement content[5]. The market has gradually shifted from specifying the highest carbon cement (CEM I with a CO_2 content of around 913 $kgCO_2/t$) to using other cement types such as CEM II, CEM III or CEM IV which have different levels of additions and embodied carbon ranging from 236 $kgCO_2/t$ to 863 $kgCO_2/t$, where technical requirements allow. On average just 10% of the concrete product is cement, making concrete a low carbon product compared to its strength and performance. There has also been research into other 'novel' cements that are non-Portland type cements. These cements are often produced using different raw materials to limestone and can be made at much lower temperatures than Portland cement. The vast majority of these novel cements are only at the research stage. A few are available commercially on the market for use in non-structural applications e.g. pavements and driveways. Some of the barriers to the deployment of these novel cements is the availability of the raw materials in the UK, for example bauxite and magnesium silicate. In several cases, the novel cements don't actually offer any additional emissions reduction compared to that achieved by Portland cements such as CEM II and III. However, it is important that research and development continues on these novel cements because they could offer innovative low carbon

[5] "Getting the Numbers Right", WBCSD, CSI, http://www.wbcsdcement.org/index.php/key-issues/climate-protection/gnr-database

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solutions for certain specialist applications. As clinker-based cement provides the durability, safety and strength of concrete, the cement industry is also directing its research into a detailed assessment of the impact of other raw materials on the durability and strength. MPA is providing evidence to the standardisation community to allow for new low carbon multicomponent cements in the concrete application standards. MPA is heading a consortium that was the first successful application under the BEIS Industrial Energy Efficiency Accelerator (IEEA) to produce, test and standardise Portland cement produced using multiple additions, in particular limestone with GGBS or PFA. MPA estimates that once the project is completed and the cements can be sold on the UK market, they could lead to a 12.1% reduction in CO_2 emissions from cement manufacture.

3. **Inclusion of re-carbonation of concrete in GHG accounting**. In its recent report on GHG removals the Royal Society recommended increased use of techniques and technologies that remove CO_2 from the atmosphere, including mineral carbonation of silicate rocks either by industrial processes or injection of CO_2[6]. Carbonation occurs by the same process in concrete structures. Over the course of its lifetime, concrete absorbs CO_2 from the atmosphere and permanently stores it (unlike temporary storage in forests and timber products). At least 23% of the process cement CO_2 emissions, i.e. 13% of the total CO_2 emitted during typical concrete production, is reabsorbed in this way, rising to 75% of cement process emissions, i.e. 42% of total production emissions for typical concrete, with appropriate end-of-life processing to optimise carbon uptake[7]. Currently this CO_2 capture is not included in CO_2 accounting and reporting. When considering moving to a net zero target, it is vital that all CO_2 sinks are considered. A recently published report by the Swedish Environmental Research Institute, IVL, "CO_2 uptake in cement-containing products", gives guidance on developing a methodology for calculating this valuable CO_2 sink[8]. MPA is willing to work with BEIS and CCC to develop an appropriate methodology for the UK using the IVL report as a basis.

The combination of CCUS with biofuel, development of new low-carbon products and inclusion of re-carbonation in GHG accounting could enable the cement sector to achieve net zero or even, with a favourable economic and policy environment, net negative emissions.

BUILDINGS

Any policy to drive carbon reduction in buildings must consider all carbon emissions over the whole building lifecycle and should be material neutral. MPA is deeply concerned by the CCC's apparent favouritism towards timber in construction because of a perceived benefit in embodied CO_2, which is only a small proportion of whole-life carbon. A building's operational energy use is intrinsically linked to the fabric choice. Therefore, a narrow focus

[6] Royal Society, and Royal Academy of Engineering. 2018. 'Greenhouse Gas Removal'.

[7] IVL, 2018. "CO_2 uptake in cement-containing products: Background and calculation models for IPCC implementation."

[8] IVL, 2018. "CO_2 uptake in cement-containing products: Background and calculation models for IPCC implementation."

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on embodied carbon of construction materials is a misleading metric for environmental impact. Focussing solely on one aspect, for example reducing operational carbon for winter heating, can lead to unintended consequences, such as summer overheating[9]. Building materials have different properties. Their performance depends on the site, design and context of the building or infrastructure. Any policy to drive carbon reduction in buildings must consider the whole building lifecycle and performance: embodied CO_2 of the materials, energy and CO_2 emissions required to heat and cool the building, and the CO_2 emitted at the end of life of the building, as well as the expected service life of the building.

