



# MISSION: CARBON ZERO

**C**limate change, the Paris Agreement and talk of saving the planet have, for many years, been highly politicized topics. Viewpoints have differed greatly, and few have been willing to risk relationships with customers, vendors and others to take a stance on the issue. Major industries such as construction, building materials and heavy machinery were relatively quiet on the issue.

Until now.

Taking steps to reduce greenhouse gas emissions to lower the global temperature increase, as the Paris Agreement aims to do—to limit global warming well below 2°C and as close to 1.5°C as possible—have long been considered a political move. Few in the manufacturing and industrial world have been willing to rock the boat and publicly embrace the Paris Agreement.

When it comes to the concrete and cement industry, some have questioned the need to change. Cement and concrete are so widely used because they are effective, affordable, accessible, highly durable, and long lasting. Concrete is also celebrated for its thermal mass, its ability to absorb and store heat energy, moderating temperature extremes in buildings, requiring less energy use.

## IF IT AIN'T BROKE

For how long it lasts, many have considered the carbon footprint of concrete to be relatively low. Cement, however, produced 2.2 billion tons of carbon dioxide (CO<sub>2</sub>) in 2016 (4% of total emissions), according to the Emissions Database for Global Atmospheric Research, making it one of the world's greatest contributors to climate change. Improving the carbon footprint of cement and concrete

is also important as cement production is expected to increase by 25% by 2030 while cities around the world become more urbanized.

Half of the emissions generated from the cement production process come from clinker, the building block that gives cement its strength and other important properties.

"Although the CO<sub>2</sub> footprint of buildings is primarily from energy consumption while in use, we must also care about the CO<sub>2</sub> emissions inherent in the production of concrete," says Ian Riley, CEO of the World Cement Association (WCA). "These come primarily from cement, which is responsible for about 7% of CO<sub>2</sub> emissions, the largest of any industrial

sector. This is the reason that when we talk about sustainability, we place carbon footprint as the number one issue and why it is such a high priority issue for us. Cement is also a hard to abate sector, since most of the emissions come from the clinker process, namely calcination of limestone, so decarbonising the energy used would only reduce emissions, not eliminate them."

Concrete has been used in construction for thousands of years. The process works and the end product is highly effective. To some, it seemed too difficult to change the process through which cement and concrete are produced, placed during the construction process, maintained, repaired and disposed of or recycled. And if any of those steps in the concrete lifecycle were altered, how can the industry be changed on a wide enough scale that the contractors who pour cement and place concrete on the jobsite will use new and different methods and materials?

Despite those challenges, the world's largest cement and concrete producers have become increasingly vocal about the industry's need to reduce emissions. The pace of the conversation has quickened in 2020 as producers enter an arms race of sorts, to research and develop new products and to reduce emissions the fastest in the industry. The cement and concrete industry's biggest names are posting to social media sites daily about their commitment to reducing emissions. Weekly and monthly, industry associations are making announcements about new goals set and benchmarks met.

## A NEW ERA OF CORPORATE ACTION

Sustainability can mean different things to those in the cement and concrete industries. Concrete is durable and long lasting and for some, that means it's sustainable. That mindset is shifting, though. Companies are increasingly talking about cement and concrete sustainability in the context of reducing CO<sub>2</sub> emissions.

"When we look at the carbon footprint of a product, we must look

at the total lifecycle footprint," Riley says. "When we buy a car, we don't just think about how much CO<sub>2</sub> was emitted during manufacture, we consider fuel efficiency and how much will be emitted during use. So, with concrete, it is not only the generated CO<sub>2</sub> during production but also the CO<sub>2</sub> generated during the building lifetime. The thermal mass of concrete gives it some advantages over steel and wood in this respect."

Several of the industry's major producers and affiliates have taken those emissions head on and have recently made announcements of emissions reductions and new products. The green building materials market as a whole is expected to grow by \$187.4 billion by 2027, according to a 2020 report by Research & Markets.

In November, HeidelbergCement, one of the world's largest cement and concrete producers, announced plans to invest more than \$500 million to modernize its factories in France and launched a pilot project for capturing CO<sub>2</sub>. The company is working on a carbon capture project in Norway and creating Europe's largest 3D-printed residential building based on technology created at HeidelbergCement's engineering and innovation department in Germany. Those are a few of many initiatives aimed at reducing the company's CO<sub>2</sub> emissions by 2025 to below 525 kg per ton, which will be 30% less than what the company produced in 1990.

"To us, sustainability means taking on our share of responsibility for our future; we aim to keep the global temperature rise well below 2°C," says Christoph Beumelburg, HeidelbergCement's director of group communications and investor relations. "To achieve this, we need to continually reduce our impacts on air, land and water. On a product level, this means offering low-carbon cement and concrete products—but also R&D on new building materials with properties favorable for lower

LafargeHolcim conducts research on reduced carbon emissions products at its Lyon Research and Development Center in France.

