Bioenergy Review (2018) - Call for Evidence

Please answer only those questions where you have particular expertise and are able to provide links to supporting evidence.

In 2011 the Committee on Climate Change (CCC) published a Bioenergy Review to provide an assessment of the potential role of bioenergy in meeting the UK's carbon budgets. The Bioenergy Review drew on the best available evidence to address questions relating to the sustainability of bioenergy, lifecycle emissions, resource availability and best-use across the economy. It highlighted the importance of bioenergy for meeting the UK's climate change targets and made recommendations for tightening the sustainability standards for bioenergy resources - recommendations that were subsequently adopted by the UK Government.

The CCC is now planning to update its work on bioenergy, culminating in a new Bioenergy Review to be published in Autumn 2018. This will consider the latest evidence to provide an updated view on the role of bioenergy in decarbonising the UK economy through to 2050. Key themes to be explored include sustainability and certification, GHG emissions accounting, developing sustainable supply, non-energy uses of bioenergy resources, and transitions to future best-uses of bioenergy resources. We will identify recommendations for further action and aim to develop indicators to allow the CCC to monitor progress over time.

Stakeholder engagement will underpin the 2018 Bioenergy Review. This Call for Evidence is the first formal step in the engagement process. It is intended to provide all stakeholders with the opportunity to input to the CCC's work and to enable the CCC to draw on the full range of up-to-date evidence relating to bioenergy production, sustainability and use.

The Call for Evidence will be followed by stakeholder workshops on specific key topics in 2018. In addition, we will be establishing an Expert Advisory Group to provide advice and support to the CCC throughout the review.

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. We may follow up for more detail where appropriate.

Please use the website form when responding, or if you prefer you can use this word form and e-mail your responses to: communications@theccc.gsi.gov.uk. Alternatively, if you would prefer to post your response to us, please send it to:

The Committee on Climate Change – 2018 Bioenergy Review Call for Evidence
7 Holbein Place
London SW1W 8NR

The deadline for responses is 9am on 5th February 2018.

Confidentiality and data protection

Responses will be published on the CCC 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).

Information on organisation / individual submitting response

If you are responding on behalf of an organisation please provide a brief description of your organisation and your role within this organisation.

Dr Diana Casey, Senior Advisor Energy and Climate Change, Mineral Products Association.
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The Mineral Products Association (MPA) is the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries. With the recent addition of British Precast and the British Association of Reinforcement (BAR), it has a growing membership of 480 companies and is the sectoral voice for mineral products. MPA Membership is made up of the vast majority of independent SME quarrying companies throughout the UK, as well as the 9 major international and global companies. It covers 100% cement production, 90% of aggregates production, 95% of asphalt and over 70% of ready-mixed concrete production and precast concrete production.

Each year the industry supplies £20billion worth of materials and services to the Economy and is the largest supplier to the construction industry, which has annual output valued at

£144billion. Industry production represents the largest materials flow in the UK economy and is also one of the largest manufacturing sectors.

If you are responding as an individual we would be grateful if you could provide a brief description of your background and interest in bioenergy.

GHG emissions and sustainability of bioenergy imports

Our 2011 Bioenergy Review concluded that UK and EU regulatory approaches should be strengthened to better reflect estimates of the full lifecycle emissions of bioenergy feedstocks, taking into account both direct and indirect land-use change impacts. Whilst changes have been made to these regulatory frameworks, both life-cycle emissions and the wider sustainability impacts of bioenergy remain highly contested issues, particularly in relation to bioenergy imports. Given the potential role for bioenergy in the UK's low-carbon transition, and the potential increase in bioenergy feedstock production in the future, it will be essential that policy is based on the latest available evidence and that bioenergy is genuinely sustainable.

The term 'sustainable' here is used to cover a wide-range of issues relating to GHG emissions, biodiversity, water use, land-use, land-rights, air-quality and other social and environmental issues.

1. What is the latest evidence on lifecycle GHG emissions of biomass and other biofuels imported into the UK? How could this change over time as a function of scaling up supply? We are particularly interested in evidence that considers the full range of relevant issues including changes to forest and land carbon stocks, direct and indirect land-use change and wider market effects.

- GHG emissions relating to imported wood for construction, will be higher than domestically produced wood, due to the additional transport emissions. The lifecycle emissions of glued wood products such as cross laminated timber are currently unclear as they are relatively new to the market. It could be that the timber glues/resins are higher in GHG footprint than mineral based binders used in other construction materials.
- The Forestry Commission's latest National Statistics show that the UK was the second largest net importer of forest products in 2015, behind China[1].
- The impacts of imported biomass are greater than just GHG emissions. How do UK buyers of imported materials ensure that the biomass is sustainably and responsibly sourced?
- The question talks about scaling up supply, but imports will always be threatened by being diverted to other countries that may be able to pay more or are closer to the source of the material. It would be better from a security of supply point of view and a sustainability point of view if UK biomass needs were sourced from within the UK or alternative materials are used, for example, the use of concrete in construction, which is almost entirely sourced and produced in the UK.

[1] *"Forestry Statistics 2017"*, Issued by IFOS-Statistics, Forest Research, Sept 2017

2. Under what circumstances can imported biomass and other biofuels deliver real GHG emissions savings (considering full life-cycle emissions and indirect/wider market effects)? Conversely, what evidence is there for ruling out certain sources on the grounds of lifecycle GHG emissions or sustainability risks?

