

PHOTOS BY KEVIN MA/St. Albert Gazette

A view of the main cement production building at the Heidelberg Materials plant in Edmonton. The curved conveyor belt takes alternative fuels into the building for combustion. The stack of the pilot carbon capture plant can be seen to the right of the scaffolding on the left.



A view of part of the pilot carbon capture plant at the Heidelberg Edmonton cement plant. CO2 is captured in the taller right stack and released for collection in the shorter left one.

Scientist seeks concrete solutions to net-zero cement

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Brent Korobanik has a hard job.

A conservation scientist and St. Albert resident, Korobanik is the permitting and community liaison at Heidelberg Material's cement plant in Edmonton. He's part of a team that has spent years trying to figure out how to make carbon-free cement to address climate change.

"It's in everything we build nowadays," he said of cement, including roads, buildings, and sidewalks, and it accounts for about seven per cent of the world's greenhouse gas emissions — about 4.7 times what Canada produces each year.

"We can't keep doing that."

Cement is a hard problem when it comes to climate change. Unlike heat, electricity, and transportation, we can't make it carbon-free just by lobbing green energy at it. Instead, we'll need a whole bunch of solutions, including the ones Korobanik is working on.

Cement 101

Cement is a powder that hardens like glue when mixed with water, the European Cement Association reports. Concrete is cement, water, gravel, and sand. Mortar is cement, water, lime, and sand.

Concrete is the second-most consumed product in the world after water, reports the federal government. Canada alone was projected to make 400 million tonnes of it between 2022 and 2027, which would fill enough concrete mixer trucks to circle the globe 4.5 times.

"Cement is actually such a good material," said Cyrille Dunant, a materials scientist with the University of Cambridge who studies cement: it's cheap, strong, fireproof, rustproof, and easy to haul and shape — traits few other materials can match.

To make cement, you heat limestone (calcium carbonate) to about 850 C to turn it into lime and CO2, Korobanik said. Roast the lime in a rotating horizontal kiln at 2,000 C with other ingredients and you get a pumice-like substance called clinker. Grind and mix that with gypsum, and you have cement.

The big shot

Net-zero cement is a two-part problem, Dunant and Korobanik explain. About 40 per cent of its CO2 comes from the fossil fuels burned to heat it. You could get that heat from green power, but not easily. The rest comes from the limestone. So long as we make cement from limestone — and we currently don't have a good substitute to it — we'll get CO2 from it.

One solution might be to stuff those emissions underground. Korobanik and his team have built a carbon capture pilot plant at the Heidelberg Edmonton cement plant to see if that's viable. Korobanik is scheduled to speak about the pilot on Nov. 4 at the 2025 Alberta Capital Airshed Clean Air Forum .

"What we're looking to do is apply the carbon capture right at the stack," he said.

The pilot plant is a house-sized jumble of pipes, tanks, and sea cans. Were it not for the "Pilot Plant" sign on it, you'd easily overlook it.

The plant takes exhaust from the production building and runs it up a tall stack. Fluids called amines rain down inside the stack and absorb the CO2. The amines flow into a second stack, get heated to release their CO2, and get pumped back to the top of the first stack to absorb more.

While the pilot plant vents its captured CO2 to the air, Korobanik said the real one will pipe it to a facility near Villeneuve for permanent underground storage.

The pilot plant catches 95 per cent of the CO2 put into it, or about three tonnes a day, and has so far cost about $100 million, Korobanik said. The real one will be the size of a large office building, and will catch about 4,100 tonnes a day, cost about $2 billion, and allow Heidelberg to produce net-zero cement.

"It's going to be a massive facility," he said.

The Cement Association of Canada predicts such facilities could abate about 28 per cent of cement's CO2 by 2050.

The big obstacles for carbon capture are policy and cost. Korobanik said the full-scale capture plant at Heidelberg was designed based on the assumption that Alberta's carbon price would reach $170 a tonne in 2030 as scheduled. Alberta froze that price at $95 earlier this year, and that has thrown the economics of the plant into question.

"We need a clear, consistent greenhouse gas policy," he said, and a stable, high price for carbon.

Carbon capture won't work everywhere, as not every cement plant has the necessary storage, Korobanik said. It's also expensive, Dunant added, with most studies suggesting it roughly triples the cost of cement.

