Response from the Mineral Products Association to the Energy and Climate Change Committee Inquiry into Carbon Capture and Storage

1. Executive Summary

1.1. Government needs to outline its funding plans for industrial CCS.

1.2. The lack of CCS transport and storage infrastructure is a significant barrier to UK CCS development.

1.3. Government needs to retain manufacturing industry in the UK so that when CCS hubs are developed their benefit is maximized.

1.4. The UK cement industry GHG 2050 Roadmap outlines the importance of CCS to the cement industry. There will be a shortfall in decarbonisation without CCS.

1.5. The financial barriers are significant. A CCS cement plant will be double the costs of a non-CCS equivalent. Government funding is needed to navigate the CCS financial barriers.

1.6. For industries with high process emissions that are not related to combustion, CCS may be the only option for significant decarbonisation.

1.7. The UK is lagging behind other countries in developing industrial CCS in the cement industry.

2. Introduction

2.1. 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 The British Precast Concrete Federation (BPCF) and the British Association of Reinforcement (BAR), it has a growing membership of 450 companies and is the sectoral voice for mineral products. MPA membership is made up of the vast majority of independent SME companies throughout the UK, as well as the 9 major international and global companies. It covers 100% of GB cement production, 90% of aggregates production and 95% of asphalt and ready-mixed concrete production and 70% of precast concrete production. Each year the industry supplies £9 billion of materials and services to the £120 billion construction and other sectors. Industry production represents the largest materials flow in the UK economy and is also one of the largest manufacturing sectors[1].

2.2. This response relates largely to the MPA Cement activities which are part of the Mineral Products Association.

3. What types of CCS technology are currently being developed and how do they differ from one another?

3.1. There are two potential CCS techniques that could be applicable for capturing CO_2 from cement manufacture: Post-Combustion Capture and Oxy-Combustion Capture. Pre-Combustion capture is disregarded on the basis that it would only address the fuel part of the CO_2 emission (only ~40% of the total emission from cement manufacture comes from fuel burning).

3.2. Post combustion capture is an 'end-of-pipe' technology that has the advantage of being able to be retrofitted to existing plant if space allows.

3.3. It works by 'scrubbing' the exhaust gases with a solvent (most likely an amine), the solvent is then regenerated using steam and the high concentration CO_2 gas is compressed for transport. These technologies also have significant electricity demands. These demands are so significant that additional power and steam

[1] "Make the Link: The Mineral Products Industry's Contribution to the UK", 2012, http://www.mineralproducts.org/documents/MPA_MTL_Document.pdf

requirements would probably need to be supplied by the addition of a Combined Heat and Power (CHP) plant.

3.4. The key constraints for this option are: Sulphur dioxide (SO_2), Oxides of Nitrogen (NOx) in the flue gas (potential interference with the CO_2 absorption by the amine); space for the capture and compression equipment; availability of steam for amine regeneration.

3.5. All the major technical issues could, potentially, be addressed using existing technology but the main barrier to its application is the cost of deploying these technologies.

3.6. The cost per tonne of CO_2 emissions avoided is substantially higher than using oxy-combustion, mainly due to the large capital costs of the Combined Heat and Power plant and the flue gas desulphurization, (FGD) plant.

3.7. Oxy-combustion CO_2-capture is at an earlier stage of development than post-combustion and its use would require the fundamental re-design of a cement plant.

3.8. Many technical issues centre on burning the raw materials in an oxygen rich environment either in the kiln precalciner or potentially in the kiln itself. Research on this and how product formation may be affected by high CO_2 concentrations is also needed.

3.9. However, the predicted cost per tonne of CO_2 emissions avoided is about 40% of that for post-combustion capture.

3.10. Other technologies such as algal biomass sequestration are believed to have been investigated but the commercial viability is not expected ahead of the post-combustion and oxy-fuel technologies.

4. What contribution could CCS make towards the UK's decarbonisation targets? Are the UK Government's expectations reasonable in this regard?

4.1. The UK Government is ambitious with its rhetoric around carbon capture but very unambitious with its support for the delivery of CCS, particularly in industry.

4.2. Climate change is very important to the cement industry for two key reasons; firstly, cement production releases carbon dioxide; and secondly, cement concrete products are needed to mitigate against climate change by producing thermally efficient high mass buildings and because cement concrete products will help society adapt to the effects of global warming e.g. drainage and flood defence. As such society will always need to consume cement and concrete. It is therefore important that the cement industry addresses its CO_2 footprint. MPA Cement is the first national cement association to outline its contribution to society's decarbonation pathway to 2050.

4.3. The UK cement industry has published its 'Greenhouse gas strategy to 2050'[2]. Outlining an ambitious target of -81% GHG emissions by 2050, against 1990, (the Kyoto Protocol baseline year), the UK cement industry has set out for the first time the actions they, and others, need to take to exceed the UK Government's own -80% aim. Government support to assist and accelerate the delivery of this strategy is noticeably absent and without such support the maximum ambition of an 81% decarbonisation of UK cement production by 2050 may not be delivered. The UK cement industry roadmap demonstrates that without CCS the decarbonisation by 2050 of 62% is all that could be possible.

5. Are there any potential benefits (e.g. the ability to export CCS technology abroad) of successfully developing CCS to the UK economy and, if so, what are they?