- In terms of waste biomass, there is likely to be a large enough supply in the UK that imports are unnecessary. In fact the use of such fuels by cement manufacturers may reduce the need for some wastes e.g. refuse derived waste, from being exported to other countries for processing. The China import restrictions on plastic and paper are also likely to increase the amount of waste biomass that needs to be treated domestically. Incineration, EfW and landfill are all less environmentally desirable options than using the biomass to replace coal in cement kilns.

3. Currently the UK imports a significant proportion of wood pellets for biomass electricity production from North America, particularly the south-east USA.

a) **What are the wider market impacts of demand for wood pellets on forestry management practices and carbon stocks at the landscape level in North America?**
b) **What evidence is there that wood pellet production displaces other uses of forestry products in North America? (e.g. panel board or lumber production)**
c) **What are the most likely alternative/counterfactual uses of forestry products used for wood pellet production?**
d) **How are these wider market impacts (sub-questions a-c) likely to change over time if demand for wood pellets significantly increases?**

- No comment

4. Aside from GHG emissions, what evidence is there of other sustainability impacts associated with imported biomass or other biofuels? What evidence is there for how these might change as a function of scaling up supply (from the US, and internationally)?

- In sourcing biomass from outside of the UK, the UK loses control over the supply chain. It is more difficult to check that the biomass is sustainably and responsibly sourced, for example to ensure that timber for construction is sourced from well managed forests. Increased demand for sustainably sourced timber, e.g. from the construction industry, may also have indirect effects if it causes other timber users to shift to less sustainable sources. Biomass from unsustainable sources could have considerable impacts resulting from land use change and could diminish the amount of biomass grown as well as reduce the emissions and soil benefits biomass brings from being left in the ground.

5. Are there any benefits resulting from importing biomass or other biofuels into the UK (e.g. development benefits)? How might these vary internationally? What are the conditions required for any benefits to be realised?

- There may be wider environmental and sustainability benefits for importing waste biomass if the country exporting the biomass does not have the facilities to dispose of it properly with the least possible risk to the environment. However, there would need to be enough capacity in the UK to handle this biomass and MPA believes the UK should ensure proper use of the biomass waste it has before looking to import more.

Sustainability policy and certification

The sustainability framework for bioenergy in the UK has evolved significantly since 2011. Changes have included the tightening over time of lifecycle GHG emissions limits for bioenergy supported under Government incentive schemes, changes to EU rules on liquid biofuels and the development of certification schemes. Nonetheless questions remain regarding the current framework's capacity to guarantee high sustainability standards.

The term 'sustainability framework' refers here to the policies, regulations and incentives in place to promote bioenergy sustainability in the UK.

6. What are the strengths, weaknesses and gaps of the current sustainability framework for bioenergy in the UK? How could the current sustainability framework for bioenergy in the UK be improved to address these issues?

- The current sustainability framework must treat waste biomass differently to that of virgin biomass. The use of waste biomass has benefits that go above and beyond that of natural biomass. For example, using the waste prevents it from being disposed in landfill and emissions from land use change are avoided. Waste biomass should therefore be separated out from virgin biomass in the sustainability framework and the benefits of using it over virgin biomass further explored.
- Sustainable bioenergy use is incentivised under the Renewable Heat Incentive. Only some activities can access this incentive and therefore biomass is switching from one consumer to another with a net detriment to the environment. For example biomass that was used very efficiently to heat cement kilns with no process waste going to landfill is now being used in RHI incentivised combustion and digestion which is less efficient from a waste and energy perspective. Government needs to address this weakness in the UK's bioenergy framework.

7. Ofgem has identified a number of certification schemes that it considers appropriate for demonstrating compliance with the 'Land Criteria' under the Renewable Obligation sustainability standards. Are these certification schemes adequate? Why/why not? How could they be improved?

- No comment

8. What certification schemes currently represent 'best practice'? Why?

- No comment

9. Ofgem has set out approaches to calculating bioenergy GHG emissions for demonstrating compliance with the 'GHG Criteria' under the Renewable Obligation sustainability standards. Are these approaches adequate? Why/why not? How could they be improved?

- No comment

10. Please highlight any further measures you feel are required to ensure bioenergy feedstocks used in the UK are sustainable and deliver significant life-cycle GHG emissions savings. Why are these measures needed?

- The GHG emission savings from bioenergy will be greater if the bioenergy is used in the most efficient way possible. In determining a hierarchy for bioenergy consumption, consideration should be given to the energy efficiency of the process and any wider benefits from e.g. recycling as well as the GHG savings that can be made.
- The cement and dolomitic lime sectors use a number of waste fuels that are 100% or part biomass including meat and bone meal, paper sludges, waste wood, tyres and refuse derived fuel. The cement and dolomitic lime manufacturing process offers a very energy efficient method of utilising this waste biomass because the heat from the combustion of these fuels is used directly, rather than to heat an intermediary substance e.g. steam for power generation.
- Furthermore, unlike other combustion processes – such as power generation, incineration and biomass boilers – the ash from fossil and waste-derived fuels forms part of the mineral content of the cement and dolomitic lime, and is not a waste residue. Thus, the mineral content of the waste is recycled as well as the energy recovered. This is known as 'co-processing' i.e. recycling with simultaneous energy recovery.
- Biomass should be discouraged from combustion activities that generate an ash waste for disposal and encouraged where the biomass combustion ash is incorporated into the final product.

