

# MPA Cement GHG Reduction Strategy



# GHG Strategy

## 1 Our Vision and Objective

Our vision is that our members will be recognised and valued for supplying essential materials for a sustainable future, in a manner that is economically viable and socially and environmentally responsible. A link to our Make the Link document can be found [here](#).

Emissions of carbon dioxide from the UK cement sector account for just under 1.5% of UK emissions. MPA Cement's<sup>1</sup> objective is to be at the forefront of GHG emission reduction and impact mitigation. The UK is the first country in the world to legally commit to greenhouse gas reduction targets as far ahead as 2050. The target set is an ambitious one - a cut of at least 80 per cent compared with 1990 levels. As an industry that emits CO<sub>2</sub> from the chemical process of making cement and from the combustion of fuels we are fully committed to playing our part and have already reduced our absolute direct CO<sub>2</sub> emissions by over 55 per cent since 1990.

We are now launching an ambitious new broader scope strategy to achieve an overall reduction of 81 per cent in greenhouse gases by 2050. This document sets out in detail how we will achieve this goal and the support we will need in our quest. A summary version of this strategy can be found [here](#).

## 2 Background

### 2.1 Worldwide

In 2009 the global cement sector was a pioneer as it published a 2050 Technology Roadmap under the auspices of the World Business Council for Sustainable development (WBCSD) Cement Sustainability Initiative (CSI)<sup>2</sup>. As the first global sector to outline its contribution to GHG abatement and mitigation the CSI Roadmap paved the way for technological development in the sector.

### 2.2 Europe

The European Union's Roadmap<sup>3</sup> states that the EU should prepare for reductions in its *domestic* emissions of 80 per cent by 2050 compared to 1990<sup>4</sup>. The Commission's analysis shows that emissions in the industrial sector should be reduced by 83 to 87 per cent in 2050 if the Union is to continue its global commitment to addressing climate change. In its roadmap the EU calls on sectors to develop sector-specific roadmaps. CEMBUREAU, the European Cement Association has this task in hand.

### 2.3 UK

In the UK the Department of Energy and Climate Change (DECC) has analysed potential pathways to an 80 per cent reduction in greenhouse gases (GHG) by 2050. DECC identify that electricity production, heat for homes and businesses and power for vehicles are the principle

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<sup>1</sup> MPA Cement is part of the Mineral Products Association, the representative body for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries. It has three members that produce Portland cement and who have signed up to the targets in this report. They are: CEMEX UK, Hanson Cement, Lafarge Tarmac. In addition, associate members include Kerneos, a producer of aluminate cements and Quinn Cement.

<sup>2</sup> "Cement Technology Roadmap 2009, Carbon emissions reductions up to 2050", WBCSD, 2009

<sup>3</sup> COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A roadmap for moving to a low carbon economy in 2050 {SEC(2011) 287}

<sup>4</sup> Domestic meaning real internal reductions of EU emissions and not offsetting through the carbon market

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areas for emissions reduction. Furthermore, the Committee on Climate Change (CCC), in their Fourth Carbon Budget report covering the period 2023-2027, has outlined a number of technological and market assumptions as industry's contribution to an accelerated path of UK emissions reduction of 80 per cent by 2050 compared to 1990.

## 2.4 MPA Cement

MPA Cement launched its first Carbon Strategy in 2005 as the British Cement Association (BCA)<sup>5</sup>. The short term period of action in the original strategy ended in 2010. Since then there has been a considerable effort by policy makers, NGO's and industry groups to map the necessary reductions in emissions to address the scientific imperative to minimize anthropogenic induced climate change. There has also been considerable research into low carbon pathways and carbon footprinting.

With the advent of these publications as well as research and policy announcements, MPA Cement has reviewed its carbon strategy so that it is closer to carbon footprint and other carbon reporting conventions. The revision includes the impacts of electricity consumption, fuel and raw material transport and non-CO<sub>2</sub> greenhouse gases. The longer time horizon of this strategy also aligns with EU and UK ambitions

This *MPA Cement GHG Strategy: Roadmap to 2050* is the next step and outlines our contribution to GHG emission reduction and presents the actions needed. In the process of analyzing the UK cement industry's potential for GHG reduction, MPA Cement has reflected upon the current legislative and policy landscape and identified the action the industry, Government, policy makers and others need to take to facilitate the shift to low carbon cement supply and use.