Photo Credit: LafargeHolcim

Cement and concrete are so widely used because they are effective; they are affordable, accessible, highly durable and long lasting. Concrete is also celebrated for its thermal mass, its ability to absorb and store heat energy, moderating temperature extremes in buildings, requiring less energy use.

Photo Credit: HeidelbergCement

material usage, which enable society to implement climate-friendly solutions. We are committed to carbon neutrality on concrete level by 2050 at the latest."

Beumelburg adds that as a company that uses raw materials in its products, HeidelbergCement has long been aware of the need for improved sustainability. "In our business, responsible business management is vital to ensure the future viability of the company," he says. "And while CO<sub>2</sub> reduction is one important element on our path to be the most sustainable building materials company, to us, sustainability certainly means more than CO<sub>2</sub> reduction. Our Sustainability Commitments 2030, the guiding principles of our sustainability strategy until 2030, covers a range of aspects from biodiversity, circular economy and water management to compliance and health and safety."

In 2019, HeidelbergCement's CO<sub>2</sub> reduction target was approved by the Science-Based Targets initiative (SBTi), a partnership through the World Resources Institute that aims to increase corporate





HeidelbergCement began construction of Europe's largest 3D-printed residential building based on technology created at HeidelbergCement's engineering and innovation department in Germany. Photo Credit: HeidelbergCement



HeidelbergCement is employing many initiatives, such as the use of alternative materials, to reduce carbon emissions in cement and concrete. Photo Credit: HeidelbergCement

participation in emissions reductions. HeidelbergCement was the first cement company globally to have approved science-based CO<sub>2</sub> reduction targets.

"As we have been making good progress toward those targets, we recently decided to further accelerate our efforts," Beumelburg says. They are reporting good progress in technologies enabling the management of and the use of remaining emissions, such as CCU/S (Carbon Capture, Utilization, and Storage). HeidelbergCement has also launched various products with innovative sustainability features in all group countries. HeidelbergCement is using alternative raw materials and fuels, such as biomass, as part of its low carbon portfolio.

The construction industry is facing a new set of sustainability-related challenges: besides climate change, the way we do business will be affected by

a major reduction in emissions.

"In order to meet these ambitious targets, we're taking a holistic approach and using a variety of levers," Cleary says. In the U.S., the company is doing everything from investing in renewable energy and increasing the energy efficiency at plants, to developing low-carbon products that will help reduce carbon emissions of construction projects.

LafargeHolcim, the world's largest cement producer, reaffirmed its commitment to reach its emissions reduction goal by 2030 and launched a 3D printing hackathon in November. "Concrete has an essential role to play in meeting the global challenges posed by population growth, increasing urbanization and resource scarcity," says Patrick Cleary, senior vice president, sales - US Cement, LafargeHolcim. "Concrete is vital to meeting these challenges. It is durable, fire and flood resilient, low carbon across its lifecycle, recyclable, versatile, affordable and available almost everywhere. We believe that sustainability creates value for our business, our shareholders and society. As the global leader in building materials and solutions we are determined to maximize this value and are committed to living up to the responsibilities that come with it."

LafargeHolcim was the first global building materials company to sign the UN Global Compact's (UNG) Business Ambition for 1.5° C initiative, with a 2030 SBTi-verified action plan. LafargeHolcim is partnering with SBTi to define its roadmap to 2050, to make

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in helping the entire industry lower its carbon footprint and can provide significant opportunity for ready-mix producers and concrete contractors to create a competitive advantage in their local communities."

GCP Applied Technologies Inc., which produces construction technologies and additives for the cement and concrete industries, recently received a European patent for sustainable cement grinding methods it developed. The company is working on improving sustainability on several fronts, by helping cement producers with the mixes and additives they use and how they reuse and recycle concrete.

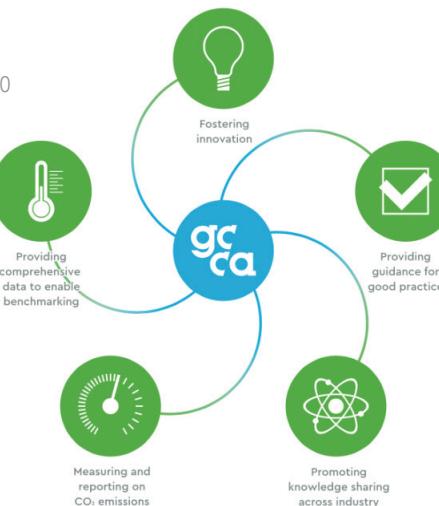
According to Diego Granell, GCP global marketing director, the industry is shifting more toward sustainability because of increased customer pressure. "The customers in the industry, the owners, the developers, are basically demanding we put more focus on lower carbon in the mix designs because that's the biggest source (of emissions) the industry

In September, GCCA unveiled its 2050 Climate Ambition Initiative, marking the first time the industry has come together globally to state a collective goal for a carbon neutral future.

