Policy Resource

Cement and Concrete

How concrete action can protect us from climate change

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Summary

Concrete is one of the materials that has made our modern world possible. This versatile resource is an essential component in everything from skyscrapers to bridges, and hydro-electric dams to the very foundations of our homes. It is also a major global polluter. Most of its emissions come from making concrete’s core ingredient: cement. Cement is a binding agent which, when combined with aggregate such as sand or rocks, forms concrete. Producing cement involves chemical reactions which produce CO2 as a by-product and require very high temperatures, which are usually achieved by burning fossil fuels. There are no easy answers to decarbonising this sector, but taking action now is crucial if we are to meet our climate targets. This resource explores some of the things you and your MP can do to take action on this area.

Cement being used in construction
Part 1: Overview of the challenge

Globally, the cement industry accounts for seven percent of all greenhouse gas emissions caused by human activities. Cement production is also the highest emitter of all UK-based industrial processes, ahead of steel and glass production. So why is the process of producing cement so carbon intensive?

Cement is produced from heating minerals like limestone in a kiln. This process removes impurities, leaving behind a substance known as ‘clinker’. This clinker is then cooled, ground up, and mixed with other materials to form cement.

While most sources of greenhouse gas emissions come from the burning of fossil fuels, with cement this is only half of the problem. Around 40% of the emissions come from the fossil fuel combustion needed to achieve the necessary heat in the kiln, but a further 50% comes from the chemical process itself.

Approximate breakdown of cement emissions (source: Carbon Brief)
Clinker: 50%

Portland cement, by far the most commonly used type of cement, is made using a binding material called clinker. The process of making clinker relies on a chemical reaction involving the heating up of limestone, of which CO2 is an inevitable by product.

The process for producing clinker consists of exposing calcium carbonate to extreme heats of around 1,500 degrees celsius. During this process the calcium carbonate breaks down into simpler compounds, leaving Calcium Oxide and Carbon dioxide, the most common greenhouse gas.

In most other high carbon sectors, such as energy or transport, the major cause of emissions is from burning fossil fuels. However, for clinker production the amount of CO2 emitted cannot be reduced through electrification or efficiency improvements because the greenhouse gases are drawn from an unavoidable chemical reaction.

On average, Portland cement consists of more than 70% clinker. For Portland cement to be produced, the proportion of clinker used cannot fall below 50%. So while some progress can be made by producing Portland cement with a lower ‘clinker ratio’, it alone will not decarbonise the industry.

It may be possible to prevent some of the CO2 released in the clinker production process by attaching carbon capture and storage (CCS) plants to cement kilns. Cement industry groups see a large role for CCS. However, creating CCS infrastructure is expensive and unproven in the cement sector. Pilot projects and demonstrations, some of which are underway across Europe, will be needed to show how effective this technology could be. Not all cement kilns in the UK have easy access to areas where carbon could be stored, meaning that CCS poses “cost, distributional and technical challenges”. This could seriously impact the extent to which CCS can be used for reducing UK clinker emissions.
Fuel combustion: 40%

The next largest emissions source in cement production is found in the fuel used to power the kilns. Cement production is similar to other industrial processes such as steel production in that it is very energy intensive and therefore difficult to electrify. Traditionally powered by fossil fuels, alternative energy sources such as biomass, waste and hydrogen may support the sector in decarbonising, although there are challenges associated with each of these options.

Challenges for biomass, waste and hydrogen

1) Biomass is an ‘energy crop’ which requires large amounts of land to produce, so realistically would not be able to power the sector alone.

2) Burning waste will produce significant quantities of CO2 unless the process is coupled with currently unproven carbon capture and storage technology.

3) In the short term, renewably produced hydrogen will not be able to meet the energy needs of the cement sector, unless it is coupled with hydrogen generated from burning gas (which will rely on unproven carbon capture and storage to make low carbon).