## 3 Progress to Date

Considerable early action by the UK Portland cement industry has decoupled economic growth from environmental impact and the industry has reduced absolute CO<sub>2</sub> emissions by 55 per cent<sup>6</sup> between 1990 and 2011 (27 per cent reduction per tonne of output), outstripping the UK economy as a whole.

The BCA 2005 Carbon Strategy focused on short, medium and long term objectives. The short-term targets were focused on delivery by 2010. These were:

- A target of 15 per cent Alternative Waste Derived Fuel use by 2010
- Growing cementitious additions to 8 per cent by 2010.
- Researching Carbon Capture and Storage.

MPA Cement members have made good progress against these targets following considerable investment in new kiln technology, fuel switching and improving product combinations. Alternative Waste Derived Fuel (AWDF) use was up to 40 per cent in 2011 and cementitious additions to the content of factory made cement were over 13 per cent in 2010. Furthermore, MPA Cement member companies have contributed to Phase I of a European cement industry

<sup>5</sup> The British Cement Association merged with the Quarry Products Association and the Concrete Centre in 2009 to form the Mineral Products Association. MPA Cement is part of the Mineral Products Association.

<sup>6</sup> This actual achievement of 55 per cent should not be compared to the 2050 goals because the actual achievement is based on actual rather than normalised production.

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collaborative project run by ECRA<sup>7</sup> to investigate the technical possibilities for carbon capture in cement manufacturing<sup>8</sup>.

## 4 Our Strategy: What is needed to build on early action and meet our 2050 ambition?

In developing our GHG strategy, there are clearly uncertainties and unknowns that could either throw us off track or enhance our ambitions. These might include a lack of availability of biomass fuels or a breakthrough in lower carbon cements technologies. Nevertheless, based on what we know now, our analysis foresees that we could reduce our GHG footprint by 81 per cent by 2050 against a 1990 Kyoto Protocol baseline year, given appropriate technological development supported by an apposite policy framework. In order to present a pathway to 2050 (and interim milestones) a number of assumptions have been developed based on current expert judgment and knowledge. The realization of these assumptions depends on a number of influencing factors both within the capability of the industry and outside of the industry in the hands of policy makers, regulators and researchers. To allow for the uncertainty surrounding the realization of some of these key assumptions MPA Cement has developed two potential scenarios:

**Scenario 1:** This is the more ambitious of the two scenarios and is designed to achieve an 81 per cent emission reduction by 2050 compared to 1990. It anticipates carbon capture and storage (CCS) technology not only being economically available in the cement industry but also being effectively deployed.

**Scenario 2:** If the huge technical and financial barriers for capturing and storing CO<sub>2</sub> from the cement industry are not overcome, the emissions reductions achievable are likely to be closer to a 62 per cent reduction by 2050 compared to 1990. Scenario 2 would still require a high level of investment and commitment to overcome its own technical and financial challenges.

Figure 1 shows the trajectories of these two scenarios and the reductions that have been made since 1990. The historic data (1990-2010) is actual direct emissions of carbon dioxide adjusted to the expanded scope and CO<sub>2</sub>e of the strategy<sup>9</sup>. As such calculations were made to expand the boundaries of the 1990 emissions to include additional activities such as electricity generation and transport of raw materials, fuels and cement product. Direct emissions of methane and nitrous oxide were also added to the data to increase the scope from CO<sub>2</sub> only to include other GHGs (CO<sub>2</sub>e). These adjustments mean that the emissions shown for 1990-2010 are for the actual level of production of each year. Going forwards (for the milestones 2020 onwards) a production output of 10Mt cement has been assumed because forecasting actual production is incredibly difficult- there is more information on this assumption below.

