

5 Strategies towards decarbonisation

By Joana Malato and Mark M. H. Goode

Cement is a critical part of modern civilisation and has been used by humankind for over 2,000 years to hold buildings together. In fact cement is one of the most important substances in the modern world, because when cement is mixed with water and aggregates in the correct amounts - concrete is formed. Try to imagine a world without cement or concrete: no roads, no bridges, no tunnels, no airports, and certainly no skyscrapers.

In this regard cement is intrinsically related to economic development, and the demand for it is booming, particularly in BRIC countries (those at a stage of newly advanced economic development) like China. In 2011 the global production of cement reached 3.6 billion tonnes and is projected to reach 5 billion tonnes by 2050.

The current cement industry is highly concentrated within a few very large firms, as enormous investment is required to construct a cement plant. But the current production of cement comes also at a very high cost to the environment: manufacturing one tonne of Portland cement¹ (PC, the most common type of cement) releases roughly *one tonne* of CO₂ to the atmosphere. Of the emissions from manufacturing PC, roughly 60% comes from clinker production and the second largest contributor is burning fossil fuels. The overall environmental impact also includes the exhaustion of natural resources and the effect of other inherent processes such as mining and transport. It should therefore come as no surprise that the cement industry is responsible for over 5% of the total human-produced CO₂ emissions.

Despite universal acknowledgement of the threat that climate change represents, as well as legislation such as the UK Climate Change Act, the cement industry still has far to go beyond just talking green towards buying green.

By developing and adopting more environmentally friendly (and cost efficient) processes and materials, the UK cement industry has achieved a 55% reduction on CO₂

¹ The production of PC involves quarrying or mining the raw materials (typically ground limestone and clay). These are transferred to the manufacturing plant where they are mixed in certain proportions and then burned in a large rotary kiln reaching temperatures greater than 1400°C. This produces a dark grey nodular material called clinker. When cool, the clinker is ground up to a fine powder and a small amount of gypsum is added to control the setting properties of the cement.

emissions (in comparison to 1990 levels). This is still far from the target 81% overall reduction of GHG emissions set by the industry and even further from a decarbonised cement industry and a zero carbon Britain.

Is a decarbonised cement industry actually possible? Yes. Change does happen, and five steps can move us a long way down this path:

1. Convergence

The green push has to involve a serious industry engagement reflecting a balance between economic incentives and a green economy. This includes research that works in an industrial environment, and a structural reform of international building codes so they actually meet sustainable targets.

2. Accept, allow and (further) develop alternatives

Carbon Capture and Storage (CCS) is the best-case scenario the industry might rely on to achieve its carbon reduction targets. The big question is: when will carbon absorbing cements be developed and when will full scale production facilities be available?

A new generation of cements already exists that could replace Portland cement. Companies in Australia, USA and in Europe (including the UK and Ireland) are already manufacturing innovative cements with very little or no PC, but the cement industry is far from embracing them. These cements must overcome scepticism of alternatives, high switching costs and the role of regulations, as well as high perceived risk. However, green cementitious materials don't have to be used in structural applications in a skyscraper, for instance, but could instead be used in things like paving blocks and street furniture.

3. Foster behavioural change through information and structural incentives

At the moment there is a serious lack of market drivers to sustain change. Building standards are a critical starting point, but can also prevent the spread of new alternative materials. Should the current, far too prescriptive standards go beyond chemical and physical properties to include sustainability information?

In a climate where cement buyers simply don't understand "why" and "how" sustainability matters, and where "green washing" is taking the lead, we need comprehensible numbers and actions. A clear definition of green cement, mandatory carbon footprint of all products (bulk and bagged) and incentives to projects with high PC replacements are essential.

Green cement shouldn't be just for visionary sustainable projects. In an industry where government buying is key, public institutions can favour and specify low carbon materials – provided they are competitive in price and high performance.

4. **Consumption, Utilisation and Production**

Reducing cement consumption is obviously one solution, but this is not a route the cement industry is willing to take. Using cement much more efficiently is the next best option.

Using supplementary cementitious materials means less clinker, less fuel, and less CO₂. As an alternative to clinker this is already common practice, but it is still far from being maximised. As a high-energy process, cement manufacturing can also benefit immensely from being powered by renewable energy.

5. **Monitor, Review and Adjust**

An effective long-term plan has to be drawn considering both short-term needs and long-term answers and results. Constant monitoring and review is of paramount importance so we know we are on the right track or if tougher measures are needed.

These are neither easy nor simple short-term steps. The decarbonisation of the cement industry is possible, but it will only happen when the new generation of cements is fully embraced by the construction industry – from leading cement manufacturers to the thousands of independent manufacturers, and from architects to building inspectors. The key starting point is government legalisation and incentives to change. We need leadership, vision and planning from governments worldwide to make this happen.

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