Committee on Climate Change

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

The Sixth Carbon Budget and Welsh emissions targets – Call for Evidence

Background to the UK's sixth carbon budget

The UK Government and Parliament have adopted the Committee on Climate Change's (CCC) recommendation to target net-zero emissions of greenhouse gases (GHGs) in the UK by 2050 (i.e. at least a 100% reduction in emissions from 1990).

The Climate Change Act (2008, 'the Act') requires the Committee to provide advice to the Government about the appropriate level for each carbon budget (sequential five-year caps on GHGs) on the path to the long-term target. To date, in line with advice from the Committee, five carbon budgets have been legislated covering the period out to 2032.

The Committee must provide advice on the level of the sixth carbon budget (covering the period from 2033-37) before the end of 2020. The Committee intends to publish its advice early, in September 2020. This advice will set the path to net-zero GHG emissions for the UK, as the first time a carbon budget is set in law following that commitment.

Both the 2050 target and the carbon budgets guide the setting of policies to cut emissions across the economy (for example, as set out most recently in the 2017 Clean Growth Strategy).

The Act also specifies other factors the Committee must consider in our advice on carbon budgets – the advice should be based on the path to the UK's long-term target objective, consistent with international commitments and take into account considerations such as social circumstances (including fuel poverty), competitiveness, energy security and the Government's fiscal position.

The CCC will advise based on these considerations and a thorough assessment of the relevant evidence. This Call for Evidence will contribute to that advice.

Background to the Welsh third carbon budget and interim targets

Under the Environment (Wales) Act 2016, there is a duty on Welsh Ministers to set a maximum total amount for net Welsh greenhouse gas emissions (Welsh carbon budgets). The first budgetary period is 2016-20, and the remaining budgetary periods are each succeeding period of five years, ending with 2046-50.

The Committee is due to provide advice to the Welsh Government on the level of the third Welsh carbon budget (covering 2026-30) in 2020, and to provide updated advice on the levels of the second carbon budget (2021-25) and the interim targets for 2030 and 2040. Section D of this Call for Evidence (covering questions on Scotland, Wales and Northern Ireland) includes a set of questions to inform the Committee's advice to the Welsh Government.

Question and answer form

When responding, please provide answers that are as specific and evidence-based as possible, providing data and references to the extent possible.

Please limit your answers to 400 words per question and provide supporting evidence (e.g. academic literature, market assessments, policy reports, etc.) along with your responses.

A. Climate science and international circumstances

Question 1: The climate science considered in the CCC's 2019 Net Zero report, based on the IPCC Special Report on Global Warming of 1.5°C, will form the basis of this advice. What additional evidence on climate science, aside from the most recent IPCC Special Reports on Land and the Oceans and Cryosphere, should the CCC consider in setting the level of the sixth carbon budget?

ANSWER:

No comment

Question 2: How relevant are estimates of the remaining global cumulative CO_2 budgets (consistent with the Paris Agreement long-term temperature goal) for constraining UK cumulative emissions on the pathway to reaching net-zero GHGs by 2050?

ANSWER:

No comment

Question 3: How should emerging updated international commitments to reduce emissions by 2030 impact on the level of the sixth carbon budget for the UK? Are there other actions the UK should be taking alongside setting the sixth carbon budget, and taking the actions necessary to meet it, to support the global effort to implement the Paris Agreement?

ANSWER:

It is absolutely vital that as well as setting carbon budgets for UK territorial emissions, the UK carries out parallel accounting for emissions in imported products that are consumed in the UK (consumption emissions).

Under no circumstances should UK carbon budgets be met, or partially met, through the offshoring of emissions due to the displacement of UK industry and/or UK goods replaced by imports. The UK has no direct control over the embodied emissions in these imported goods and as a result they could be coming from less carbon constrained economies, areas with lower sustainability, welfare and labour standards and could have higher embodied carbon than they would if they were produced in the UK. Furthermore, as well as the embodied carbon of these goods, there are additional transport emissions associated with them.

Question 3: How should emerging updated international commitments to reduce emissions by 2030 impact on the level of the sixth carbon budget for the UK? Are there other actions the UK should be taking alongside setting the sixth carbon budget, and taking the actions necessary to meet it, to support the global effort to implement the Paris Agreement?

If the UK is to be a world leader in reducing emissions it must start to take responsibility for the emissions it consumes and not just the emissions it produces. This would shift the focus from meeting the domestically focused carbon budgets at all costs to a broader environmentally encompassing objective to reduce the UK economy's impact on the climate. There is a potential win-win as encouraging new industrial output to the UK, through supportive decarbonisation policies, could be good for the environment and emissions but also of great benefit to the UK economy. The first step towards achieving this is to appropriately estimate, report and manage consumption emissions.

Question 4: What is the international signalling value of a revised and strengthened UK NDC (for the period around 2030) as part of a package of action which includes setting the level of the sixth carbon budget?

ANSWER:

The UK's international signalling value is hugely undermined by the recent emissions profile of the UK economy. The Office of National Statistics, in its report (The decoupling of economic growth from carbon emissions: UK evidence. October 2019) clearly shows (fig.9) that whilst consumption-based and territorial emissions are both declining there is a widening gap between the UK's consumption impact and territorial impact. This divergence signals a worrying trend for the UK economy, the environment and signals internationally that the UK model for emissions reduction is unhelpfully reliant upon 'offshoring'. If the UK wants to genuinely show leadership in terms of decarbonisation, in the hope that others will follow suit it must supplement its accounting system with an honest account of the UK economy's impact.

B. The path to the 2050 target

Question 5: How big a role can consumer, individual or household behaviour play in delivering emissions reductions? How can this be credibly assessed and incentivised?

ANSWER:

Even with a willingness from the public they cannot always be relied upon to make the most sustainable choices. Even with a strong price signal, consumers don't always react e.g. the rapid increase in electricity prices has not led to a commensurate improvement in energy efficient decisions. So, where possible, practical and desirable 'designing out' the emissions has to be the first course of action so that behavioural change is not relied upon. Examples of this in buildings include designing an operationally low carbon building fabric that can reduce or eliminate the need for heating and cooling technologies i.e. reducing the temptation for occupants to purchase space heater or air conditioning units to modify the building temperature.