Sourcing and transporting raw materials: 10%

Extracting the key raw materials for cement production, such as limestone, clay and marl, is an intensive process that involves heavy machinery. Beyond using an alternative material to cement, the best way to reduce these emissions is through circular economy principles; reduce quantities used, reuse, repair, recycle.
Part 2: What is the Government doing?

In March 2021, the government published its **Industrial Decarbonisation Strategy**. It set out a broad range of plans and principles relating to many key industries, including cement. However, it did not set an emissions reduction target for the cement industry, or commit to considering one in future. The Climate Change Committee (CCC) recommends a ‘near-zero’ emissions target of 2040.

Alternative Materials

In 2017, the UK government committed to **collaborate with industry** to establish and develop lower-carbon cements, alternative materials, and clinker replacements. Many of these have been proven to be viable in some contexts. **Clinker substitutes**, such as fly ash and blast furnace slag, have shown potential as a means of decarbonising the cement industry. These substitutes are byproducts of fossil fuel use in the coal and steel industries. In the long term, as these industries transition towards net-zero, some clinker substitutes may become less easy to procure.

There are barriers to the adoption of alternative materials. Incentives and rules would need to be put in place to promote adoption of these new materials among business and industry. Before this can happen, materials must pass through rigorous testing and demonstrations to show that they are effective and safe. Even then, the materials produced may have a more limited number of uses than cement, which is a highly versatile material.

The Department for Business, Energy and Industrial Strategy (BEIS) is supporting the mineral sector with programmes such as the BEIS Fuel Switching Programme and the BEIS Industrial Energy Efficiency Accelerator programme. The funds supplied through these programmes help to support businesses and industry groups to conduct demonstrations for zero- and low-carbon alternative materials and fuel mixes.
Alternative fuels and CCS

The 2021 Industrial Strategy sets out a significant role for CCS and hydrogen in the decarbonisation of industry. As mentioned above, both require large scale infrastructure, which are not always viable for existing plants. Equally, the effectiveness of both technologies in reducing carbon emissions is currently far from certain. CCS in particular cannot be guaranteed to work effectively in capturing cement production emissions, since it has not yet been proven at an industrial scale.

Reduce, reuse, repair, recycle

The government identified embedding circular economy principles as a challenge in its 2021 Industrial Strategy, saying that:

“Business and consumer habits are not presently set up to encourage product sharing, reuse and other circular economy measures.”

The Department for the Environment, Food and Rural Affairs (DEFRA) is currently analysing feedback to their consultation on a Waste Prevention Programme for England.

Carbon Pricing

Cement is included in the UK’s emissions trading system. The aim of this mechanism is to incentivise decarbonisation by putting a price on carbon which slowly rises over time, and financially rewarding those who decarbonise fastest.

The Industrial Decarbonisation Strategy 2021 promotes reducing the amount of clinker in cement compared to other materials as a way of reducing overall emissions. The UK’s emissions trading system will help incentivise companies and organisations to pursue this.

Emissions trading is a highly complex policy area; you can read more about it in our carbon pricing policy resource.
Part 3: What more can be done?

There are three major areas where politicians could promote greater UK action on cement decarbonisation: ambition, pilot projects and circular economy.

Ambition

Decarbonising industry will be crucial in meeting the UK’s net zero targets. The Climate Change Committee’s have recommended that the cement industry adopts a 2040 near-zero emissions target. Likewise, the major organisation representing businesses in this sector, the Mineral Products Association, has committed to reduce emissions by 81% by 2050. Consequently it is notable that the government’s Industrial Decarbonisation Strategy made no direct mention of either of these targets.

Without a target, or even a commitment to consider a target, it is difficult to set out an overarching approach for decarbonising the sector. Individual funds for alternative material demonstrations or circular economy incentives are welcome, but without a long-term goal, it is unclear how much each element of the industry is expected to achieve.

Greater ambition for decarbonising the industry could start with the development of a near-zero emissions target, as proposed by the Climate Change Committee.