5.1. The UK is already lagging behind other countries so the prospect of the UK being an exporter of CCS technology in for example the cement industry is slim. The bulk of the research into CCS in the cement industry is taking place in Germany and due to

[2] http://www.mineralproducts.org/documents/MPA_Cement_2050_Strategy.pdf

financial support from the Norwegian Government the Norwegians will have the first CCS pilot plant in the European cement industry[3].

6. **What are the main barriers (e.g. economic, political, regulatory, scientific and social) to developing large-scale integrated CCS projects in the UK and internationally? How can they be overcome?**

6.1. The technical challenges of CCS in the cement are not insurmountable but the financial barriers are considerable.

6.2. Exhaust gas from a cement kiln contains about 25% CO_2 – appreciably higher than in coal fired power generation (about 14%). Although the concentration of CO_2 in the exhaust gas makes cement CO_2 capture an attractive proposition when compared to power generation, economies of scale make it more expensive. A single 2GW coal fired power station emits approximately the same amount of CO_2 as the whole of the UK cement industry.

6.3. IEA GHG[4] have estimated that a post-combustion capture fitted cement plant could cost around €558m (more than twice the cost of a non-CCS equivalent) but providing a potential emissions avoided efficiency of 77%. An equivalent output oxy-combustion plant, however, could cost €327m (25% more expensive than the non-CCS plant) but at an emissions avoided rate of 52%.

6.4. Operational costs are potentially considerable too; they double for the post-combustion option and increase by 25% for oxy-combustion compared to non-CCS plant.

6.5. Although these costs make the oxy-combustion plant comparatively attractive it must be noted that oxy-combustion is at a much earlier stage of development compared to post combustion and for cement making it would radically change the design and operation of the kiln.

6.6. The work of the British Geological Survey has improved the knowledge of potential storage sites around the UK but regulatory controls and legal liabilities are at the early stages of development. It is unlikely that the cement industry will get too involved in storage sites and will look to third parties for the development of this important part of the CCS chain.

6.7. The volumes of CO_2 generated by individual cement installations are too small to warrant dedicated pipelines connected to either potential off-shore or on-shore storage sites. Consequently, a strategic CO_2 pipeline infrastructure is needed for high volume emitters in the power generation sector with connection nodes for smaller industrial emitters. Such a project has to be centrally funded by Government. Until a strategic infrastructure pipeline network is in place this represents a significant barrier to CCS deployment in the non-generation sectors.

6.8. Finally, industrial processes are much more vulnerable to the economic cycle than power generators that have a captive non-mobile market in the domestic sector where they are able to pass on the cost of CCS to the consumer without much risk. Industrial operator output is influenced by the economic cycle, for example the UK cement market it around 35% lower than pre-recession levels and the sector does not have the ability to pass on the cost of CCS to its consumers.

7. **Are there any safety issues associated with capturing, transporting and storing carbon dioxide? How could they be overcome? Who should have responsibility for ensuring these activities are safe?**

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[3] http://www.akersolutions.com/en/Global-menu/Media/Press-Releases/All/2013/Aker-Solutions-to-perform-worlds-first-tests-for-capture-of-CO2-from-cement-industry/

[4] IEA GHG (2008) IEA Greenhouse Gas R&D Programme (IEA GHG), "CO2 Capture in the Cement Industry", 2008/3, July 2008.

7.1. MPA does not envisage that the safety issues associated with carbon capture in the cement industry would be any greater than in any other industrial or power CCS project.

7.2. The UK has a good record of regulating industrial processes and CCS should be no different, although effort might be needed to gain public acceptance of CCS.

8. How have other countries incentivised CCS development? How successful have they been? How do they compare to the UK's efforts?

8.1. As outlined earlier the Norwegian Government has part funded a cement pilot plant in Brevik, Norway. The UK Government has been slow to develop industrial CCS in the UK and appears to have a preference for carrying out studies and holding workshops instead of formulating a funding programme to facilitate the development of industrial CCS in the UK.

9. Is the UK Government's approach, set out in its CCS Roadmap, likely to incentivise development of CCS in the UK?

9.1. Government is correct to focus its early efforts on the power generation sector but clusters of CCS that involve industry will only exist if we maintain our manufacturing industries in the UK and the Government support the crucial infrastructure development.

10. **Could the successful development of CCS improve international efforts to mitigate climate change? What role could UK CCS play in this?**

10.1. The UK must play its part in addressing climate change but should not place costs on energy consumers that are not faced by competing nations. The power generation sector will pass on the costs of CCS to consumers, including its industrial consumers that are most vulnerable (in terms of carbon leakage) to the price increases.

10.2. The UK CCS programme has to ensure that industrial consumers are shielded from the costs of CCS in power generation in the transition to a low carbon economy.

11. What are the consequences of failing to develop CCS and what alternatives are available for decarbonisation if CCS fails?

11.1. In its 2050 roadmap the UK cement industry has highlighted the importance of CCS. Even with 100% biomass fuels the UK cement industry will be a considerable CO_2 emitter because 60% of the total emission is 'process emission' which is the CO_2 driven off from the calcium carbonate ($CaCO_3$) in the 'calcination' process to produce cement clinker. So without some method of capturing and utilising or storing this CO2 the industry will remain a significant emitter.

11.2. If the UK fails or delays its CCS programme then other nations will take the initiative. Already, other European nations are better placed than the UK to decarbonise their cement production and if the UK is left behind we could in the future see the UK importing the essential ingredient it requires for concrete production, with the consequential job losses, reduced security of supply and increased transport emissions.