In infrastructure shorter travel distances and lower carbon transport modes can be improved using bridges and tunnels.

Question 6: What are the most important uncertainties that policy needs to take into account in thinking about achieving Net Zero? How can government develop a strategy that helps to retain robustness to those uncertainties, for example low-regrets options and approaches that maintain optionality?

ANSWER:

There are a number of uncertainties relevant to the UK minerals industry decarbonisation profile that could be reduced through the setting of Government policy. These are:

1. Availability of biomass. Fuel switching to biomass is a key decarbonisation technology lever for the cement sector. However, current Government policy is shifting biomass out of the sector. Policies such as RHI are shifting biomass to numerous smaller consumers and there have been proposals made recently in Wales to ban the incineration of waste without considering the impact of this on the recycling of waste biomass in cement production. As well as decarbonising cement manufacture, there are other benefits to waste biomass resources being utilised in cement manufacture. Firstly, cement plants are regulated under the Industrial Emissions Directive and therefore have to adhere to strict air quality limits, unlike smaller consumers of biomass, who might, in the long term, cause local air quality concerns. Secondly, the use of waste fuels in cement manufacture is different to burning waste for energy because the mineral content of the waste is recycled into the cement product and there is no residual ash that requires disposal. Policy must ensure cement manufacture is not treated in the same way as waste incineration when it comes to considering the burning of waste and ideally policy is required to ensure cement manufacturers can access waste biomass and this isn't shifted to other sectors/users with no additional benefit.
2. Development of Carbon Capture and Use/Storage (CCUS) infrastructure: Around 70% of the emissions from cement and lime manufacture result from the breakdown of the raw materials, known as process emissions. The only way to significantly reduce these emissions is through the deployment of CCUS. However, many UK cement and lime plants are located outside of the key industrial cluster areas that are the current focus for CCUS infrastructure development. It is unclear currently when this focus will be broadened out to other more isolated sites. The uncertainty around when, or even if, isolated sites will be able to link to CCUS transport and storage infrastructure is a barrier to these sites investing in research, testing and deployment of carbon capture technology. It is vital that, even if CCUS policy and support starts with a cluster focus, consideration is given to how more isolated sites can link to these clusters and a clear pathway to deployment of transport and storage infrastructure for these sites is provided as soon as possible.

Question 7: The fourth and fifth carbon budgets (covering the periods of 2023-27 and 2028-32 respectively) have been set on the basis of the previous long-term target (at least 80% reduction in GHGs by 2050, relative to 1990 levels). Should the CCC revisit the level of these budgets in light of the net-zero target?

ANSWER:

The carbon budgets are set far in advance to provide long term certainty of the overall direction of decarbonisation. This has helped to inform the direction of travel for the decarbonisation of the UK which in turn has enabled mineral products suppliers to start to offer low carbon product alternatives. The issue has been that consumers and specifiers

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don't always take up these options. Changing the fourth and fifth carbon budgets now would undermine the long-term certainty that businesses require. It would send the wrong 'interventionist' signal that could impede future investment decisions. What is required is action to reduce the barriers to the take up of existing low carbon options. One example is the production of warm mix asphalts which offer CO_2e savings in the region of 10% compared to traditional mixes. However, take up in the UK has been much lower than other parts of the world (currently this low carbon option accounts for only 4% of UK production while in the USA it accounts for over 40% of production and in France it makes up 16% of production). The publicly funded local authorities and central agencies who account for the vast majority of asphalt volumes must implement change and lead the way in using these low carbon options.

Furthermore, it is unlikely that the path to a net zero 2050 target will be a straight line. In the minerals sector we know that decarbonisation will likely ramp up as more innovative technologies are researched, tested, deployed and gradually reduce in cost. This will take time to do. Rather than change the budgets, what is needed is support through policy and finance mechanisms to speed up this development. "Nice to have" policy support will need to become "must have" support that kick starts the innovation and research ground work required to ensure the sector doesn't just make it to 80% but can help achieve the net zero ambition.

Question 8: What evidence do you have of the co-benefits of acting on climate change compatible with achieving Net Zero by 2050? What do these co-benefits mean for which emissions abatement should be prioritised and why?

ANSWER:

There are a number of co-benefits associated with the use of mineral products that are often overlooked because emissions from production such as cement manufacture are seen solely as a climate change problem rather than being put in context of the benefits concrete and masonry can bring in terms of emissions reduction downstream.

One of the huge benefits of decarbonising cement manufacture is that not only would cement and concrete have very low embodied carbon but all the operational benefits remain unchanged.

Concrete is an essential material for our homes, buildings and infrastructure. Concrete is vital to delivering new homes, schools, hospitals, workplaces, roads and railways, as well as the infrastructure that provides us with clean water, sanitation and energy. Its unique characteristics – strength, fire resistance, durability and energy efficiency – provide us with safe, secure and comfortable homes and resilient infrastructure that can last for generations. Concrete is a locally produced material using predominantly indigenously sourced raw materials (sand, gravel and crushed rock) where supply is largely influenced by the proximity principle that ensures security of supply, cuts carbon and contributes to the UK's homegrown economic prosperity. Over 95% of UK concrete is produced in the UK. By comparison, two thirds of timber and 60% of steel is imported from around the world, posing a risk to UK manufacturing jobs. Low carbon concrete is 100 per cent recyclable, with the UK a global leader in the recovery and reuse of this material. At the end of its life it can be crushed for reuse as a cost-effective material for hard core or used as a recycled aggregate in new concrete.

Concrete's thermal benefits can keep people safe and warm in winter but also protects from the increased risks of overheating buildings in summer and saves energy through the year providing an important co-benefit of reducing bills and cost to occupants and owners. Concrete naturally absorbs atmospheric carbon throughout its lifetime and beyond through 'carbonation', helping to further offset the CO_2 emitted during its production.