Pilot Projects and Demonstrations

The UK has laid out plans for a rapid increase in hydrogen production and CCS capacity. It has also approved some funding for other low carbon cement production techniques. However, there is potential for greater investment and pace in this area.

The UK is a world leader in innovation, research and development. We have the potential to support a global transition towards lower-carbon cement and alternative materials and gain a significant economic advantage as a ‘first mover’ in the sector. Greater ambition and urgency to promote innovative solutions could have benefits for the UK and global climate action.
When pilot projects and demonstrations have been shown to operate successfully at scale, industry standards, building regulations and public procurement practices should be updated where these materials are most appropriate. These could support businesses that are starting to use alternative materials and lower-carbon cements by enabling their use and providing early investment.

Circular economy

Following their analysis of the feedback to their Waste Prevention Programme for England consultation, the government should set out plans to reduce the need to produce new cement where feasible by managing demand and reusing, repairing and recycling the material where possible.

Part 4: How to approach your elected representative?

MPs have to engage in a variety of important issues, often many in a single day. Consequently most MPs are generalists, knowing something about a lot of issues, with one or two specialist interests. Consequently, it is unlikely that your MP will be an expert in cement decarbonisation. It is an area of public policy that is under-discussed relative to its environmental impacts. If you are interested in talking to your MP about cement decarbonisation, it may be worthwhile to send them an introductory report ahead of your discussion (many useful reports are listed at the end of this resource). You could also start by setting out the scale of the cement industry’s emissions (it is the largest industrial polluter in the UK, ahead of steel and glass) so that they can gain an understanding of the scope of the issue.

One way to engage your MP on cement is linking to jobs and the economy
Business and jobs focused MPs

One way to engage your MP on this issue is to emphasise the opportunities that it could bring to the UK. The government could drive investment, both through direct spending and leveraging funding from within the cement industry, into innovation around new cements and alternative materials. It could also support businesses working with these materials through public procurement practices and demonstrate how advanced supply chains could integrate circular economy principles successfully in the sector.

By encouraging a market for lower-carbon cement and alternative materials, new jobs could be created and existing ones could be insulated from the effects of increases in the price of carbon. British businesses could also secure competitive advantages on the global market place by utilising the innovative technologies produced through public and private investment. Framing your argument like this could appeal to MPs on the right of the political spectrum and MPs whose constituents would likely benefit from growth in these sectors.

Social justice focused MPs

An alternative approach would be to frame the issue as one of global economic justice. The world’s most advanced economies, like the UK, have benefited from generations of concrete infrastructure at great cost to the global climate. Developing nations should be able to grow their economies and improve their populations’ standards of living. The UK can support their efforts to do this by developing the tools to achieve this growth without compromising global climate targets.
Conclusion

Whichever way you frame your argument, the first policy suggestion is likely to be the same. The government should set out a more comprehensive strategy for decarbonising cement production. The first step is to start formulating targets to meet near-zero emissions in the industry, in line with the Climate Change Committee’s recommendations.

Here are two examples of what you might want to ask your MP to do:

You could ask your MP to forward a letter - written by you or a group of constituents - to the Business Secretary, Kwasi Kwarteng, who is responsible for industrial decarbonisation, urging him to set a target for reaching near-zero greenhouse gas emissions in the cement sector.

You could ask your MP to write their own letter and send it to the Environment Secretary, George Eustice, urging the Department for Environment, Food, and Rural Affairs to work with BEIS to publish a strategy for reducing demand for cement through reducing demand, reusing, repairing, and recycling.

Whichever subject you wish to raise, it is important to tailor your lobbying approach to your MPs interests and position. Hope for the Future can help you discuss this subject with your MP and ensure that your interaction leads to meaningful action. Get in touch with Hope for the Future to request a meeting with one of our Constituency Support Officers to start planning your MP engagement. For more information on any of the issues raised in this resource, contact our research team using research@hftf.org.uk.

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