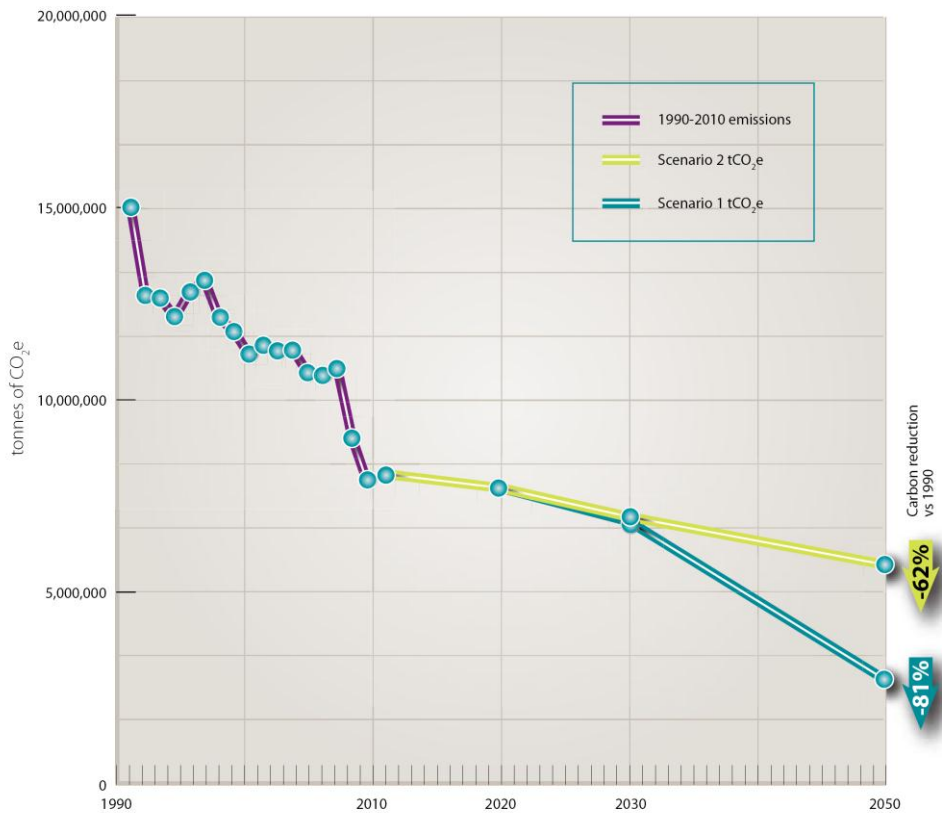
<sup>7</sup> European Cement Research Academy

<sup>8</sup> For more information visit [www.ecra-online.org](http://www.ecra-online.org)

<sup>9</sup> Unfortunately some data was missing for 1991-1993

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Figure 1: MPA Cement greenhouse gas reduction 1990-2050, trajectories of two scenarios<sup>10</sup>



The MPA Cement greenhouse gas strategy scenarios use the assumptions set out below.

Figures 2 and 3 below show the modelled emission reduction from the principle GHG impacting activities of cement manufacture for both scenario 1 and 2 respectively where all data points including the baseline are normalized to 10Mt of Portland Cement to remove any ambiguity with production fluctuations<sup>10a</sup>.

<sup>10</sup> Greenhouse Gas is measured as carbon dioxide equivalent (CO<sub>2</sub>e) using the UNFCCC six gases CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs and SF<sub>6</sub>