11. Some large UK users of imported biomass use a risk-based approach to assess the sustainability risks associated with importing biomass from specific jurisdictions. What is the role for these approaches?

- No comment

Supply of bioenergy feedstocks

In our 2011 Bioenergy Review we considered scenarios for the amount of sustainable bioenergy resource available to the UK over the coming decades. Our central 'Extended Land Use' scenario suggested that around 10% of the UK's primary energy demand could be met from bioenergy in 2050, with over half coming from domestic feedstocks. We are now looking to develop new supply scenarios through to 2050 to reflect the latest evidence on sustainability and different assumptions about the potential future availability of imported and domestically produced bioenergy resources.

To support the development of these scenarios and our wider work, the CCC is currently undertaking new analysis on how the use and management of land in the UK can deliver deeper emissions reduction and increased sequestration. This analysis will provide updated data on the potential supply of non-waste and non-food bioenergy resources from UK sources. For projections of international bioenergy resources and waste-based UK bioenergy resources we will review the latest evidence and publicly available literature. We are particularly interested in quantitative estimates of resource potential, broken down by feedstock type, that are underpinned by explicit assumptions relating to sustainability.

12. What are the most credible and up-to-date estimates for global bioenergy resource potential through to 2050, broken down by feedstock type? What key assumptions underpin these estimates?

Please provide details of any assessments of global bioenergy resource explicitly tied to sustainability standards (covering GHG emissions, biodiversity, water use, land-use, land-rights, air-quality and other social and environmental issues)

- No comment

13. What is the latest evidence relating to the availability of 'marginal' and abandoned agricultural land for growing bioenergy crops (where possible, reflecting broader sustainability requirements e.g. water stress, biodiversity, social issues)? Is this evidence adequately reflected in global resource estimates?

- No comment

14. What are the most credible and up-to-date estimates for the amount of bioenergy resource that could be produced from UK waste sources through to 2050? Where possible please state any assumptions relating the reduction, reuse and recycling of different future waste streams.

- In considering global bioenergy resource the CCC must consider both 100% biomass sources and sources that are part biomass e.g. tyres, refuse derived fuel and waste wood (wood which contains glues, paints and/or preservatives). Although these latter sources are only partly biomass, they have a valuable role to play in emissions reduction.

15. What factors (opportunities, constraints, assumptions) should the CCC reflect in its bioenergy resource scenarios through to 2050?

- In assessing resource scenarios for non-energy biomass uses, the CCC must carefully consider alternatives to biomass and the real whole life savings that the biomass source can make compared to those alternatives. For example, when considering wood in construction, the CCC must weigh up whether, across the entire life of a building, timber can produce real GHG savings compared to other materials such as concrete. This assessment must:
    - Compare materials on a like for like basis i.e. the timber and concrete have to have the same structural performance.
    - Note the important differences between untreated timber/lumber and wood construction components such as Glulam and Cross Laminated Timber. The latter products have a GHG impact (both in production and at disposal) associated with the glues, resins and preservatives used for treatment.
    - Include any emissions from the transport of imported products.
    - Look at what the building material can do to reduce the need for heating and cooling by the occupants, which itself produces considerable GHG emissions
    - Show what emissions are produced at the end of the buildings life. Where does the material go after demolition? Into landfill? Is it incinerated? Can it be recycled? How long does the building last? Does it have to be demolished or can it be refurbished or re-purposed?

16. What should be the assumptions on the share of international resource which can be accessed by the UK (e.g. per capita, current or future energy demand)?

- The UK share of finite biomass resources is likely to decrease as more countries switch to use bioenergy to meet emission reduction targets and GHG reduction ambitions e.g. Paris Agreement.

17. What are the prospects for the development and commercial production of 3rd generation bioenergy feedstocks (e.g. algae)? What are the timescales, costs, risks, opportunities and abatement potential of using algae to make biofuels?

- The cement industry has researched the growth and use of algae but there are many other decarbonisation options that would be chosen before taking this any further.

Scaling up UK sustainable supply

An objective of our current work on bioenergy is to better understand and reflect the potential for scaling-up of the supply of sustainably produced domestic (UK) bioenergy resources through to 2050. We aim to identify and develop policy recommendations for 'low-regrets' measures/strategies that can be implemented in the near term.

18. What are the main opportunities to scale-up the supply of sustainably-produced domestic bioenergy supply in the UK? Where possible please provide details on the scale of opportunity.

- The environmental and sustainability benefits that waste biomass bring over that of virgin biomass mean that waste biomass should be processed into useful energy before virgin biomass supply is scaled up.
- Scaling up of supply, requires more demand. There is more opportunity to supply the cement and dolomitic lime sectors with waste biomass. In 2016, 39% of the thermal input was sourced from waste derived fuels (around 17% from waste biomass sources). There is potential for 80% of the thermal input in cement kilns to be sourced from waste fuels (40% from biomass sources).

19. What risks are associated with scaling-up domestic supply and how can these risks be managed?

In terms of non-energy biomass:

- The scale up of wood in construction could lead to increased energy use to heat and cool buildings and an increase in hazardous waste when the building is demolished. The use of biomass does not automatically mean a reduction in emissions when the whole life of a building is considered.
- This risk can be managed through a full impact assessment of the use of wood in construction across the whole life cycle of a building and comparing this to that of other materials such as concrete (see response to question 28 for more detailed information on what should be included in a whole life assessment).