The CO_2 absorbed by concrete is permanently stored and will only be released if the concrete is heated to volcanic temperatures. Concrete therefore provides an important emission 'sink'.

The production of cement and concrete uses a wide range of wastes and secondary materials to support decarbonisation of production but this in turn contributes to tackling the UK waste problem.

Further co-benefits exist within construction and material innovation. Technological advances such as low carbon cements, 3D printing, offsite and automated manufacturing are unlocking new ways of using concrete to deliver critical new buildings and infrastructure. Pollution eating, self-healing, water permeable and bio-receptive concretes are just some of the wave of innovative new materials being developed leading to co-benefits of improved air quality, flood prevention, improved drainage and a range of other improvements. The use of Warm Mix Asphalt not only results in lower carbon emissions from its production but it also reduces fumes both at the production plant and on site, resulting in improved air quality for workers and local residents. It also enables a quicker return to service of the road which reduces delays, carbon emissions from static traffic and benefits the economy.

C. Delivering carbon budgets

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

ANSWER:

The UK minerals industry takes its environmental obligations extremely seriously and is committed to being part of a net zero carbon society. We support the ambition to de-carbonise as soon as practically and economically possible and are working hard every day to achieve it. We want to accelerate progress and call on Government to create a more effective legislative and policy framework to encourage innovation and investment to make this happen whilst maintaining competitiveness. The following is a summary of the key areas where supportive policy and financial incentives are required:

1. **Competitiveness:** There is no escaping the fact that the UK is an island and importing goods from overseas is extremely easy. Imports of cement have steadily increased over the last decade and in 2017, 23% of UK cement sales come from imported cement. Until the rest of the world catches up to the UK net zero ambition, the competitiveness of UK industry must be maintained. Recent experience with electricity prices has shown that added cost alone is not the answer. Policies that incentivise rather than penalise are required and, indirect impacts of decarbonisation policies i.e. the costs of deploying renewable electricity generation passed on in electricity bills, must be compensated to ensure Energy Intensive Industries (EIIs) are not disadvantaged. Reducing the cost of electricity in the UK for EIIs is also vital if one of the decarbonisation options for these industries is to electrify more processes to move them away from using high carbon fossil fuels.
2. **CCUS:** CCUS is currently high cost, high risk and currently has no infrastructure. Together these represent one of the main decarbonisation barriers. CCUS is vital to the decarbonisation of process emissions and therefore access to a transport and storage (T&S) network is required. To enable the deployment of CCUS in minerals sectors the following would be beneficial:
    a. Government policies, that will deliver CCUS T&S infrastructure including underwriting the main costs of T&S risk, need to be formulated and communicated as soon as possible to make CCUS an investable proposition in the 2030's.
    b. Financial mechanisms that allow the development and deployment of CCUS whilst maintaining UK manufacturing and jobs is vital. A support programme for the research and deployment of a demonstration and then full commercial scale CCUS capture plant at a UK cement/lime site. Support is required initially to start the deployment of these innovative and unproven technologies so that lessons can be learnt and costs can be reduced for future implementation. Ideally, sector specific support is required. This could be linked to the BEIS decarbonisation roadmaps to ensure the right technologies for each sector are targeted.
    c. An incentive programme to encourage fuel switching to biomass waste fuel with CCUS. The cement and dolomitic lime sector can use a wide range of waste biomass fuels. In combination with CCUS (which will be required to decarbonise process emissions), this technology has the potential to result in negative emissions.
    d. A clear roadmap showing the expected progress of CCUS T&S across both clusters and expansion out to more isolated sites. A clear timeline of implementation will increase confidence that CCUS is still an option for decarbonisation of these more isolated sites. This in turn will signal to multinational companies that investment in research, development and deployment of capture technology in the UK, won't be wasted.

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e. Support for industrial mineral CO_2 capture as a utilisation technique and permanent CO_2 store.

3. **Biomass:** Investigation of biomass resource and availability and Government policy that incentivises its most efficient, best value for money use (i.e. targeted use of biomass), particularly in efficient directly fired operations. Currently biomass is being diverted out of the sector by imbalanced incentives. This needs to be addressed if cement and other mineral operations are to fully decarbonise.
4. **Buildings**: Legislation that encourages property developers to design buildings based on whole life performance and not just embodied carbon. This should also ensure the building fabric is designed using thermal mass to reduce or eliminate heating and cooling input energy to ensure a building is low carbon. This will have far more benefits in terms of reducing overall energy use and is likely to be cheaper in the long term than relying on technology and low carbon renewables to decarbonise the building/housing stock. Furthermore, Government should maintain material neutrality and not favour one construction material over another. This will enable architects and designers to use the most appropriate materials to produce the best whole life low carbon building option.
5. **Standards and procurement:** Standards that accelerate the take up of low carbon options must be developed and kept under regular review. In addition, a balanced scorecard approach to procurement must be taken where materials are selected based on the impact of their whole life carbon and not just the embodied carbon generated in their production (i.e. in use emissions/ reductions must also be taken into consideration). Government procurement must be altered to prioritise whole life low carbon options.

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

ANSWER:

Climate change is a global issue, everyone has to play a part in reducing emissions but action at a local level needs to be in the context of the overall budgets and not the other way around. Cities are proportionally high consumers of concrete and so can make use of its properties to reduce energy demand and store CO_2. High density buildings e.g. flats, apartments or offices are best placed to utilise the thermal properties of concrete and reducing or eliminating heating or cooling demand for occupants. Concrete's durability means that it is resource efficient, providing strength and structure at low cost and in a resource efficient way. Importantly for low carbon city targets, concrete's ability to capture CO_2 from the air and permanently store it is an asset. Cities in their planning strategies can include measures that maximise the recarbonation CO_2 storage of concrete both during the building use and after use. It is also important to effectively plan for the supply of the mineral resources that are required to support construction activity in urban settings, to ensure the most sustainable sources of supply are available in the right place and at the right time. In doing this, it is essential to recognise the benefits derived by the proximity principle with local resources supporting local needs.