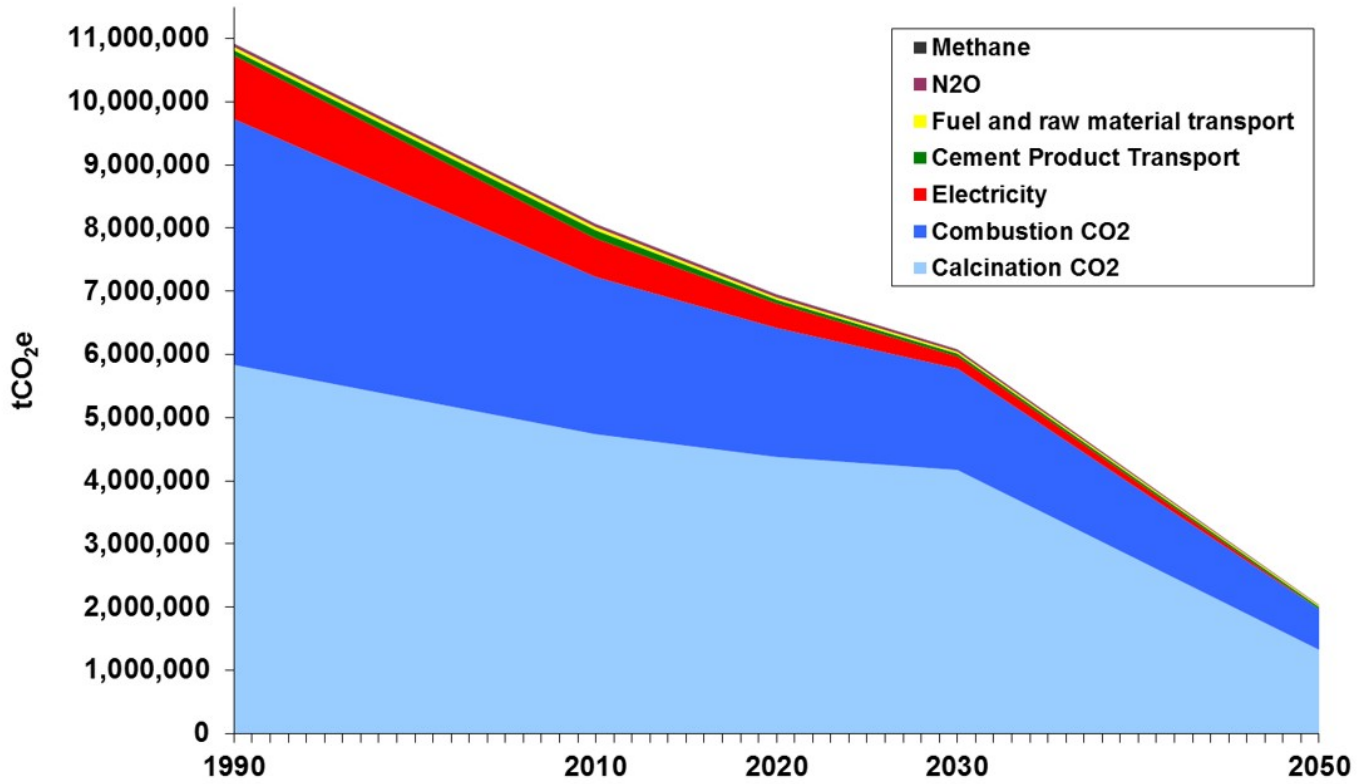
<sup>10a</sup> Since publication of the Technical Report, MPA Cement has updated its assumptions on the cementitious substitution during cement manufacturing and concrete production. This does not affect the GHG reduction ambition of the sector in 2050, but does change the profile of the GHG reductions towards 2050. Figures 2 and 3 have been updated to reflect these updated assumptions.



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Figure 2: Trajectory of Scenario 1 showing contributions from each emission reducing aspect of cement production