20. What 'low-regrets' measures should be taken now (e.g. planting strategies) to increase sustainably-produced domestic bioenergy supply?

- The use of waste biomass could be incentivised over the use of virgin biomass. This might encourage greater investment in the processing of waste into fuel and increase supply.

21. What international examples of best-practice should the UK should look to when considering approaches to scaling-up domestic supply?

- No comment

22. What policy measures should be considered by Government to help scale-up domestic supply?

- Supply will likely scale up if the demand for bioenergy is increased. Currently government incentives such as RHI and CfD shift bioenergy from one sector that doesn't receive incentives, to another that does. A level playing field in terms of incentives is required for all bioenergy consumers if demand is to increase.

Best-use of bioenergy resources

Our 2011 review developed a hierarchy of appropriate uses for bioenergy feedstocks based on minimising costs and maximising abatement. We concluded that if CCS technology is available it is appropriate to use bioenergy in applications with CCS, making it possible to achieve negative emissions under the right circumstances. This could include power and/or heat generation, hydrogen production, and biofuels production for use in aviation and shipping. If CCS is not available, bioenergy use could be skewed towards heat generation in energy-intensive industry, and to biofuels in aviation and shipping, with no appropriate role in power generation or surface transport. In either case, we concluded the use of woody biomass in construction should be a high priority given that this can potentially secure negative emissions through a very efficient form of carbon capture.

We are now looking to update this analysis to reflect the latest technological and market developments. We are particularly interested in technologies such as biomass gasification, CCS and advanced second and third generation biofuels as well as the potential role of hydrogen to support decarbonisation across the economy. To support our consideration of these areas, the CCC is currently undertaking analysis into the potential of the hydrogen economy and we are planning to undertake further investigation into non-energy uses of bioenergy resources.

23. Gasification has been identified as a potentially important technology for unlocking the full potential of bioenergy to support economy-wide decarbonisation.

a) **What are the likely timescales for commercial deployment of gasification technologies?**
b) **What efficiencies and costs are likely to be achieved? What scope is there for improvement and/or cost reductions over time? Please differentiate between feedstocks where possible/necessary.**

c) **What are the main barriers and uncertainties associated with the development, deployment and use of gasification technologies?**
d) **What risks are associated with gasification technologies and how can these be managed?**
e) **What policies and incentives are required to facilitate commercial deployment?**

- No comment

24. Bioenergy with Carbon Capture and Storage (BECCS) has been identified as a key potential mechanism for achieving the UK's 2050 carbon target due to the 'negative emissions' it could offer.

a) **What are the potential timescales for commercial deployment of BECCS technologies?**
b) **What are likely to be the optimal uses of BECCS (e.g. electricity generation, hydrogen production)?**
c) **What efficiencies and costs are possible?**
d) **How will performance and cost differ according to feedstock type? What are likely to be the optimal feedstock types for BECCS? What are the implications for domestic supply vs imports (e.g. feasibility, considerations in scaling up over time)?**
a. **What are the main barriers and uncertainties associated with the development, deployment and use of BECCS?**
b. **What are the risks associated with the pursuit of BECCS that go beyond the risks that relate to supplying sustainable feedstocks and CCS more generally? How can these be managed?**

- The 2015 decarbonisation and energy efficiency roadmap identified that CCS and CCU are vital to the decarbonisation of the cement sector, which has a very high proportion of unavoidable process emissions (around 70%) that arise from the chemical decomposition of raw materials including limestone. In 2017, MPA co-signed an action plan with the Minister of State for Climate Change and Industry, which set out the tasks needed to help decarbonise the cement sector.
- The main barriers to deployment of CCS and CCU in the cement sector include the current high cost of developing the capture technology, the isolated location of many cement plants and the lack of a strategy for infrastructure and storage in the UK.
- MPA is concerned that the development of BECCS for power generation could divert much needed biomass fuel sources from cement manufacture. The likely delay in deploying CCS in the cement sector compared to that in power generation (as a result of the barriers identified above) and a diversion of biomass fuel away from the sector could have serious implications for decarbonisation of cement manufacture and its competitiveness. This goes against the ambition of BEIS to help the cement sector to decarbonise where the Minister of State at the Department for Business, Energy and Industrial Strategy has co-signed the cement sector decarbonisation action plan.
- The CCC bioenergy review should therefore consider any wider impacts the use of BECCS might have on other sectors of the economy that are unable to deploy CCS/BECCS as quickly as in power generation.

25. Once developed BECCS is a technology that could be deployed in many different countries around the world. What principles and mechanisms should be used to determine where BECCS is deployed and how any associated negative emissions are accounted for? Should any UK participation in any international BECCS scheme be counted as additional to efforts to meet domestic carbon budgets?

- The UK should focus on assisting its domestic industry to decarbonise production in a similar way that it has assisted power generation. Biomass fuelled cement and lime production offers similar environmental benefits to bioenergy CCS for power. However, for power generation there are many more technological options for decarbonisation than exist in industrial processes such as cement and lime manufacture.