Photo Credit: GCCA

has," he says. "We want to make sure we offer them a solution to enable that to happen. We not only provide solutions, but we also provide networks and transparency so they can basically make a more informed decisions on what specific tools to use."

GCP is investing in control management systems, such as VERIFI and other technologies to improve its carbon footprint. VERIFI, for example, monitors and adjusts slump in transit, reducing waste and the number of trips needed between the cement plant and jobsite. The company is also developing technology and mixtures to replace the clinker in cement and reduce the use of cement in mix designs.



"The big, key message that we basically are trying to convey to our customer is that we are really focused on reducing CO<sub>2</sub> emissions but doing that in a cost effective way, saving money, optimizing the operations, reducing the costs of LEED design, enabling other materials to be used to substitute the cement; it's all these things," Granell says.

Another major player in the sustainability movement is CEMEX, which in November was awarded a grant from the U.S. Department of Energy to research and develop carbon capture technology at the company's cement plant in Texas. The company is also researching the use of nanotechnology to produce low emissions concrete. CEMEX is developing a net-zero CO<sub>2</sub> concrete known as Vertua, based on a geopolymer binder solution from the Cemex Research and Development Center in Switzerland. The company is also partnering with Synhelion to create the first solar-driven cement plant.

Many other companies are making strides in emissions reductions. Votorantim Cimentos, for example, recently announced its 2030 sustainability commitments. Smaller startups are creating new products, such as CarbonCure Technologies, which is creating carbon dioxide removal solutions for the concrete industry. CHRYSO and Solidia Technologies are working together to create high-performance, ultra low CO<sub>2</sub> concrete. Carbon Cast, a grid of carbon fiber reinforcement in insulated wall panels, reduces weight involved in shipping, erection and substructure costs. Dozens of similar product innovations are in the pipeline across the globe.

Academic institutions are playing a role as well. Massachusetts Institute of Technology (MIT), Iowa State Concrete Paving Tech Center, Yale School of Architecture, Pudue SMART Lab and others are making significant progress researching and developing more sustainable concrete solutions.

The industry is in for another challenge, as well: keeping up with codes and requirements. In a November webinar hosted by the National Precast Concrete Association, Kevin A. MacDonald, a respected expert in the concrete industry, pointed out that cement and concrete have great potential to be more sustainable and more durable, but codes and specifications can't keep up with the latest advancements in materials. Several variations of high-performance concrete have been made available in recent years, he says, but the codes don't address changes in specifications to use those new products effectively.

"We know how to make high-performance concrete, but the codes and systems won't allow it," he says.

#### ASSOCIATIONS PLAY A MAJOR ROLE

Industry associations are also playing a major role in the race to increased sustainability. Many are creating initiatives and establishing goals for industry partners to meet.

The National Ready Mixed Concrete Association (NRMCA) published its NRMCA Sustainability Initiatives vision statement back in 2009. The statement called on the industry to "transform the built environment by improving the way concrete is manufactured" to balance environmental, social and economic conditions.

To achieve this goal, the NRMCA called on using the concrete lifecycle (acquisition, production, construction, operations and maintenance and recycling) to reduce its footprint. The group also established the MIT Concrete Sustainability Hub in 2010 to research and measure progress toward that goal. In 2012, it adopted the Architecture 2030 Challenge, which established

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carbon reduction goals for buildings and products. By 2019, the industry was able to report a 13% reduction in its carbon footprint in five years.

"As an industry, we must listen to what our customers are demanding," says Lionel Lemay, NRMCA's executive vice president/division head, structures and sustainability. "Most architects, engineers, owners, and contractors etc., who like the benefits of concrete like strength, durability, energy efficiency, the solid feel, low noise transmission, fire resistance and so forth. But they also want to lower the embodied carbon footprint of the buildings they design and build. So, it's up to us as an industry to meet that challenge."



Half of the emissions generated from the cement production process come from clinker, the building block that gives cement its strength and other important properties.

Photo Credit: HeidelbergCement

NRMCA has also developed its Build with Strength program to help educate engineers, architects and others about what keeping the carbon footprint low and hosts a podcast, "Concrete Credentials" led by Gregg Lewis, NRMCA's executive vice president.

NRMCA put on its first-ever Global Concrete Summit Nov. 30-Dec. 10 to exchange ideas about improving the sustainability of concrete. More than 2,500 people were expected to attend the virtual event. Speakers included many industry and academic notables, such as WCA's Riley, LeMay and Rick Bohan, the Portland Cement Association's (PCA) vice president of

sustainability. The summit is one of many cement and concrete industry events focused on decarbonization. In November, the American Concrete Institute hosted its virtual Conference on Sustainability & Durability touched on durability, alternative materials for cement and building codes, among other topics.