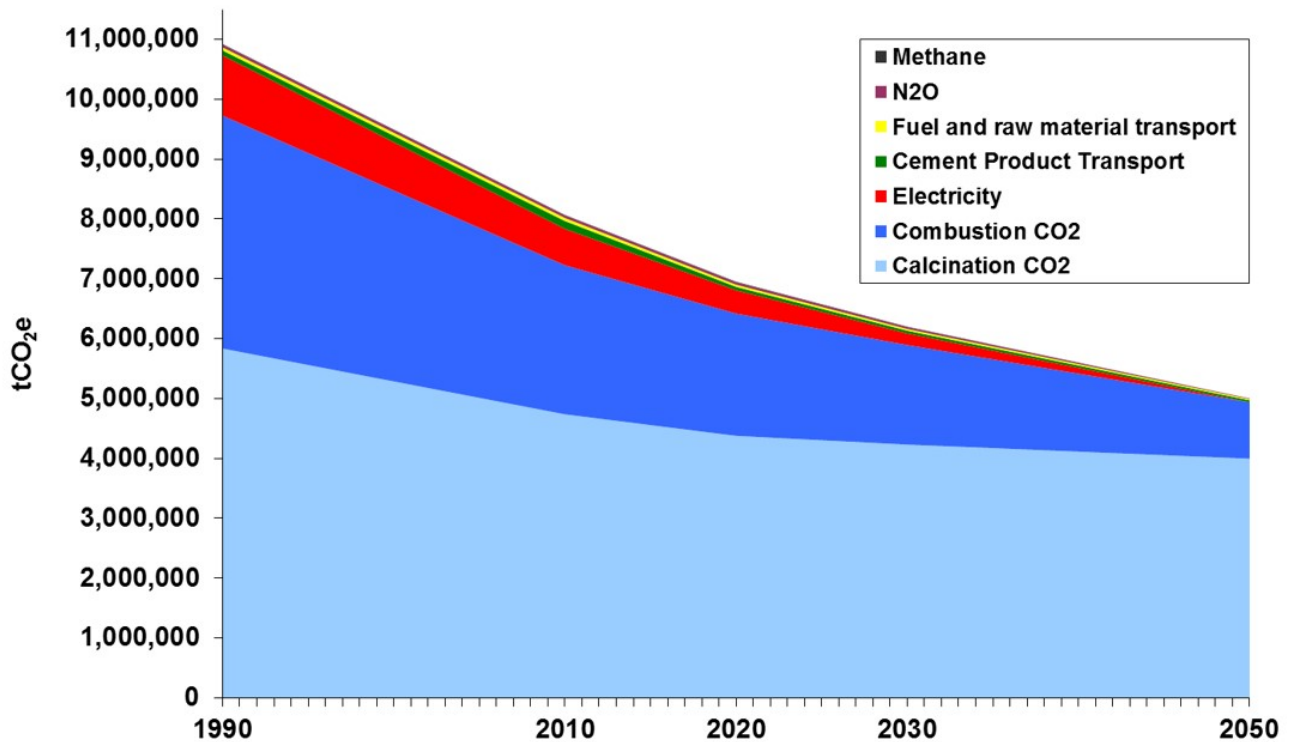
Scenario 1: Reduction in GHG Emissions by 2050 Compared to 1990



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Figure 3: Trajectory of Scenario 2, showing contributions from each emission reducing aspect of cement production

Scenario 2: Reduction in GHG Emissions by 2050 Compared to 1990



## 4.1 Delivering on our commitments: Model Assumptions

### 4.1.1 Output

Variation in production levels can often obscure year on year comparisons of emissions data. To avoid confusion 10Mt Portland Cement equivalent (PCe)<sup>11</sup> has been used for all milestone years so that forecast fluctuations of production output do not influence the modelled results.

### 4.1.2 Alternative Waste Derived Fuel (AWDF) Use

In 2011 almost 40% of fossil fuel use was replaced by alternative waste derived fuel. It is assumed that by 2050 UK Portland cement production will require around 80 per cent fossil fuel replacement from locally sourced alternative fuels that have been diverted from the waste stream. This is an ambitious assumption that is technologically challenging and could be adversely affected if the declassification of waste takes place via End of Waste Protocols and Publicly Available Specifications. This declassification may divert materials to other uses. Commercial pressures may also inhibit the use of waste derived fuels in the cement sector as

<sup>11</sup> Portland Cement Equivalent (PCe) is a normalising factor related to cement output often used by the cement industry, which enables a comparison of impacts such as environmental between sites whilst taking into consideration differing production methods.

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other energy consumers seek new ways to generate heat/electricity or produce gas also using the limited locally sourced waste derived fuels.