Timber sequesters carbon whilst it grows, but the carbon will be re-released as CO_2 or even as methane, a much more potent GHG, at the end of its life. In contrast to timber which only emits greenhouse gases at the end of its life, concrete continues to act as a carbon sink with accelerated CO_2 absorption and storage at the end of its life. Concrete is durable and 100% recyclable. Concrete buildings can last 100 years or more, whereas timber buildings have a considerably shorter service life of 50 or 60 years or less. Furthermore, timber in building structures must be treated to prevent rot and infestation and protect it from fire. These chemical glues and treatments also contribute to CO_2 emissions.

MPA are in favour of afforestation. MPA members have planted 535,000 trees in the last 5 years and created the equivalent of a National Park in terms of restored land area. However, MPA is concerned that most UK timber is not suitable for structural purposes, and that the UK is already the second largest importer of timber after China. Although EU regulations prevent use of illegally harvested timber, it is much harder to guarantee that 100% of timber used is responsibly sourced from sustainably managed forests. Even recognised sustainability standards such as PEFC and FSC allow a downgrading such that only 70% of timber so-labelled is from sustainably managed forests. Increasing demand for timber in the UK, whilst relying on imported supply, does not guarantee reduced carbon emissions and may ultimately lead to unintentional deforestation and increased carbon emissions.

Favouring timber in construction could stifle innovation in cement and concrete, and puts continued investment in efficient plant and breakthrough decarbonisation technologies, such as CCUS, at risk. Concrete and cement bring myriad environmental and emissions benefits throughout the supply chain including:

- **Concrete is locally sourced**. The entire supply chain can be located within the UK. Not only does this reduce emissions from transport (ready mixed concrete travels on average only 8 miles from plant to customer) but it ensures employment, skills and contribution to the UK economy. Furthermore, around 90% of concrete is

[9] Shrubsole, *et al*. 2014. '100 Unintended Consequences of Policies to Improve the Energy Efficiency of the UK Housing Stock'. Indoor and Built Environment 23 (3): 340–52.

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certified to the responsible sourcing standard BES 6001.

- **Concrete is a low carbon material**. The embodied carbon of concrete has reduced by 28% since 1990[10]. This has been achieved through significant investments by manufacturers without the support of subsidies that have been required by other sectors of the economy, such as power generation. Cement is only a small proportion of concrete (around 10-15%), with the rest being low carbon aggregates (including recycled aggregates).
- **Concrete has high thermal mass**. This enables the storage and then slow release of heat or coolth. This has the effect of stabilising the temperature within a building year-round. Less heating is required in winter and less cooling is required in summer, reducing the energy demand and associated CO_2 emissions. This also reduces the associated risks of fuel poverty and overheating in summer months. Lightweight, highly insulated timber buildings may work well in winter, but they can trap heat within the building in summer months leading to considerable overheating.

In summary, government policy must remain material neutral so that architects and specifiers can optimise buildings without constraint. An overtly pro-timber policy removes choices available to architects and specifiers to design the lowest carbon buildings

Finally, building regulations must consider other important issues, for example the health safety of occupants. Timber is inherently combustible, whereas concrete has proven fire resistance.

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:
Cement and dolomitic lime manufacturing are uniquely placed to use waste biomass fuels, combined with CCUS. This could enable the cement sector to achieve net zero or even to contribute to removal of greenhouse gas emissions, but will require significant investment and policy support,

"Unlike other combustion processes – such as power generation, incineration and biomass boilers – the ash from fuels forms part of the mineral content of the cement and is not a waste residue. Thus, cement manufacturing recycles the mineral content of wastes with energy recovery as a co-benefit of that recycling, known as 'co-processing' i.e. recycling with simultaneous energy recovery". This extract is taken from the 2017 Government report "From waste to resource productivity" co-authored by Professor Ian Boyd, the Chief

[10] "10 Years 10 Insights", 2018, MPA The Concrete Centre, https://www.concretecentre.com/Footer/News/2018/10-Years,-10-Insights.aspx

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Scientific Adviser at the Department for Environment, Food and Rural Affairs (Defra) and Professor Sir Mark Walport (Government Chief Scientific Advisor)[11].
The fuels currently used in the sector are wastes and by-products from other industries and not virgin biomass resources. In 2017 the cement sector consumed 1.5 million tonnes of waste and by-products as fuels and raw materials making it a key component of the circular economy.

Concrete absorbs and permanently stores CO_2 from the atmosphere over the course of its lifetime, which reduces its carbon impact by around a third. A methodology is being developed to enable this vital CO_2 sink to be included in national emissions reporting.

Furthermore, cement and concrete are vital to enabling decarbonisation in other sectors such as the energy sector and buildings, as well as providing strategic materials for the transition to the low carbon economy and protection against the impacts of climate change e.g. flooding.