26. There is currently substantial interest in the development of 'advanced' biofuels for use in sectors such as aviation, shipping and/or heavy duty transport.

a) **What are the most promising technologies/processes for advanced biofuel production up to 2050? Please provide details on each technology/process including advantages/disadvantages, timescales for commercial deployment, feedstock type, fuel type and end-user.**
b) **What efficiencies and costs are likely to be achieved? What scope is there for improvement and/or cost reductions over time? Please differentiate between technologies/processes.**
c) **What are likely to be the optimal feedstock types for advanced biofuel technologies?**
d) **What are likely to be the optimal end-uses of advanced biofuel technologies?**
e) **What are the main barriers and uncertainties associated with the development, deployment and use of advanced biofuel technologies?**
f) **What risks are associated with the pursuit of advanced biofuel technologies and how can these be managed?**
g) **What policies and incentives are required to facilitate commercial deployment of advanced biofuels?**

- No comment

27. In 2015 the Government published the Industrial Decarbonisation and Energy Efficiency Roadmaps to 2050. These Roadmaps explored decarbonisation options across multiple industrial sectors and the estimated deployment potential, timescales, cost data and abatement for each option (including bioenergy). Are there any substantial changes from these estimates that the CCC should consider when assessing abatement options in industry? If so please provide your reasoning and details of any recent evidence that relates to these changes.

- The data and information contained within the BEIS cement roadmap is still relevant as is the information in the MPA roadmap that was published in 2013[2].

[2] "*Greenhouse gas reduction strategy*", Mineral Products Association, 2013, http://cement.mineralproducts.org/documents/MPA_Cement_2050_Strategy.pdf

- However, over the last few years MPA has reported a worrying downward trend in the use of waste derived fuels including waste biomass fuels in cement manufacture. In 2016 39% of the thermal energy required to produce cement was sourced from waste derived fuels. 17% of the thermal energy (included within the 39%) was sourced from waste biomass (see Figure 1 for information on 2016 fuel use). This is a reduction from a peak of 44% waste derived fuel use in 2014 with almost 20% of thermal input being sourced from waste biomass.

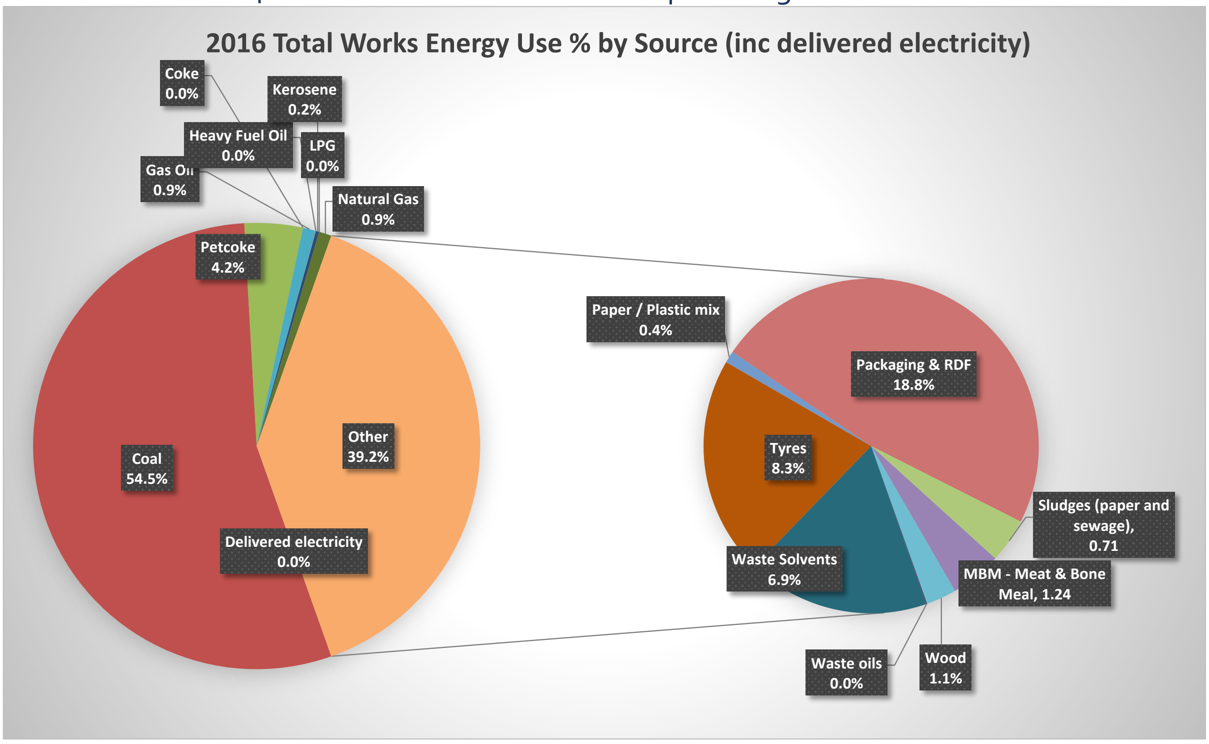

Figure 1: 2016 fuel and electricity use by UK cement manufacturers.