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

ANSWER:

With the current territorial emissions focus of the UK Carbon Budgets it is impossible to effectively manage the competitiveness and other fiscal impacts of raising the carbon budget expectations. As the ONS has shown in its report (The decoupling of economic growth from carbon emissions: UK evidence. October 2019) territorial emissions declined as the result of a combination of environmental policies and a shift of the UK economy from more carbon-intensive manufacturing to less carbon-intensive service-based industries. As the UK relied more heavily on its service industries it's import emissions have increased as a proportion of its total emission footprint. This evidence demonstrates that the UK is currently unable to manage the economic cost of the carbon budgets.

Importantly, to date the largest share of emissions reduction effort has fallen on industry and energy sectors so it is important to consider not just the level of the budget but how that ambition is shared across different sectors of the economy.

Maintaining competitiveness is a particular concern to EIIs in the UK (note that in an ideal world, the UK should be ambitiously looking to increase the competitiveness of UK business, not just maintain it). Unilateral UK policies (e.g. Carbon Price Support, CPS) aimed at decarbonising power generation, indirectly impacts EIIs because they add huge costs to energy bills. Some EIIs receive partial compensation but this compensation is patchy in terms of sector coverage (and even across businesses within a sector), and is determined at an EU level which misses sectors that are vulnerable as a result of their location in the UK, an island where imports are far more of a threat than for the EU as a whole. The cement industry, for example, is one such sector that does not receive compensation for the indirect cost of CO_2 in electricity bills, and over the last decades imports of cement have steadily increased, indicating that maintaining competitiveness is already a challenge.

The EU Green Deal included proposals for a Border Carbon Mechanism aimed at addressing the competitiveness issues with imports. In response, CEMBUREAU, the European Cement Association, noted (see press release here: https://cembureau.eu/media/1903/green-deal-statement-11122019.pdf) that the Green Deal carbon border adjustment mechanism is proposed only as an alternative to carbon leakage measures and as such is problematic. EIIs, such as cement already face a shortfall of allowances under the EU ETS rules, increasing the production cost and the risk of production being offshored. In this context, the replacement of the existing carbon leakage measures by an untested mechanism would create considerable uncertainty and risks. However, policy makers should look at a design that complements the existing carbon leakage measures.

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

ANSWER:

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The minerals sector is committed to helping to deliver UK net zero ambitions. However, it is important that the right policy and financial mechanisms are in place to ensure decarbonisation can happen without displacing manufacturing and jobs overseas. There are many local economies and local supply chains that rely on UK mineral plants, quarries and sites. The UK's response to climate change must ensure that what remains of our industrial heritage is assisted in its transition to a modern and vibrant net zero carbon future. Foundation industries provide the basic building blocks of a modern society and economic value, the UK will always need essential mineral products such as cement and concrete, it is impossible to envisage a net zero society with cement and concrete. The competitiveness threat is real and 23% of UK consumed cement is now imported. This is lost revenue, GVA, jobs and wider supply chain value that could be generated in the UK. No amount of the 6th carbon budget should be achieved by losing manufacturing jobs to overseas supply and exporting our environmental responsibility.

D. Scotland, Wales and Northern Ireland

Question 13: What specific circumstances need to be considered when recommending an emissions pathway or emissions reduction targets for Scotland, Wales and/or Northern Ireland, and how could these be reflected in our advice on the UK-wide sixth carbon budget?

ANSWER:

For EIIs the key considerations when recommending an emissions pathway or emissions reduction target for the devolved administrations is less to do with the target that's set and more to do with how the share of the burden to meet that target will be split across sectors within those countries. It's important that industry in one jurisdiction isn't put at a competitive disadvantage to the same industries in other parts of the UK. Intra-sectoral distortions across the UK must be avoided.

Question 14: The Environment (Wales) Act 2016 includes a requirement that its targets and carbon budgets are set with regard to:

- The most recent report under section 8 on the State of Natural Resources in relation to Wales;
- The most recent Future Trends report under section 11 of the Well-Being of Future Generations (Wales) Act 2015;
- The most recent report (if any) under section 23 of that Act (Future Generations report).

a) What evidence should the Committee draw on in assessing impacts on sustainable management of natural resources, as assessed in the state of natural resources report?

b) What evidence do you have of the impact of acting on climate change on well-being? What are the opportunities to improve people's well-being, or potential risks, associated with activities to reduce emissions in Wales?

c) What evidence regarding future trends as identified and analysed in the future trends report should the Committee draw on in assessing the impacts of the targets?

d) Question 12 asks how a just transition to Net Zero can be achieved across the UK. Do you have any evidence on how delivery mechanisms to help meet the UK and Welsh targets may affect workers and consumers in Wales, and how to ensure the costs and benefits of this transition are fairly distributed?

ANSWER:

14a). As well as the sustainable management of natural resources (which include minerals), it's important that Wales sustainably manages its waste resources too. As set out in the answer to question 6, MPA is concerned that the Welsh proposal to ban the incineration of waste, could inadvertently prevent the cement sector from utilising key waste biomass fuels to help it decarbonise. Use of waste fuels in cement manufacture is different to burning waste for energy because the mineral content of the waste is recycled into the cement product and there is no residual ash that requires disposal. Policy must ensure cement manufacture is not treated in the same way as waste incineration when it comes to considering the burning of waste.

14b). Generally acting on climate change can have additional benefits for well-being too. For example, designing building fabric using heavy weight materials such as concrete, that reduce or eliminate the need for heating and cooling will result in buildings that maintain a steady temperature whatever the weather, which means people don't suffer from overheating in summer or being too cold in winter. The reduction in energy required for heating and cooling will reduce the cost of running the building, which in turn relieves some of the stress associated with the high cost of energy bills. A comfortable home that is cheap to run can only be positive for general well-being.

14c). No comment

14d). No comment

Question 15: Do you have any further evidence on the appropriate level of Wales' third carbon budget (2026-30) and interim targets for 2030 and 2040, on the path to a reduction of at least 95% by 2050?

ANSWER:

In terms of the share of the burden put on EIIs, this should not go beyond that required by the UK as a whole or it might put Welsh industry at a disadvantage compared to the rest of the UK. MPA would suggest the trajectory for EIIs matches that of EU ETS or whatever UK ETS replaces this after the EU exit transition period.