The high thermal mass of concrete acts as an affordable and efficient thermal battery as it stores the thermal energy to lower the building energy consumption and CO_2 emissions. "Thermal mass" refers to concrete's unique ability to store energy and release it over a daily cycle, stabilising building temperatures and leading to reduced energy demand for heating and cooling. In addition, the flexibility provided by the thermal mass of buildings could lead to significant savings at the level of the electricity grid. More information is available in a report by 3E[12].

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:
For technologies such as CCUS more than just innovation is needed. The transport and storage facilities also need to be available and someone (Government?) needs to take ownership of this. Setting a tighter long-term emissions target for the UK without having a robust plan for meeting it could render industry uncompetitive and result in carbon leakage. A very careful balance is needed. An assessment of the technology required, and the support needed to deploy it, must be undertaken before tighter targets are adopted.

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?

[11] https://www.gov.uk/government/publications/from-waste-to-resource-productivity

[12] "Structural Thermal Energy Storage in heavy Weight Buildings- analysis and recommendations to provide flexibility to the electricity grid", 3E, 2017, https://cembureau.eu/media/1249/3e_structuralthermalenergystorageheavyweightbuildings_2016-10-25.pdf

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:
Setting whole life carbon targets for buildings, including all stages of the building life (embodied, operational and end-of-life carbon emissions) will encourage manufacturers, designers, architects and engineers to innovate. For example, BRE undertook an evidence review of solutions to overheating as part of the Zero Carbon Hub's Overheating in Homes project, funded by government and industry[13]. The BRE review includes innovative cooling systems, such as ventilated ducts of thermally active building systems, which use the cooling properties of thermal mass without relying on occupants opening windows for ventilation. These innovations are a low-energy alternative to air-conditioning, which exacerbates the Urban Heat Island and creates further issues around energy supply and demand, and fuel poverty.

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:
Policy support for deployment of CCUS, including storage and transport facilities, is essential to decarbonising the lime, cement and concrete sectors. Carbon capture is expected to double the operating cost of a cement plant. Industry will need a scale of support and subsidies to decarbonise, similar to that already invested in the power sector.

Policy must also be used to target biomass resources where the greatest benefit in terms of emissions reduction and value for money can be achieved. Incentivising small residential consumers will not achieve a step change in emissions reduction. The cement sector co-processes waste biomass to produce high-value cement and concrete products which are essential to adapting to a changing climate. Furthermore, as cement manufacturing is a point source, the carbon emissions could potentially be captured with CCUS, unlike emissions from domestic biomass combustion. Combining the use of waste biomass in cement manufacturing with CCUS is a valuable route to the UK achieving its net-zero targets.

Finally, construction policy must set ambitions for and assess whole-life carbon emissions of buildings, rather than focussing on embodied carbon at the expense of operational carbon. With respect to carbon emissions, policy should not interfere in the construction market by favouring one construction material over another. Rather, policy should be material neutral to allow building materials, designers and construction companies to use innovative ways to meet whole-life carbon outcomes.

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?

[13] Zero Carbon Hub, 2016, "Solutions to Overheating in Homes: Evidence Review" http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-OverheatingEvidenceReview.pdf.

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:

- CCUS is essential for deep decarbonisation of the cement and lime sector.
- Setting targets that are at the limit of what is technologically achievable will require even greater financial support and commitment from government to develop CCUS technologies to commercial deployment within a constrained timeframe.
- CCUS is expected to double the operating cost of a cement plant. Without support from government, the risk is that emission targets will be met through offshoring of production and deindustrialisation of the UK, with severe economic – and climate - impact.
- With financial commitment from government to support the development and growth of these technologies and sectors, there is the opportunity for the UK to enhance its capability and skills base and become a low-carbon industry leader.
- The government has the opportunity to commit to supporting the growth of technologies, such as CCUS, financially. By encouraging industry to decarbonise through incentives, rather than high taxes, the government can stimulate low-carbon industrial and economic growth.

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:
No comment

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:
For industry, it is important that there is a level-playing field across all devolved administrations. Otherwise, businesses will compete across DAs as well as internationally. This will undermine overall UK competitiveness and could also potentially result in carbon leakage, either from one DA to another, or out of the UK entirely.

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:

- The Government CCUS deployment pathway is key to deep levels of decarbonisation in Energy Intensive Industries. This is vital to the long-term competitiveness of EIIs and to protect existing industries and jobs.

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?

- Consideration of decarbonisation policy in other countries. For example, carbon prices are currently higher in the UK than the rest of the EU. Differing carbon prices can have a significant impact on investment decisions made by international companies and on businesses in the UK that trade or compete with other countries.