### 4.1.3 Biomass Fuels and Biomass fractions

In 2011 almost 17% of fuel was from biomass fuel and biomass fractions. It is assumed that 40 per cent of fuel use will comprise of biomass by 2050. This is an ambitious assumption for the same reasons as outlined above for AWDF but is also likely to be principally influenced by the pressure on the power generators and others to fuel switch. The power generators are not subject to the same international competition as cement manufacture and this means they have a stronger purchasing power in the biomass fuel market which could restrict the potential for biomass use in cement production.

### 4.1.4 Non-Portland Cements

By 2050 it is assumed that low carbon non-Portland cements will be further developed, tested and potentially included in standards to allow them to be commercially produced for specific applications and markets. It is unclear at present which 'low carbon' cement(s) will make the break through to commercial production or the technical limitations they might have. Furthermore, the CO<sub>2</sub> savings may differ between the various types of new cements. This makes the CO<sub>2</sub> savings from the market penetration of low carbon cements difficult to predict. Therefore, a conservative estimate has been made, that by 2050 low carbon cements will replace 5 per cent of the PCe (0.5 million tonnes PCe). For further information on low carbon cement see the [MPA factsheet](#).

### 4.1.5 Cementitious Substitution

The UK cement and concrete industry already replace cement clinker with cementitious alternatives at levels that compete with the best in Europe. In 2011 cementitious additions to the content of factory made cement were over 13%. Some of the UK replacement takes place at the cement plant but most takes place at the concrete mixer. It is assumed that the level of replacement will increase to 30 per cent by 2050 but this will be largely dependent upon availability. Ground Granulated Blast Furnace Slag (GGBS) availability is dependent upon iron production and quality Pulverised Fuel Ash (PFA) availability is dependent upon coal fired power generation. The supply of cementitious materials from both of these activities is under threat and this places uncertainty on their further use by 2050.

### 4.1.6 Decarbonisation of the electricity sector

The Government has ambitious targets to decarbonise electricity generation to 2050. The success of this programme, coupled with energy efficiency improvements in the manufacture of cement will determine the indirect CO<sub>2</sub> savings that can be made in the cement industry by 2050. MPA Cement has used forecasts by the Committee on Climate Change (CCC) in its model scenario's where it is assumed that electricity will be 0gCO<sub>2</sub>/MWh by 2050. Whilst the action needed for this decarbonisation will be at the hands of the power generators it is likely that they will pass on the considerable cost of doing so on to large consumers like the cement industry.



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## 4.1.7 Carbon Capture and Storage (CCS)

60 per cent of CO<sub>2</sub> arising directly from cement manufacturing comes from the decomposition of limestone when it is burned in cement kilns (calcination or process emissions). One of the ways to reduce these process emissions is through the use of a carbon capture technology. Carbon capture technologies can take many forms and the principle technologies are expected to be widespread in power generation by 2050. The World Business Council for Sustainable Development (WBCSD) is ambitiously predicting 200-400 CCS cement plants by 2050. The MPA strategy assumes that around 3Mt CO<sub>2</sub> will be captured per year by 2050 in Scenario 1. In Scenario 2 it is assumed that it has not been possible to overcome the huge technical and financial barriers to deploying CCS and therefore the assumption is that there is no CCS deployed (0MtCO<sub>2</sub> capture) by 2050.

## 4.1.8 Transport

All sectors of the economy will need to play their role in delivering the Government's 2050 ambitions. Significant decarbonisation of the transport sector is expected through deployment of low carbon electric vehicles and biodiesel haulage. It is assumed that raw material and product transport will be largely fuelled by biodiesel and biodiesel blends by 2050. The DECC 2050 pathways work has been used as the basis for the MPA Cement strategy. It has been assumed that by 2050 fuel and raw material transport CO<sub>2</sub> emissions will be 60 per cent lower than in 1990.

## 4.1.9 Plant Efficiency

The Best Available Techniques (BAT) conclusions for cement, lime and magnesium oxide manufacture indicate that the newest and most efficient cement plants in Europe are around 20 per cent more efficient than those in the UK. It has therefore been assumed that as old plant is replaced efficiency is improved so that by 2050 the MPA models assume that UK cement plants will be 22 per cent more efficient than in 1990.