- The MPA cement roadmap set out that by 2050 40% of the thermal input should be from biomass. Indeed, fuel switching to biomass was identified as one of the three main technologies available to the cement sector to reach the level of 80% emissions reduction on 1990 levels by 2050. This trend of reducing biomass must be reversed if the level of decarbonisation identified in the roadmaps is to be achieved.
- One of the reasons for the reduction in waste biomass fuel use is the targeting of Government incentives, such as the Renewable Heat Incentive and Contracts for Difference, to other users. These incentives mean that cement and lime operators can't compete on the biomass market and biomass fuels are being moved away to other less energy efficient users (the use of biomass in cement manufacture is inherently very efficient because the heat from combustion is used directly rather than producing some sort of intermediary e.g. steam that can be used to generate power). For example, there has been a considerable reduction in the use of Meat and Bone Meal (MBM) by cement manufacturers since the introduction of the non-domestic RHI in 2011. In 2011 MPA members used 68kt of MBM, in 2016 MBM use was less than half that in 2011, at only 30kt. One MPA member ceased using MBM in 2017 and another expects to cease using MBM in 2018 because they can't compete with other technologies that receive RHI and other subsidies.

- The use of waste biomass fuels in cement manufacture has additional benefits beyond decarbonisation. As set out in a case study to the recent report "From waste to resource productivity"[3], unlike other combustion processes – such as power generation, incineration and biomass boilers – the ash from fossil and waste-derived 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 needs to be taken into consideration when producing a hierarchy of appropriate bioenergy use.

28. In our 2011 review we identified wood in construction as a potentially effective method of CCS and a high priority 'non-energy' use in our best-use hierarchy.

a. **What lifecycle GHG emissions savings can be achieved by using WIC? Under what circumstances does WIC fail to deliver GHG emissions savings? Please consider the full range of impacts associated with using WIC including substituted product emissions (e.g. cement), product equivalence (impacts on co-products), end-of-life options and biogenic carbon storage.**
b. **What is the potential for increasing the amount of wood used in construction in the UK? What are the barriers and how can they be overcome?**
c. **What is the potential for using UK-produced timber in construction rather than imports? What are the barriers and how can they be overcome?**
d. **What is the expected lifetime of different wood products in construction (e.g. cross-laminated timber)?**
e. **What currently happens to wood in construction at the end of its useful life? What other viable options should be developed?**

The 2011 Bioenergy review notes that "*the use of wood in construction offers the opportunity both to sequester carbon and to displace the use of carbon-intense construction materials […] e.g. iron, steel and cement*". However, this compares only the embodied emissions of the materials and not the emissions across their whole life cycle. In order to properly define the benefits of wood in construction the assessment of carbon savings must look at emissions across the whole life cycle of a building including energy performance in use and emissions at end of life. The following points need be considered for such an assessment:

- **Where the materials are sourced:** Transport can increase the emissions of any material that is imported compared to domestically produced products.
  - The majority of timber grown in the UK is unsuitable for construction purposes. This is demonstrated in the most recent timber utilisation statistics published by the Forestry Commission[4], which show that in 2014 84.6% of the market share

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[3] "*From waste to resource productivity*", Defra and GO-Science, December 2017, cement case study on Page 83.

[4] "Timber utilisation statistics 2014 & 2015 estimates", Collated for the Forestry Commission by Timbertrends, November 2015, Pg 24, https://www.forestry.gov.uk/pdf/Timber_Utilisation_Report_2015.pdf/$FILE/Timber_Utilisation_Report_2015.pdf

  - of sawn softwood consumption in construction is imported. A full assessment of the quantities imported and that required in future as well as the level of emissions from importing must be included in any assessment of carbon emissions.
  - Concrete is a low cost, locally sourced material and around 90% of it is certified to BES 6001. This standard requires concrete producers to demonstrate (and have verified by an independent third party) that organisational governance, supply chain management and environmental and social responsibilities have been responsibly managed.
  - The majority of concrete is entirely sourced within the UK, so emissions from transporting material from overseas are negligible and the UK has complete control and management over the concrete supply chain.
- **Production CO_2 Profile:** The UK has set carbon targets in legislation and every sector must do its part to reduce emissions.
  - The 2011 Bioenergy Review referenced cement but it is concrete that is used in construction. Concrete only contains around 15% cement, which is used to bind low carbon aggregates (including recycled aggregates). UK cement manufacturers have invested heavily to reduce emissions and since 1990 emissions have been on a downward trend so that absolute emissions were reduced by 49% by 2016.
  - Before wood can be used in construction it has to be chemically treated to prevent rot, infestations and to provide some fire resistance. The type and level of chemical treatment required may depend on the type of wood used and will increase the carbon associated with the wood.
  - Products such as Cross Laminated Timber (CLT) contain considerable quantities of glue. The emissions from the production of this glue must be taken into account as well as the emissions generated from the glue at end of life (see end of life section below).
  - MPA strongly suggest the CCC analyse whether, like cement and concrete, the CO_2 profile is on a downward trend or if, as MPA suspects, the increased use of treatment and glues, is actually increasing emissions.
- **CO_2 Sequestration:**
  - The removal of carbon dioxide from the atmosphere is one of the significant benefits of growing trees. However, once a tree is cut down for use, it will ultimately decay. This can be delayed through the use of carbon intensive preservatives, paints and glues but ultimately the tree will either end up in landfill with the resulting emission of methane or it will be incinerated with the re-emission of carbon dioxide. The sequestration of CO_2 by a tree is therefore only temporary whilst alive in the ground, so it is important to consider the complete life cycle of timber and other building products to get an accurate indication of their whole life emissions.
  - Whilst the end of life emissions of timber can vary those for concrete are certain. Concrete sequesters CO_2 from the atmosphere both while in use and to an even greater extent in its secondary-life as a recycled material. Over its whole life the amount of CO_2 sequestered by concrete can reach around a third (33%) of the material's initial cradle-to-gate CO_2 emissions. Unlike a tree that is cut down for

use, once the CO_2 is sequestered in concrete, it is permanently stored and will not be released to the atmosphere again.