Question 16: Do you have any evidence on the appropriate level of Scotland's interim emissions reduction targets in 2030 and 2040?

ANSWER:

Scotland also needs to ensure it doesn't put more burden on its EIIs compared to the rest of the UK. See the answer to Q15 above.

Question 17: In what particular respects do devolved and UK decision making need to be coordinated? How can devolved and UK decision making be coordinated effectively to achieve the best outcomes for the UK as a whole?

ANSWER:

Decision making needs to be coordinated where there are potential cross boundary impacts. This relates particularly to industry where forcing businesses in one part of the UK to decarbonise faster than other parts of the UK, with the same access to resources/technologies etc, could result in competitiveness issues and intra-sectoral market distortions. This could particularly impact the cement sector, which only has 11 plants spread across the UK.

Equally where there are more resources in one part of the UK to decarbonise, advantage should be taken and the ambition increased e.g. Scotland renewable energy resource is in abundance and it makes sense for power generation to decarbonise more rapidly than other parts of the UK. Equally some parts of the UK lend themselves to develop CO_2 transmission and storage capability. The utilisation of strategic resource such as this should be coordinated.

E. Sector-specific questions

Question 18 (Surface transport): As laid out in Chapter 5 of the Net Zero Technical Report (see page 149), the CCC's Further Ambition scenario for transport assumed 10% of car miles could be shifted to walking, cycling and public transport by 2050 (corresponding to over 30% of trips in total):

a) What percentage of trips nationwide could be avoided (e.g. through car sharing, working from home etc.) or shifted to walking, cycling (including e-bikes) and public transport by 2030/35 and by 2050? What proportion of total UK car mileage does this correspond to?

b) What policies, measures or investment could incentivise this transition?

ANSWER:

No comment.

Question 19 (Surface transport): What could the potential impact of autonomous vehicles be on transport demand?

ANSWER:

No comment.

Question 20 (Surface transport): The CCC recommended in our Net Zero advice that the phase out of conventional car sales should occur by 2035 at the latest. What are the barriers to phasing out sales of conventional vehicles by 2030? How could these be addressed? Are the supply chains well placed to scale up? What might be the adverse consequences of a phase-out of conventional vehicles by 2030 and how could these be mitigated?

ANSWER:

No comment.

Question 21 (Surface transport): In our Net Zero advice, the CCC identified three potential options to switch to zero emission HGVs – hydrogen, electrification with very fast chargers and electrification with overhead wires on motorways. What evidence and steps would be required to enable an operator to switch their fleets to one of these options? How could this transition be facilitated?

ANSWER:

The mineral products industry is looking to decarbonise and is working with HGV suppliers to determine the most appropriate route for the decarbonisation of surface transport for mineral product requirements. As well as looking at decarbonising HGV's there has been considerable investment in the minerals sector to shift product transport from road to using rail instead. This does require investment in rail access, depots for rail and an element of road travel is often still required to transport from rail depots to customers so total movement away from HGV's is difficult.

Question 21 (Surface transport): In our Net Zero advice, the CCC identified three potential options to switch to zero emission HGVs – hydrogen, electrification with very fast chargers and electrification with overhead wires on motorways. What evidence and steps would be required to enable an operator to switch their fleets to one of these options? How could this transition be facilitated?

Many HGV operators are SME's. An HGV bought new today would most likely be a Euro VI diesel powered vehicle (currently the best available technology). An operator would normally expect to operate the vehicle over a relatively long investment period, often around 8 years before investing in a replacement. Currently, there are no commercially available zero carbon (i.e. powered by hydrogen or electricity) HGV's and when they do become available their cost could potentially be prohibitively expensive, particularly for smaller operators. When considering the 6th carbon budget these investment cycles must be taken into consideration alongside a realistic timetable for the commercial availability of low carbon HGV's. Timelines for phasing out of diesel-powered HGV's need to be long enough to take account of investment cycles and a phased transition to new low carbon options. It is also likely that as this transition, and more stringent targets on air quality occurs, the market for second hand diesel HGV's will decline, which means the most carbon efficient, technologically advanced, commercially viable vehicles bought in the near future, well before zero carbon HGV's are deployed, could lose far more value than expected. This is highly likely to affect the affordability of replacement vehicles. Support is therefore likely to be required to make zero carbon HGV's affordable until prices start to reduce.

All of the zero carbon options given for HGV's require considerable investment in infrastructure. Currently hydrogen is a key focus for fuel switching for a number of sectors across industry as well as transport. Its availability depends on investment in low carbon production of hydrogen and in sufficient quantities to meet all these needs.

Commercially-viable electrification of HGVs also requires considerable investment in charging infrastructure as well as battery technology that will enable range improvements capable of hauling the necessary payloads over the required distances. New charging infrastructure will need to be capable of charging HGVs fast enough to prevent any delays to deliveries, particularly those that might be time sensitive e.g. food. The use of overhead cables seems impractical and may only work for motorways, which wouldn't therefore be applicable to 'final mile' deliveries, such as concrete mixer HGV's which will be using local road networks most of the time. Therefore, consideration needs to be given to how these vehicles can be powered. Whilst much development would be needed, a more practical option could be to embed charging plates in the road at traffic lights so when vehicles are stopped they can recharge their batteries.

An intermediate option for conversion of HGV's might be to move to the use of biofuels. As with electric and hydrogen, significant development of the infrastructure required for such technology is needed, along with identifying sustainable sources of the biofuels. This presents a similar issue to hydrogen and biomass, in that they are key technologies to decarbonise many sectors of the economy.

Off-road mobile machinery or yellow plant e.g. large quarry plant is another consideration. At the moment diesel powered engines are the only proven technology to give the power and torque necessary for the functions these vehicles need to perform at the scale required, such as quarry excavators and dumpers that are breaking, digging and hauling significant payloads. Whilst there is some alternative technology available for machines of the smallest sizes, it comes at a significantly increased cost. Considerable research and

Question 21 (Surface transport): In our Net Zero advice, the CCC identified three potential options to switch to zero emission HGVs – hydrogen, electrification with very fast chargers and electrification with overhead wires on motorways. What evidence and steps would be required to enable an operator to switch their fleets to one of these options? How could this transition be facilitated?

development is required before a commercially viable alternative to these vehicles is available, especially at the scale required.