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Summary table of key assumptions for the two scenarios

	2010/11	2020	2030	2050		
UK production output	Actual production used.	Normalised to 10 Mt cement to avoid production based fluctuations				
Alternative waste derived fuel (i.e. switching from virgin fossil fuels)	In 2011 AWDF made up almost 40% of all fuel use.	Waste derived fuel use milestone figures were not set because for the industry emission it is biomass that is most important. However indirect benefits of using WDF occur as they replace fossil fuel and prevent the wastes being landfilled or incinerated.		80% thermal input		
Biomass fuels and biomass fractions (i.e. renewable fuels that are either entirely or partially carbon neutral)	In 2011 biomass and biomass fractions accounted for almost 17% of fuel use.	22.5% of thermal input would need to be bio-alternative waste-derived fuel	25% of thermal input would need to be bio-alternative waste-derived fuel	40% of thermal input would need to be bio-alternative waste-derived fuel		
Lower carbon cements (cements that contain lower embodied carbon)	Lower carbon cements are currently under development.	Lower carbon cement are not forecast to enter the market until cementitious replacement is maximized and full testing and standardization has taken place		0.5 Mt cement		
Cementitious substitution (i.e. reducing the amount of high energy cement clinker in the final cement mix)	In 2010 cementitious additions to the content of factory made cement were over 13%.	25% replacement where on average 75% of the market cement is clinker	27.5% replacement	30% replacement		
Decarbonisation of the electricity sector (aligned with CCC 4 <sup>th</sup> carbon budget)	0.54 kgCO <sub>2</sub> /kWh in 2008	0.3 kgCO <sub>2</sub> /kWh	0.15 kgCO <sub>2</sub> /kWh	Total decarbonisation to align with DECC ambition		
Carbon capture and storage	0 Mt CO <sub>2</sub> capture. Research into CCS is ongoing through organizations such as ECRA.	0 Mt CO <sub>2</sub> capture	<b>Scenario 1</b>	<b>Scenario 2</b>	<b>Scenario 1</b>	<b>Scenario 2</b>
			0.1Mt CO <sub>2</sub> capture	0 Mt CO <sub>2</sub> capture	3.0 Mt CO <sub>2</sub> capture	0 Mt CO <sub>2</sub> capture
Transport emissions (i.e. switching to lower CO <sub>2</sub> transport modes and transport fuels)		30% lower CO <sub>2</sub> e resulting from more efficient vehicles and mode switching	45% lower CO <sub>2</sub> e		60% lower CO <sub>2</sub> e	
Plant efficiency (assumes there is no breakthrough in technology but investment brings plant efficiency up to match the most efficient plants in Europe (BREF)).		No significant change	10% improvement in thermal efficiency		22% improvement in thermal efficiency	

## 5 The Route: Call for Action

In order that the UK Cement industry continues to play an active role in the UK's path to a low carbon economy both the industry and policy makers need to take action. Failure by industry and Government, policy makers and others to take action in the following areas could result in the sector falling short of the ambitious trajectories set out in this strategy.

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- 1. Government policies should incentivise the use of waste derived fuel use to replace the use of fossil fuels where it can be demonstrated that the waste is being used most efficiently i.e. both its energy and ash are being beneficially used.***

The cement industry is a prime outlet for the use of waste as replacement for conventional fuels or raw materials. The use of waste derived fuels in cement production is often disadvantaged despite being a very efficient use of the fuel (both the energy and the ash from combustion are used). Government policies currently inhibit the maximized use of Alternative Waste Derived Fuel in cement manufacture which results in a continued reliance upon fossil fuels. Other policies allow Alternative Waste Derived Fuel to be incinerated without a charge being placed on the resulting GHG emissions which means there is uneven treatment of the combustion of the same fuels in different applications. There are also initiatives to create end of waste status for a number of materials and these are likely to increase, however it is important that Alternative Waste Derived Fuels continue to be consumed only in plants that meet the tightest emission standards in Europe.