- **Energy consumption and emissions in use:**
  - Can timber be used to reduce the energy required for heating and cooling buildings? Can timber protect buildings from overheating in summer?
  - Concrete has high thermal mass properties, which, when used correctly in buildings, enables the storage and then slow release of heat. This has the effect of stabilising the temperature within a building so that less heating is required in winter and less cooling is required in summer, but the benefits are year-round as the diurnal temperature cycle peaks are reduced. This considerably reduces the energy required (and associated carbon emissions) to heat and cool the building.
  - Rising external temperatures are identified by the latest UK Climate Change Risk Assessment and in the recent Clean Growth Strategy as a significant climate change challenge, which poses a threat to health, wellbeing and productivity. The annual number of premature heat-related deaths in the UK is expected to rise from 2000 currently to around 7000 in 2050. A BRE review for the Zero Carbon Hub[5], identified that thermal mass is particularly useful as a passive cooling measure to reduce the risk of summer overheating in homes and thus increase resilience to these rising temperatures and reduce the need for energy intensive air conditioning. Analysis by the Adaptation Sub-Committee suggests that if air-conditioning is used in both existing and new homes, it would cost society an additional £2 billion (existing homes) and £400 million (new homes) respectively over 15 years compared to passive cooling measures, such as thermal mass[6].
  - In winter, passive solar design can exploit thermal mass to reduce the overall space heating demand and thus increase energy efficiency. Solar gain from the low angle winter sun enters the home through south facing windows. The solar energy is absorbed and later released as heat by thermal mass in the walls and floor, which means that less additional space heating is required.
  - Masonry/concrete walls and floors can also store heat produced by a heat pump, which in turn can make use of any excess power from a PV installation during the heating season. In this way, thermal mass in the building fabric helps match supply and demand in respect of power and space heating.
- **Durability of construction:**
  - Concrete and masonry materials have a proven track record of durability, with buildings lasting over 100 years. This structural durability allows buildings to be refitted or re-purposed easily, and reduces the waste from demolition as well as the amount of new material required for replacement. How durable are timber buildings? How often do they need to be replaced?
  - In assessing the carbon savings that wood in construction can make compared to other materials, the CCC must ensure that like for like comparisons of the

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

[6] Davis Langdon (2011) for the ASC Research to identify potential low-regret adaptation options to climate change in the residential buildings sector. http://www.theccc.org.uk/publication/adapting-to-climate-change-in-the-uk-measuring-progress-2nd-progress-report-2011/

structural performance of the different materials is considered. This is also vital when considering how much of the construction market wood can penetrate. A response from the Brick Development Association to the 2011 Bioenergy Review stated that 'Arup studies have found that by looking at material characteristics, for example, compressive strength against embodied carbon, concrete, steel and glulam have a similar bending performance to embodied CO_2 ratio.'
    - Concrete is fire resilient. Concrete and masonry solutions have been recommended to address the risk of fire spread both within buildings, between buildings and to reduce the combustible structural content in our urban environment. Government statistics show that fires in timber framed buildings are more extensive than those of no special construction[7]. Recent full-scale experiments by Arup and the University of Edinburgh raise serious questions about the fire safety of cross-laminated timber[8].
    - Concrete construction is flood resilient. BS 85500 (Flood Resistant and Resilient Construction) advises that timber-framed walls are not recommended for new buildings at risk of flooding as most timber swells in contact with water, deforms or cracks on rapid drying and is at risk of fungal growth. All the recommended construction details provided in BS 85500 are of concrete and masonry construction[9].
    - Once in place concrete/masonry structures are low maintenance and further treatment is not required. Wood used in finishes and façades is likely to require an ongoing programme of maintenance and treatment to aid long term durability. This treatment will in itself carry some level of carbon emissions.
- **End of life:** How long will a building last before it has to be demolished? What happens to the material when the construction is demolished?
    - Any comparison of building products must consider what happens to the material at the end of the building's life. Although wood sequesters carbon during its life as a construction product, what happens to this carbon once the building is demolished? The preservatives and glue used for wood in construction is classified as hazardous waste (see the latest EU List of Waste), therefore its use on timber would also deem the wood a hazardous waste. This often results in it being landfilled and the release of considerable emissions including that of methane. Equally, if the wood is incinerated, the emissions are still released into the atmosphere.
    - Concrete on the other hand is 100% recyclable and it absorbs CO_2 from the atmosphere over its lifecycle and continues to do so to an even greater extent in its secondary-life as a recycled material. Ultimately, the amount of CO_2 absorbed can reach around a third[10] of the material's initial cradle-to-gate embodied CO_2.

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[7] "*Analysis of fires in buildings of timber framed construction, England 2009-10 to 2011-12*", Department for Communities and Local Government, December 2012.

