

Fuel Switching

Carbon neutral and zero carbon kiln energy

Key facts

- 1 43% of UK cement kiln fuel is sourced from waste derived alternative fuels to replace coal.**
- 2 Biomass fuels used together with carbon capture will help cement to go beyond net zero.**
- 3 Fuel switching to meet net zero is technically and financially challenging.**

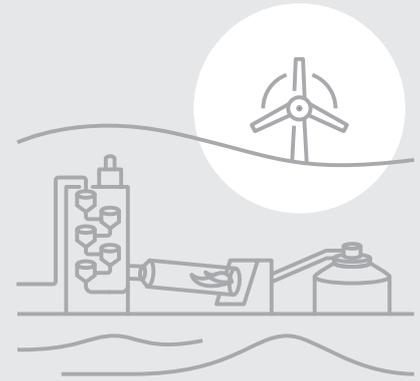
The concrete and cement industry has taken the lead in the transition from traditional fossil fuels such as coal and petcoke to the use of waste, waste biomass and waste part-biomass fuels.

Waste derived alternative fuel now accounts for 43% of the fuel used, replacing the equivalent of half a million tonnes of coal every year.

Increasing the replacement of fossil fuels with carbon neutral waste biomass and innovative zero carbon

energy sources (e.g. hydrogen and electrification) could replace the current 2 million tonnes of fuel related CO₂ emitted each year.

When carbon neutral and zero carbon heat is combined with carbon capture, usage and storage (CCUS) and other decarbonisation levers, together they could enable concrete and cement manufacture to go beyond net zero by 2050 – removing more carbon dioxide from the atmosphere than is emitted overall.



Fuel switching in cement kilns

- The production of cement emits CO₂ through both combustion and the high temperature thermal decomposition of limestone. Typically around 30-40% of CO₂ emissions arise from the combustion of fuels, with the exact amount depending on the fuel.
- In cement production, raw materials are preheated to around 900°C using recovered heat and fuel. In the rotary kiln, clinker is produced by further heating the raw materials to 1,450°C. Clinker is the principal ingredient in cement.
- Alternative waste derived fuels (WDF) are used to replace coal and petcoke. Waste derived fuel use is considered best practice by environmental regulators because there are multiple environmental benefits, including from reducing non-CO₂ related air emissions to lessening the UK's reliance on landfill and incineration.
- WDF use in cement manufacture has been determined as a best available technique (BAT) by an international panel of experts through a European Commission process. It is industry best practice globally.
- WDF use lowers emissions compared to fossil fuels and their use means coal can stay in the ground.
- In UK cement production today, biomass fuel is sourced from waste remaining after a previous use. This includes waste packaging, processed sewage pellets, waste textile fibres or the natural rubber fraction of tyres.
- When WDF are used in cement kilns the energy value is recovered and the mineral/metal content of the ash is simultaneously recycled into the clinker, in a unique process called 'co-processing'.

Fuel switching and net zero

Using waste biomass is a sustainable choice and makes the best use of natural resources.

Co-processing, where WDF energy recovery and material recycling takes place simultaneously, is resource efficient and an excellent example of the circular economy that avoids landfill and incineration. Wastes are used that are not suitable for other recycling.

New energy sources such as hydrogen and electricity could supplement waste biomass to further reduce emissions by around 2MtCO₂ per year by 2050.

These alternative energy sources are being investigated for their suitability for cement production in innovation demonstrations led by the Mineral Products Association (MPA).

Technical and financial challenges exist for the full deployment of a net zero fuel mix for cement production. MPA has received Government research support to investigate net zero fuel switching. However, in addition to the technical research, the Government needs to address the current inequity in their support of renewable fuels.

Net zero fuel mix – barriers and accelerators

A 'net zero' fuel mix is a real possibility for cement production with favourable technical development, the right energy supply infrastructure and competitive pricing. Government subsidies currently divert biomass to other energy uses. A balanced policy for biomass energy and support for zero carbon energy use will be needed to accelerate the transition to a net zero fuel mix. Some net zero fuel switching options are:

- **Biomass fuels:** Biomass resources are limited and there are many different activities and sectors competing for these resources, including power generation. Cement kilns can use waste biomass meaning virgin biomass resources can be used more efficiently, for example by leaving trees in the ground to absorb CO₂.
- **Hydrogen gas:** Hydrogen burns as a clean fuel without producing CO₂ when the fuel is used, but large volumes are needed to supply industry.

CO₂ free hydrogen production, e.g. using renewable electricity or using CCUS, is needed to make it a good environmental option and it needs to be tried and tested in a cement kiln.

- **Electrical heat:** Renewable electricity could be used with technologies such as plasma torches or microwave energy to apply heat or to assist combustion of solid fuel. These technologies are largely unproven in cement production and require significant research and development.

There are several critical issues that must be addressed before a net zero fuel mix can be a real possibility for UK cement production.

- 1. Infrastructure and supply:** Advances need to be made for the production and delivery of zero carbon hydrogen. Green electricity scale up also requires unprecedented investment but there needs to be a fair balance on how these infrastructure costs are distributed.

- 2. Consumer support:** To accelerate and facilitate the switch to zero carbon energy options, industrial consumers need to be given a competitive choice. Fiscal support will be needed in the short term and until these options become cost competitive.
- 3. Fair subsidies:** Biomass subsidies that are not available for some biomass uses e.g. direct firing in kilns, are creating a barrier to the economical availability of biomass for cement manufacturers. Fair access to biomass must be allowed so the market can discover the most efficient uses.
- 4. Procurement:** A market for UK produced low carbon products could help to accelerate fuel switching. Using whole life and life cycle assessment, a market demand for low carbon products and solutions can be created to help drive investment in fuel switching. Government, with its purchasing power, can take the lead.

Key Government enablers

- 1 Financial support for the provision and use of biomass and waste biomass in directly fired operations and industrial combustion activities (equivalent to the support offered to boilers, heaters and anaerobic digestion).**
- 2 Ensure that the UK electricity system is regulated to provide decarbonised electricity at internationally competitive prices to industrial customers throughout the transition to net zero, including a transitional support programme for modifying industrial processes from fuel to electrical energy.**
- 3 Support the development of a zero carbon gas network with cost competitive prices for industrial consumers to encourage fuel switching.**
- 4 A robust financial support model for the capital and operational costs of carbon capture no later than 2021. The technology can then be developed, deployed and become an investable proposition in the 2030s, facilitating emissions removal through the deployment of industrial biomass fuel carbon capture.**

MPA fuel switching research

MPA successfully attracted BEIS funding to research and demonstrated the use of up to 100% carbon neutral fuels:

Trials are underway at two cement sites and a lime site to switch energy input from fossil fuels to carbon neutral biomass and zero carbon hydrogen and electrification. If successful and deployed widely throughout these sectors, this could yield emissions savings of over 2.6 million tonnes of CO₂ per year. Used in combination with other decarbonisation technologies such as carbon capture and accelerated carbonation, net zero fuel switching will make significant progress to net zero and beyond.

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

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