Question 22 (Industry): What policy mechanisms should be implemented to support decarbonisation of the sectors below? Please provide evidence to support this over alternative mechanisms.

a) Manufacturing sectors at risk of carbon leakage

b) Manufacturing sectors not at risk of carbon leakage

c) Fossil fuel production sectors

d) Off-road mobile machinery

ANSWER:

a). For sectors at risk of carbon leakage, it is important to design policy to incentivise decarbonisation without pushing industries offshore. The UK Government has provided considerable support to low carbon power generation to reduce the risk of investment in new technology and assist in the transition to lower carbon power. The result has been successful with the cost of renewables coming down, the reliance on fossil fuels much lower and the resultant lower grid CO_2 factors. EIIs Implementing decarbonisation technology in industry comes at a significant cost and will require support. As renewable energy has become much more cost competitive it would make sense to refocus the public support the renewables industry has benefitted from to industry where deep decarbonisation currently presents unmanageable competitive or financial risk. This is not an additional cost to the taxpayer but a reprioritisation of support now that renewables are competitive in their own right

The Clean Steel fund is a good example of targeted sector specific support but similar support is required for the minerals sector too which has some hard to abate, 'process emission' challenges.

Other policy mechanisms that might help support manufacturing sectors as they decarbonise is for Government procurement of items like building materials, to actively prioritise locally sourced low carbon materials e.g. cement produced using CCUS. The proximity principle has a role to play here.

The prevention of carbon leakage should be the central plank of any comprehensive decarbonisation strategy. Offshoring emissions driven by unequal carbon pricing or 'carbon leakage' potentially pushes the environmental problem to countries that are currently less capable of managing the decarbonisation transition. As such, carbon leakage provision within policies such as the EU emissions trading system or any UK equivalent must be retained. Furthermore, the UK's island geography makes it particularly vulnerable to imported material. Cement is a material that has traditionally been thought of as a local

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product and heavy to transport for its low value, however, imports now stand at 23% of UK cement consumption illustrating the particular vulnerability of the UK.

This vulnerability to carbon leakage was evidenced in the most recent carbon leakage assessment for EU ETS (available here: https://ec.europa.eu/clima/sites/clima/files/events/docs/0127/6_cll-ei-ti_results_en.pdf). This showed that in terms of emissions intensity (including both direct and indirect emissions), the cement and lime sectors are the two most exposed sectors out of all 245 sectors assessed. When combined with trade intensity and indirect emissions intensity, the cement sector had the 5th highest carbon leakage indicator and lime was 16th on the list.

b). Sectors that are not at risk of carbon leakage are more likely to be able to pass some of the decarbonisation cost through to their customers. In this case it's important that businesses know the technology options available to them for investing in reducing emissions. Policies like Climate Change Agreements work well to make businesses more aware of their energy use and emissions and help them focus investment on reductions.

c). No comment

d). Off-road mobile machinery or yellow plant is used extensively in mineral sectors. It is likely to be particularly difficult to decarbonise because of the nature of the work these vehicles are required to do. Policy therefore needs to support and incentivise further development in both electric and hydrogen for use in future.

Question 23 (Industry): What would you highlight as international examples of good policy/practice on decarbonisation of manufacturing and fossil fuel supply emissions? Is there evidence to suggest that these policies or practices created economic opportunities (e.g. increased market shares, job creation) for the manufacturing and fossil fuel supply sectors?

ANSWER:

The Italian White Certificate scheme incentivises the take up of biomass fuels to replace natural gas use in industry in Italy. This has successfully increased biomass use and is something the UK could consider. More information is available here: https://es.catapult.org.uk/wp-content/uploads/2018/10/Italy-White-Certificate-Scheme-Case-Study-FINAL.pdf

Co-processing of fuels in cement and lime manufacture is international best practice as set out in the cement and lime BREF document (https://ec.europa.eu/jrc/en/publication/reference-reports/best-available-techniques-bat-reference-document-production-cement-lime-and-magnesium-oxide). As described in the

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answer to question 6, as well as utilising the energy content of fuels, cement and dolomitic lime manufacture recycles the mineral content into the product produced. There is no residual fuel ash that requires disposal. Cement and lime are well placed for fuel switching if the right support is in place to enable this.

Question 24 (Industry): How can the UK achieve a just transition in the fossil fuel supply sectors?

ANSWER:

No comment.

Question 25 (Industry): In our Net Zero advice, the CCC identified a range of resource efficiency measures that can reduce emissions (see Chapter 4 of the Net Zero Technical Report, page 115), but found little evidence relating to the costs/savings of these measures. What evidence is there on the costs/savings of these and other resource efficiency measures (ideally on a £/tCO2e basis)?

ANSWER:

Under the topic of construction, the CCC identified using more timber in construction and using more clinker substitutes in cement manufacture as methods of reducing emissions. Increasing the use of timber may appear to reduce the embodied emissions of a building but often these claims do not take into consideration all of the emissions associated with timber production and that it takes many decades to replace the CO_2 through the planting of new trees i.e. the carbon payback time of deforestation.

A report on “Emission Omissions: Carbon accounting gaps in the built environment” by the International Institute for Sustainable Development (https://www.iisd.org/library/emission-omissions) highlighted that:

1. Compared to a baseline that assumes biogenic carbon emissions are zero over the building life cycle, cradle-to-gate life-cycle emissions for wood buildings increased between 5% and 72% depending on the scenario.
2. Wood building products’ end-of-life emissions are highly dependent on disposal conditions
3. Biogenic carbon emissions and sequestration related to the production and end-of-life stages of wood building products hold the most significant uncertainty in existing LCAs.
4. Previous studies have found that as little as 15% of the carbon stored in a standing tree is sequestered in the final wood product.

