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Cement industry

Net zero will never work out this way

Eight percent of global greenhouse gases are produced in the manufacture of cement. The industry, led by Swiss global market leader Holcim, promises CO2-neutral production by 2050. On closer inspection, such announcements turn out to be hot air.

By Daniel Stern and Ursula Häne

The world's largest cement company, Holcim, is not at a loss when it comes to using slogans and logos to give itself a climate-friendly profile. "Net zero building for people and the planet" or "The time for climate action is now" - the slogans are as promising as they are misleading. According to its own figures, the Swiss company emitted 105 million tons of CO2 from the chimneys of its factories last year. More than twice as much as the whole of Switzerland. This puts the company in the league of carbon majors, i.e. those global corporations that bear a considerable share of the blame for climate change.

But now everything is supposed to get better. At least that's what Magali Anderson, who sits on the executive board of the global corporation and holds the title of Chief Sustainability and Innovation Officer, tells WOZ over Zoom: "We have the most ambitious 2030 climate targets in our industry. We will publish every year whether we are on track."

However, for a global corporation that made a profit of 1.9 billion Swiss francs in 2020 despite sales losses due to Corona, that seems a bit modest. By 2030, CO2 emissions per ton of cement are to be reduced to 475 kilograms. According to the company, the current figure is 555 kilograms. In addition, the company, like the rest of the industry, wants to achieve net zero by 2050. How that might happen remains vague.

Trouble with the Clinker

Josef Waltisberg sits at the dining table in his family home and explains cement production. He worked at Holcim for over thirty years before retiring in 2009. The thermodynamicist studied the exhaust gases from the Group's factories and visited plants in nearly 50 countries during his career. He also taught at the Zurich University of Applied Sciences. Lined up in front of him are jars containing the basic materials used in cement production, which he used in his lectures.

"The original material of cement is limestone, which is found in large quantities in many places around the world," he says.

Crucial to production, he says, is the right mix of limestone and marl. When the limestone is burned at a temperature of 1450 degrees, clinker is produced. This material, in turn, produces cement the most widely used material of all: the binder in concrete, without which hardly any bridges, dams, tunnels or high-rise buildings are built today. "The annoying

thing about it," says Waltisberg, "is that a lot of CO_2 is released during production. Not only through the required fuels (such as coal and waste), but also to a much greater extent through the limestone itself, from which CO_2 escapes when it is very hot. "This means that one kg of clinker produces half a kg of CO_2 in any case, not even counting combustion," Waltisberg says.

So cement production always leads to high CO_2 emissions. And even if the emissions per ton can be reduced by using a lower proportion of clinker and lower-CO_2 fuels, the basic problem remains - especially since more cement is being produced year after year, driven by the construction boom in Asia and Africa, for example. How do you expect to get to net zero?

One reason for the continuing cement glut is the low price. "Cement would have to be at least twice as expensive to cover the climate damage caused by its production alone," says Patrick Hofstetter, climate protection expert at WWF Switzerland. If the price were significantly higher, there would be more demand for sustainable building materials such as wood or bamboo.

Actually, countries would have a mundane means of building climate costs into the price of cement. For example, an emissions trading system has been in place in the EU since 2005 and in Switzerland since 2008. This is based on "cap and trade", i.e. a limited number of emission rights are issued, each of which entitles the holder to emit one ton of CO2. These certificates are tradable. Those who emit few greenhouse gases can sell surplus certificates. At the same time, countries can put fewer certificates into circulation each year, thus continuously raising the price of CO_2 emissions. So much for the theory.

But the system has completely failed. Both the EU and Switzerland have distributed far too many certificates for free so as not to put the industry under pressure. Holcim, for example, like many other companies, has made money from the system. According to calculations by the NGO Carbon Market Watch, the Group (or the two independent Group units Lafarge and Holcim until 2015) collected around 1.1 billion euros too many certificates in the European trading system between 2008 and 2015. More recent figures should be published in the coming weeks. The picture is the same in Switzerland: between 2013 and 2020, Holcim received around 1.9 million too many emissions certificates, according to WOZ calculations. Switzerland has been part of the European system since 2021. In it, the 1.9 million certificates are worth over 100 million euros (as of the beginning of this week).

"The whole emissions trading system has so far been a pure enrichment operation of the big industries, especially the cement industry as well," says Sam Van den plas, who is responsible for policy issues at Carbon Market Watch. "The industry has never really had to make an effort." Van den plas is calling for carbon credits to stop being given away for free. With the money collected, the government could finance climate protection projects.

After all, because the EU recently agreed on stricter climate protection targets, the price of certificates has risen rapidly in recent weeks. Companies are stocking up on emission rights because they fear a

noticeable shortage and even higher prices. Holcim, too, is aware that emission certificates are now becoming noticeably scarcer, says Anderson. Two years ago, therefore, it had already invested 160 million euros in the renewal of its European cement plants. "The emissions trading system is a good incentive."

Less cement, less concrete

An ETH study entitled "A Sustainable Future for the European Cement and Concrete Industry" shows what price incentives could achieve. According to the study, around eighty percent of CO2 emissions could be saved compared to 1990 - and that "without major changes in standards and with moderate investments. The entire value chain needs to be addressed. So: different fuel in the cement plants, less clinker in the cement, less cement in the concrete and less concrete in the construction.

"Experiments have been carried out since the 19th century to reduce the proportion of clinker in cement," says Frank Winnefeld of the Swiss Federal Laboratories for Materials Science and Technology (Empa). Holcim now also offers a cement with a particularly reduced clinker content as well as concrete with a high proportion of recycled material. At Empa, Winnefeld is testing various substances that could replace some of the clinker in cement. The key is to find materials that are locally available, he says.