[8] "*Fire safety design in modern timber buildings*", The Structural Engineer vol **96**, Jan 2018

[9] BS 8500: 2015, Flood Resistant and Resilient Construction - Guide to Improving Flood Performance of Buildings

[10] "*Whole life carbon in buildings*", The Concrete Centre, 2016

- There are also wider societal benefits to the production of cement that should be considered. In 2016 cement manufacturers in the UK recycled 1.5 million tonnes of waste and by-products from other industries. In this regard, cement production is a valuable component of the circular economy. These benefits are not considered when comparing only the embodied carbon.

Several studies have already been completed into the whole life carbon of new build housing. NHBC Foundation[11] research found that "No significant differences emerged between masonry and timber construction in terms of overall CO_2 impact over 60 and 120 year study periods." More recently, a study conducted in Sweden[12] compared ecological, economic and social sustainability of precast concrete, cast in-situ concrete and solid wood buildings. The work had a specific requirement that the functions of the three materials must be equivalent during the use phase of the building. The results found no significant differences between concrete and timber structures for the same functions during the life cycle, either for climate or for primary energy.

Further supporting evidence for the long term sustainability credentials of concrete/masonry are set out below, with relevant supporting references should you require more evidence-based data:

- The concrete industry has been reporting on carbon and a wide variety of other sustainability measures since 2008[13]. The concrete and masonry industries are committed to the ongoing reduction in carbon. The CO_2 per tonne of concrete has reduced by 21.7% since 1990.
- The concrete industry is a net user of waste, using around 107 times more waste and recovered materials than it sends to land fill[13].
- Concrete and masonry can achieve the highest ratings in BREEAM and deliver Passivhaus accredited homes. Examples of concrete building with an excellent or outstanding BREEAM rating include: 5 Pancras Square, London; University Square, Stratford; 4 West Building, University of Bath; Vanguard House, Daresbury Science & Innovation Campus, Cheshire; Innovate Green Office, Leeds; CAFOD Headquarters (Romero House), London.
- The material efficiency benefits of concrete and masonry include multi-tasking providing finish, structure, sound insulation and fire resistance[14].

29. There are also a number of other potential non-energy uses of bio-feedstocks including bio-based plastics and bio-based chemicals.

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[11] "*Operational and Embodied Carbon in New Build Housing: A Reappraisal*", NHBC, 2011

[12] "*Energy and climate-efficient construction systems: environmental assessment of various frame options for buildings*", SP Sveriges Tekniska Forskningsinstitut, 2017

[13] "*The ninth concrete industry sustainability performance report*", The Concrete Centre (on behalf of the Sustainable Concrete Forum), 2016

[14] "*Material efficiency*", The Concrete Centre, 2016

a. **What other non-energy uses of bio-feedstocks have the most potential through to 2050 in terms of GHG abatement, cost, timescales and market size?**
b. **What are the barriers to increasing these non-energy uses and how can these barriers be overcome?**
c. **What risks are associated with the pursuit of other non-energy uses of bio-feedstocks and how can these be managed?**

- No comment

GHG emissions reporting and accounting

GHG emissions reporting rules for bioenergy are different to those for other forms of energy. Emissions relating to the use (combustion) of bioenergy resources are not reported in the country of use but rather in the country where bioenergy resources are produced. Only Annex 1 countries under the Kyoto Protocol currently account for land-use emissions as part of binding emission reduction targets. In addition under Paris Agreement rules emissions (as under the Kyoto Protocol) will be reported against land-use baselines that may already assume a degree of land-use change. For these reasons and others, bioenergy GHG accounting has been criticised for not properly reflecting the impacts of bioenergy.

30. What are the strengths and weaknesses of the current approach to GHG emissions accounting for bioenergy in the UK and internationally? Specifically, what are the main gaps in the current land use emissions accounting rules?

- One of the main weaknesses of the current approach to GHG emissions accounting for non-energy biomass use is that it only compares the embodied emissions of wood in construction with alternatives rather than looking across the whole life of a building. Such a narrow analysis completely neglects the emissions from importing timber, the emissions associated with the glues and preservatives used in timber for construction, how the building material impacts the energy consumed in heating and cooling a building, how durable a building is and how often it has to be replaced (a building that has to be replaced more often leads to more waste in demolition and more material to rebuild it and therefore has more emissions associated with it) and emissions at end of life. This approach must change and a full assessment made before government policy starts favouring one construction material over another.

31. What are the risks, in terms of GHG emissions, associated with importing biomass or other biofuels from countries that have not committed to limiting or reducing emissions under the Kyoto Protocol or Paris Agreement? How can these risks be managed?

- No comment

32. What alternative method(s) for bioenergy emissions accounting should be considered? What would the implications of these alternative method(s) be?

- No comment

Indicators

As part of the 2018 Bioenergy Review the CCC is planning to develop a set of indicators to track progress towards key bioenergy outcomes. We envisage these will cover key areas such as sustainability, policy development, supply and best-use.

33. What key areas should be reflected in these indicators?

- Best use of bioenergy should take into consideration the energy efficiency of the process and the wider benefits a process can bring such as the recycling of mineral and metal content of bioenergy that co-processing in cement and dolomitic lime kilns offers compared to other uses where only the energy is recovered and residual ash remains for disposal.

34. Please provide details of any examples of international best-practice in the area of bioenergy indicators.

Other

35. Please submit any further evidence that you would like us to consider.