The use of lightweight building materials requires the use of considerable insulation. In winter this may result in warm homes that are affordable to heat but as summer

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temperatures rise, insulation traps heat in the house leading to overheating. When this occurs, the occupant may resort to artificial methods of cooling the house. Air conditioning often has considerable emissions of F-gases associated with its production and a high energy demand in use. Therefore, although increasing the use of timber in construction may seem an easy win for replacing other construction materials, it is unclear as to whether emissions are genuinely reduced over the lifetime of the building, including during operation and especially at end of life when timber is often disposed of via landfill or incineration.

Clinker substitutes in cement manufacture and concrete use are already heavily utilised in the UK. The ECRA CSI technology papers for cement set out some costs for the use of clinker substitutes (see https://ecra-online.org/fileadmin/redaktion/files/pdf/CSI_ECRA_Technology_Papers_2017.pdf).

Question 26 (Buildings): For the majority of the housing stock in the CCC's Net Zero Further Ambition scenario, 2050 is assumed to be a realistic timeframe for full roll-out of energy efficiency and low-carbon heating.

a) What evidence can you point to about the potential for decarbonising heat in buildings more quickly?

b) What evidence do you have about the role behaviour change could play in driving forward more extensive decarbonisation of the building stock more quickly? What are the costs/levels of abatement that might be associated with a behaviour-led transition?

ANSWER:

26a). Decarbonising heat in new buildings could be achieved quickly through good building design that utilises thermal mass to reduce or eliminate the need for heating and cooling energy, providing a long lasting zero carbon legacy for future generations. The materials and knowledge to do this are already available and could be implemented today rather than waiting for low carbon heating options to be developed and the market to gain enough confidence to try them out.

26b). The Carbon Budget should keep any behavioural change requirements to an absolute minimum because it is difficult to achieve and introduces considerable uncertainty that targets will be met. Ideally behavioural change and occupant choice needs to be taken out of the equation wherever possible. Innovative design can help to do this where buildings are concerned. Houses have been specially designed and built using heavy weight materials like concrete that require no heating in winter or cooling in summer (e.g. https://www.nottingham.ac.uk/creative-energy-homes/houses/tarmac-house/tarmac-houses.aspx). Rather than being dependent on occupiers turning the thermostat down or not using air conditioning in the summer, ensuring buildings maintain a comfortable steady temperature year-round can reduce the need to even have a thermostat in the first place. This does require careful design and positioning of the building to make best use of sunlight and shade etc but it can be done.

Question 27 (Buildings): Do we currently have the right skills in place to enable widespread retrofit and build of low-carbon buildings? If not, where are skills lacking and what are the gaps in the current training framework? To what extent are existing skill sets readily transferable to low-carbon skills requirements?

ANSWER:

The key skills that are needed in this area is in the design of homes that don't just keep occupants warm in winter but prevent overheating and reduce energy use. These skills are available but more needs to be done to get the message out to architects and specifiers.

Question 28 (Buildings): How can local/regional and national decision making be coordinated effectively to achieve the best outcomes for the UK as a whole? Can you point to any case studies which illustrate successful local or regional governance models for decision making in heat decarbonisation?

ANSWER:

A promotion of the benefits of utilising the high thermal mass properties of heavy weight building materials such as concrete nationally, could help extend the coverage and benefit of local heat networks. Thermal mass can be used to store heat when there is an excess of heat available and maintain a steady temperature within homes when there might be less heat available.

The same mechanism can also help reduce consumer demand for electricity for heating and cooling at peak times as set out in this report: http://www.3e.eu/buildings-sites/buildings-sites-our-work/structural-thermal-energy-storage-in-heavy-weight-buildings/

Question 29 (Power): Think of a possible future power system without Government backed Contracts-for-Difference. What business models and/or policy instruments could be used to continue to decarbonise UK power emissions to close to zero by 2050, whilst minimising costs?

ANSWER:

The UK Government has provided considerable support to low carbon power generation to reduce the risk of investment in new technology and assist in the transition to lower carbon power. The result has been successful with the cost of renewables coming down, the reliance on fossil fuels much lower and the resultant lower grid CO_2 factors. EIIs Implementing decarbonisation technology in industry comes at a significant cost and will require support. As renewable energy has become much more cost competitive it would make sense to refocus the public support the renewables industry has benefitted from to industry where deep decarbonisation currently presents unmanageable competitive or financial risk. This is not an additional cost to the taxpayer but a reprioritisation of support now that renewables are competitive in their own right

Question 30 (Power): In Chapter 2 of the Net Zero Technical Report we presented an illustrative power scenario for 2050 (see pages 40-41 in particular):

a) Which low-carbon technologies could play a greater/lesser role in the 2050 generation mix? What about in a generation mix in 2030/35?

b) Power from weather-dependent renewables is highly variable on both daily and seasonal scales. Modelling by Imperial College which informed the illustrative 2050 scenario suggested an important role for interconnection, battery storage and flexible demand in a future low-carbon power system:

   i. What other technologies could play a role here?

   ii. What evidence do you have for how much demand side flexibility might be realised?

ANSWER:

No comment

Question 31 (Hydrogen): The Committee has recommended the Government support the delivery of at least one large-scale low-carbon hydrogen production facility in the 2020s. Beyond this initial facility, what mechanisms can be used to efficiently incentivise the production and use of low-carbon hydrogen? What are the most likely early applications for hydrogen?

ANSWER:

BEIS funded a project in the cement sector looking at the feasibility of using hydrogen as a fuel in cement manufacture. The study showed that hydrogen could replace around 10% of the current thermal input to cement manufacture (BEIS is due to publish a summary report of the work for more information). There are some technical barriers to overcome to the use of hydrogen and currently it's prohibitively expensive. However, if the technical barriers are overcome and support was available for its use, then the cement sector could be a possible option for its early adoption. There is potential for other mineral products such as asphalt and lime production to utilise hydrogen or a natural gas/hydrogen blend.