The EPF Lausanne has developed a promising solution: it has reduced the clinker content in cement to up to fifty percent and mixes in unburned limestone, burned clay and gypsum. This so-called LC3 cement is used in Cuba and India, for example, as Guillaume Habert, professor of sustainable construction at the ETH, knows. Haber co-authored the study on the sustainable future of the cement and concrete industry. His chair is co-financed by Holcim. However, he emphasizes the independence of his research.

Habert also sees a lot of potential for savings in concrete mixes: the proportion of cement can be greatly reduced, and other materials can be added in its place. "But this requires incentives," says Haber. Cement is simply too cheap, he says. "So the concrete mixer prefers to mix in too much cement, even if it's not necessary." New standard specifications would be needed for which buildings concrete with a low cement content could be used.

In general, a lot of concrete could be saved in buildings, says Habert. "If concrete is used to insulate noise, other materials can be used for that." Many concrete structures can also be fitted with cavities. In addition, he says, there are many ways to avoid concrete altogether and use wood or bamboo, for example, instead. "The challenge is to make other building materials popular," Habert said. In general, the construction industry needs more incentives for cooperation and integration, the ETH study says. Concrete producers, engineering firms and demolition companies need to work together. Patrick Hofstetter also sees an opportunity for the cement industry: "It must see itself as a provider of integrated construction solutions. Today, cement producers still want to sell mainly cement and concrete." This does not fit into a sustainable climate strategy.

Everything that burns, into the kiln

In terms of fuels, the cement industry has been working since the 1990s to move away from coal. In Switzerland, waste oil, solvents, animal fats or waste wood are burned in this way, but so is almost every worn-out car tire. On its website, Holcim refers to a "circular economy. It converts five million tons of waste into "alternative fuel" every year.

Burning waste is considered a clean solution - after all, it's still better than dumping it somewhere. But it's not quite that simple: the waste must first be available in the desired form. In Switzerland, there are collection points and collection organizations for this purpose. In many other countries, however, this is lacking, says Waltisberg. In addition, waste incineration often leads to higher pollution of the environment (see "Pollutants from all pipes" following this text).

Waste incineration is also not harmless in terms of the climate aspect. Waste also emits CO2. But if a cement plant incinerates a used tire, it is allowed to deduct 27 percent from the CO2 emissions, since the tire consists of roughly this proportion of rubber. This is a natural product that binds CO2 from the air. No certificates need to be credited for this. This is far too gross a simplification, according to the organization Doctors for Environmental Protection. In its magazine "Oekoskop", it points out that the CO2 backpack of rubber is not included in the calculation. This is because most rubber now comes from Southeast Asia, where forests have to make way for rubber plantations.

"We only recycle what cannot be recycled," says Magali Anderson from Holcim's management. But this statement is questionable: Several million car tires are burned in cement plants every year in Switzerland alone, instead of being processed and reused, as "Oekoskop" writes. Each tire could be re-treaded up to three times, which would require seventy percent less crude oil than new production. "Oekoskop" writes of a "huge waste of resources" and "climate outrage".

CO2 under the ground

No matter how it turns it around: The cement industry is caught in a dilemma. As long as it still wants to sell as much cement and concrete as possible, it will never get to net zero. A large part of its net-zero promise is based on a technology that is still in its infancy: capturing the CO2 emitted during cement production and storing it in a safe place - or using it for new products. This is called carbon capture and storage (CCS) or carbon capture and utilization (CCU).

CO2 capture has long been tried and tested on a small scale. There are also applications for storage in a new product. For example, the ETH start-up Neustark has developed a process in which demolition concrete is treated with liquid CO2, thereby storing around ten kilograms of CO2 per ton. The CO2, which Neustark receives from a biogas plant in Bern, is then firmly bonded to the concrete. Subsequently, the treated material is mixed with cement for the production of fresh concrete. "We are part of what it takes to get to net zero," says Neustark co-founder Valentin Gutknecht. Their process, he says, is easy to implement. Any concrete plant could be equipped with their technology. However, it would not solve the cement industry's problem.

"We can't store as much CO2 as they emit in demolition concrete."

According to Anderson, Holcim is also currently focusing primarily on pilot projects that involve storing CO2 in new products. "The idea is to scale up these projects over the next ten years," he says. The good thing is that last year alone, various governments pledged $4.5 billion to develop the technology." So the government should ultimately pay for the cement industry's CO2 problem? "It's a global problem that needs to be solved. We're doing our part, but we can't do it alone," Anderson says.

A larger project is currently being pushed forward in Norway under the name Northern Lights. Holcim's competitor Heidelberg Cement is also involved. In the first phase, the plan is to capture CO2 from its cement factory in Brevik and from a waste incineration plant in Oslo, liquefy it, transport it by ship to a special terminal on the country's west coast, and from there pump it by pipeline 2,600 meters below the seabed - to a place where natural gas used to be extracted. The Norwegian government is paying $1.8 billion for the project, more than half the total cost. Later, much more CO2 from all over Europe will be stored in Norway via pipeline.

Whether such large-scale capture and storage solutions are feasible at all, however, is more than questionable. The ETH study mentioned above writes of "very high investment costs" that make large-scale solutions seem rather unrealistic. In addition, energy consumption would "increase drastically. Massively more capacities of renewable energy would be needed - which in a net-zero world is already needed on a larger scale for many other applications anyway.

And so the big promises made by Holcim and its competitors seem to be driven more by a desire to keep producing as they have for as long as possible. But talking about net zero on the one hand and continuing to sell as much cement as possible on the other - that simply doesn't go together.