At the PCA, the realization that concrete can play an important part in improving sustainability has helped lead the charge toward reduced emissions in recent years, Bohan says.

"The focus on sustainability reflects PCA's ongoing commitment to everything that sustainability represents," he says. "This is nothing new. What's new is the realization by everyone throughout the value chain that concrete is the optimal solution to sustainable construction."

PCA has been measuring environmental standards in concrete for years. "We're one of the brightest success stories in the EPA's ENERGY STAR program including PCA's Partner of the Year Award in 2020," he says. The association has been providing resources that support sustainable construction for more than 100 years. For example, its landmark publication, *Design and Control of Concrete Mixtures*, soon to be in its 17th edition.

PCA created its Shaped by Concrete program to tell the positive story of cement and concrete. The group is working with the American Concrete Paving Association (ACPA), NRMCA, MIT, Iowa State Concrete Paving Tech Center and others on sustainability efforts. PCA recently announced a roadmap for reaching its sustainability goals.

Another organization, the WCA, helps its members with benchmarking, gap analysis and performance improvement when it comes to sustainability. "There are many developing technologies that will enable the cement industry to reduce its carbon footprint," Riley says. "We are optimistic that by accelerating the development of these technologies and by applying best

practices in energy efficiency, alternative fuels and use of alternative cementitious materials, the cement industry will be able to fully decarbonise." Recently, WCA launched a podcast series called Clinker Factor that talks with other industry leaders and experts about cement and decarbonization.

## 2050 CLIMATE AMBITION INITIATIVE

The Global Cement and Concrete Association (GCCA) was formed two years ago to focus on reducing the industry's carbon footprint.

"The cement producers saw that there was an increasing expectation from both the outside world and the general public stakeholder community, and also the people that they sell cement and concrete to, so developers, plus the people that are using it, engineers and architects, for a potentially more sustainable product," says Paul Adeleke, GCCA's communications and policy director.

In September, GCCA unveiled its 2050 Climate Ambition Initiative, marking the first time the industry has come together globally to state a collective goal for a carbon neutral future. It matches up with the requirements and deadlines of the Paris Agreement and names specific actions needed to create carbon neutral concrete, including reducing and eliminating energy-related emissions, reducing process emissions through new technologies and carbon capture, more efficient use of concrete, reuse and recycling of concrete and buildings and harnessing concrete's ability to absorb and store carbon from the atmosphere.

GCCA members include companies such as Buzzi Unicem, CEMEX, CRH, HeidelbergCement, LafargeHolcim, Votorantim Cimentos and many more. Before the GCCA was formed, cement and concrete were discussed as part of smaller committees in large organizations. GCCA makes the cement and concrete industries major players in the movement toward reducing emissions.

"There was nobody advocating for concrete at a global level and telling the positive side of concrete," Adeleke says.

The first step in achieving 2050 initiative goals is by creating a roadmap, which will set the pathway and milestones needed to reduced emissions, he says. In North America, the GCCA is teaming up with the PCA, which just published its corresponding roadmap.

Andrew Minson, GCCA's concrete and sustainable construction director, is creating the initiative roadmap. GCCA's next step is to launch its third version of verified environmental product declarations, called EPDs. Minson likens EPDs to a nutrition label on food packaging; EPDs create a standardized way of measuring the carbon footprint of materials used in the manufacturing process of a product, like concrete, and are recognized in LEED. The EPDs measure the carbon footprint across 30 environmental indicators. Companies, such as LafargeHolcim, are issuing their own EPDs, as well.

"It enables us to get beyond greenwashing," Minson says of conveying a false impression of a product's sustainability. "It uses metrics and certifications that have received external verification that has been recognized by LEED. It enables them to not only be virtuous, but actually be seen to be virtuous and communicate their credentials."

With that information in hand, architects and engineers are more likely to create more sustainable buildings. "If there's an infinite number of mixes, you can tune your mix to be exactly what you need over and above the credentials of concrete as a product and the way it performs, the fact that it doesn't rot, the fact that it doesn't burn, it doesn't rust; it's got these fantastic attributes, including its thermal mass," says Minson, who was also a speaker at the Global Concrete Summit.

"What you'll see next from us is at the end of 2021, a comprehensive roadmap to demonstrate how we will get to carbon neutral concrete by 2050, and it will explore the technologies that are required and the policy implications."

Minson says. "That policy will enable us to get there, and it will consider and reflect on how people who use concrete can contribute, as well, to collectively reach a carbon neutral concrete scenario." GCCA's roadmap is expected to be complete at the end of 2021.

The 2050 Climate Ambition Initiative is one of many efforts ongoing in the cement and concrete

industries to reduce the carbon footprint of construction materials. There will likely be many advancements in coming months and years to further that mission. **CC**

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