- 2. Government policies should maximize and incentivise the use of biomass to replace traditional fossil fuels. Government policies should seek to increase the supply and stabilise the use of biomass energy sources in industry and take care not just to move available biomass from one sector to another in the economy to the detriment of efficient large scale industrial use.***

Current Government policies to enhance the use of renewable heat are poorly focused and incentivise the use of biomass for some activities but not others, potentially creating a shift in biomass use from one sector to another without an overall environmental benefit. The current Renewable Heat Incentive creates an incentive to move biomass use from cement kilns to other potentially less efficient uses. This is an unwelcome intervention in the market by a poorly designed policy.

- 3. Growth in the construction sector will provide the parent companies of the major cement producers and others the certainty to invest in novel and low carbon cement technology.***

Low carbon cements can take various forms and have various technical challenges related to their implementation and use, including; availability of raw materials, suitability for applications, testing and standardization requirements needed for full commercialisation. Growth in the construction sector will provide a platform for investment in new products. Without construction sector growth UK assets will continue to decline and will place the UK vulnerable to imports when demand returns.

- 4. Government should be committed to full decarbonisation of the electricity generation sector by 2050 but not by increasing the costs to industrial electricity consumers at a rate higher than their international competitors. Higher electricity costs could impact on the carbon leakage of certain products. By applying necessary discounts and rebates for industrial electricity consumers Government can help mitigate unnecessary carbon leakage.***

Electricity accounts for around 10 per cent of the energy consumed in cement production, so it will be important that Government meets its targets for

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decarbonisation of the power generation sector by 2050. However, to date UK industrial consumers have experienced higher electricity costs than our competitors. Analysis carried out by BIS has confirmed that UK energy consumers will pay more for their electricity than competing nations as a result of the UK's decarbonisation policies. Industries that are significantly vulnerable to carbon leakage such as cement will need protection from these unilaterally applied costs so that they are able to compete with importers on an equivalent basis.

- 5. *Government and industry will need to collaborate to find carbon capture, transport and storage solutions for process industries. Government will need to invest in national infrastructure and fund demonstrations in the UK cement industry.***

Cement manufacture is one of the prime candidates for carbon capture because of the high proportion of process related emissions (typically 60 per cent from the process and 40 per cent from combustion). This means that even with biomass fuels 60 per cent of the direct CO<sub>2</sub> emission will need to be captured. There are a number of capture options that range from chemical methods through to mineralogical recarbonation and biological capture. The European industry is undertaking practical research and collaborating with equipment suppliers to find the best capture methods for cement but if the UK wants to be a leader then UK Government financial support is necessary for the UK cement industry. Without this support the UK cement industry will miss its most ambitious scenario of an 81 per cent emission reduction by 2050.

- 6. *Government needs to have a procurement policy and robust carbon accounting that is focused on the whole life performance of buildings so that the properties of cement and concrete can be maximized and the impact on the climate minimized.***

Too often carbon accounting is 'product' or 'activity based' even though these accounting methods often fail to explain the full picture. The GHG impacts of cement and concrete production are far outweighed by the benefits of the materials in their use. In particular the Thermal Mass benefits of concrete in heavy weight buildings where the CO<sub>2</sub> 'penalty in manufacture is re-paid in just 11 years in a well-designed house. Consequently, Government needs to shift away from product and activity based accounting policies to 'whole life performance'.

- 7. *Government should provide incentives for industrial freight to switch to lower carbon transport methods either by mode switching or by using low carbon road transport.***

Government's spending plans need to ensure that domestically and locally sourced construction materials are utilized to grow the economy on a local, regional and national level. A strong demand for cement and concrete will create jobs and support rural economies. In creating a locally based responsible sourced economy the need for transport will be less. However, as the cement plants maximize the efficiencies of scale there will remain a need for cement, raw material and fuel transport. The UK cement industry will need to rely on Government policy to support the shift to a low carbon transport system, particular assistance will be needed for industrial freight.

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The Mineral Products Association is the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries.

With a growing membership of 450 operators across the UK, it is the sectoral voice for mineral products, representing the vast majority of independent SME companies across the UK as well as nine major international and global companies.