Question 32 (Aviation and Shipping): In September 2019 the Committee published advice to Government on international aviation and shipping and Net Zero. The Committee recognises that the primary policy approach for reducing emissions in these sectors should be set at the international level (e.g. through the International Civil Aviation Organisation and International Maritime Organisation). However, there is still a role for supplementary domestic policies to complement the international approach, provided these do not lead to concerns about competitiveness or carbon leakage. What are the domestic measures the UK could take to reduce aviation and shipping emissions over the period to 2030/35 and longer-term to 2050, which would not create significant competitiveness or carbon leakage risks? How much could these reduce emissions?

ANSWER:

No comment

Question 33 (Agriculture and Land use): In Chapter 7 of the Net Zero Technical Report we presented our Further Ambition scenario for agriculture and land use (see page 199). The scenario requires measures to release land currently used for food production for other uses, whilst maintaining current per-capita food production. This is achieved through:

- A 20% reduction in consumption of red meat and dairy
- A 20% reduction in food waste by 2025
- Moving 10% of horticulture indoors
- An increase in agriculture productivity:
  - Crop yields rising from the current average of 8 tonnes/hectare for wheat (and equivalent rates for other crops) to 10 tonnes/hectare
  - Livestock stocking density increasing from just over 1 livestock unit (LU)/hectare to 1.5 LU/hectare

Can this increase in productivity be delivered in a sustainable manner?

Do you agree that these are the right measures and with the broad level of ambition indicated? Are there additional measures you would suggest?

ANSWER:

No comment

Question 34 (Agriculture and Land use): Land spared through the measures set out in question 33 is used in our Further Ambition scenario for: afforestation (30,000 hectares/year), bioenergy crops (23,000 hectares/year), agro-forestry and hedgerows (~10% of agricultural land) and peatland restoration (50% of upland peat, 25% lowland peat). We also assume the take-up of low-carbon farming practices for soils and livestock. Do you agree that these are the key measures and with the broad level of ambition of each? Are there additional measures you would suggest?

ANSWER:

Bioenergy requirements are only going to increase as all sectors of the economy do their part to meet the net zero ambition. Many industries' net zero plans have relied heavily on bioenergy, suggesting a big growth in demand. Establishing the right framework for the market to deliver enough biomass in the context of the wider changes in environment and agriculture policy will be vital.

Question 35 (Greenhouse gas removals): What relevant evidence exists regarding constraints on the rate at which the deployment of engineered GHG removals in the UK (such as bioenergy with carbon capture and storage or direct air capture) could scale-up by 2035?

ANSWER:

If the CCC are considering direct air capture in the 6th Carbon Budget then the removal of CO_2 from the atmosphere by concrete in use and at end of life must also be considered as a sink and an estimation of its CO_2 removal potential to 2050 included in the budget. There

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is considerable evidence on this reaction including calculations of how much CO_2 is taken up in the process. Further information can be found here: https://cembureau.eu/media/1753/ivl-report-co2-uptake-in-cement-containing-products-isbn-number-b2309.pdf

Question 36 (Greenhouse gas removals): Is there evidence regarding near-term expected learning curves for the cost of engineered GHG removal through technologies such as bioenergy with carbon capture and storage or direct air capture of CO_2?

ANSWER:

As mentioned in answer to question 35 recarbonation of concrete throughout its life is an important CO_2 sink that should be included in greenhouse gas accounting. There are opportunities to increase recarbonation particularly at end of life. The report by IVL (referenced above in the answer to question 35) sets out some measures to increase CO_2 uptake at end of life including storing the crushed material in fractions and sheltering them from the rain to enhance air circulation in the piles.

Another option for greenhouse gas removals is accelerated carbonation. This process can be used to produce useful materials/ products such as building materials and aggregates as well as removing CO_2 from the atmosphere. The speed at which these technologies are progressing is increasing and there are now a number of examples of use of these technologies and funding streams to increase their development further including:

Carbon8 (http://c8s.co.uk/technology/): Carbon8 Systems uses carbon dioxide (CO_2) to carbonate and treat a broad range of industrial by-products and residues. The process is a controlled, accelerated version of the naturally occurring carbonation process, but takes 15-20 minutes instead of the decades to millennia of the natural process. This circular solution can turn thermal and industrial by-products into mineralised products for various applications.

CO_2LOC (http://www.cacaca.co.uk/): Patented CO_2LOC technology sequesters CO_2 through a two-stage mineralization process which permanently locks the sequestered CO_2 in rock form and due to its flexibility, can be utilized across a range of industries.

CO_2 Concrete (https://www.co2concrete.com/): CO_2Concrete uses CO_2 to make precast CO_2Concrete™ products.

CarbonCure (https://www.carboncure.com/): CarbonCure manufactures a technology for concrete producers that introduces recycled CO2 into fresh concrete.

CarbonXPrize (https://carbon.xprize.org/prizes/carbon): The $20 million NRG COSIA Carbon XPRIZE is a global competition to develop breakthrough technologies that will convert CO_2 emissions from power plants and industrial facilities into valuable products like building materials, alternative fuels and other items that we use every day.

Question 37 (Infrastructure): What will be the key factors that will determine whether decarbonisation of heat in a particular area will require investment in the electricity distribution network, the gas distribution network or a heat network?

ANSWER:

No comment

Question 38 (Infrastructure): What scale of carbon capture and storage development is needed and what does that mean for development of CO_2 transport and storage infrastructure over the period to 2030?

ANSWER:

MPA has estimated that by 2050 the UK cement industry will need to be capturing at least 6 million tonnes of CO_2 if it is to match UK net zero ambitions. Only around 2 million tonnes of this CO_2 is emitted at plants that are in the vicinity of industrial cluster regions. That means that infrastructure to transport around 4 million tonnes of CO_2 from relatively isolated inland areas of the UK (e.g. Derbyshire) will be required for the cement industry alone.

The above covers the transport and storage aspect but further research and development is required for the technology to capture the CO_2 in the first place. Currently there is no UK based research taking place on this, although many MPA members and MPA itself are involved in capture projects across Europe. It will be important to start targeting CCUS funding at UK cement plants so a specific UK demonstration can be realised.