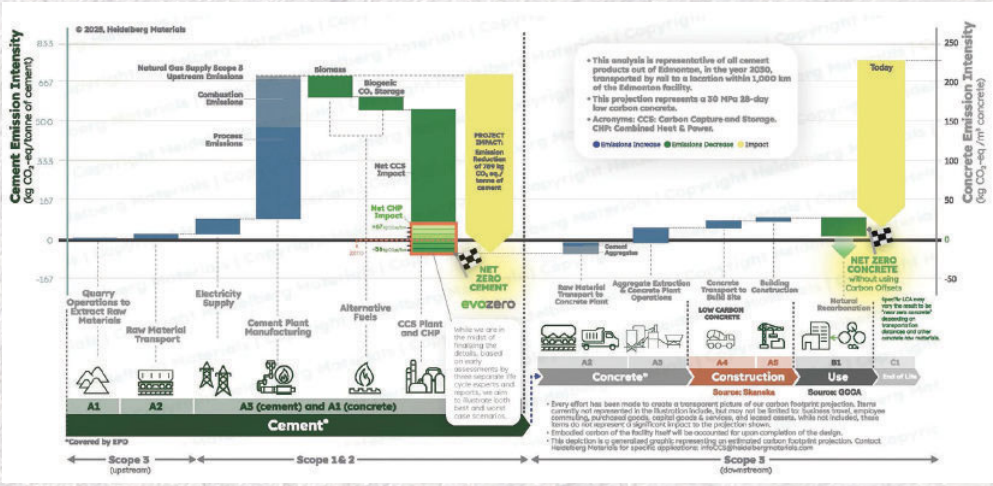
Heidelberg opened the world's first carbon-capture cement plant in Norway last June, and is now producing reduced-carbon cement from it. Korobanik said Heidelberg plans to make a decision on the Edmonton carbon-capture plant next March.

Silver buckshot

There's no silver-bullet solution for net-zero cement, the Cement Association of Canada reports. Instead, the industry believes it can get to net-zero by 2050 through a combination of policies and technologies, many of which are still in development.

"The low-hanging fruit right now is alternative fuels," Korobanik said, especially garbage.

The Heidelberg plant in Edmonton started using various forms of trash for about half its heating needs last year.



HEIDELBERG MATERIALS/Graphic

This chart shows the many technologies Heidelberg Material's Edmonton plant hopes to use to reach net-zero cement and concrete. They include carbon-capture, a combined heat-and-power system, and natural CO2 absorption by concrete.

Korobanik said. The waste (which includes tire fibres from a Sturgeon County recycler) arrives by the (very smelly) truckload and gets dropped onto a conveyor to the furnaces with a big red claw.

"It's a very high energy fuel for us," Korobanik said of this waste, and they don't have to worry about the ash — it goes right into the cement.

Korobanik said these alternative fuels reduce the plant's greenhouse gas emissions by about 22 per cent. Other companies hope solar concentrators and green-powered electric kilns could yield further reductions.

We could also reduce cement's CO2 emissions by using less of it.

One way to do so is recycling, but that's tough. If you grind up used cement and add water, it becomes useless sludge, Dunant said. To really recycle it, you have to reactivate it with about 1,450 C of heat. You can't get that heat without burning lots of coal or building an expensive green-powered electric furnace, which is why hardly anyone recycles cement.

But steel recyclers already have green-powered electric furnaces. They also mix lime flux with their molten metal to remove impurities — a job used cement can do just as well. Dunant's team showed that if steel recyclers mixed used cement with their hot metal instead of flux, they could get recycled metal and cement out of the same furnace.

"You get double the value out of the heat and double the value out of the [cement]," Dunant said, with little to no additional CO2 released.

Dunant said this form of recycling could optimistically eliminate 80 per cent of cement's carbon footprint if deployed everywhere — something he thinks is feasible, as steel recyclers could make a bundle off it. It has limits, though: not every cement plant is close to a steel recycler, and not every recycler has access to green power.

We can also use less cement with clinker substitutes such as fly ash (used at the Edmonton plant), the Cement Association of Canada reports. These substitutes tend to be site-specific and supply-constrained, though, which limits their potential. Efficient designs and waste reduction could also cut our cement needs, shaving 14 per cent off of the industry's carbon footprint by 2050.

Cement itself could cut another five per cent by 2050, the cement association projects. Korobanik explained cement naturally absorbs CO2 to turn back into limestone. If we could exploit this through building design and other processes, we could turn our cement structures into CO2 sponges.

Net-zero cement is hard, but the rewards for making it are great. Not only is there huge demand for carbon-free cement, but the technologies you develop to make it (such as waste-to-energy and carbon capture) can help other sectors address climate change, Korobanik said.

"We've got a lot to things we can offer society," he said.

Net-zero cement is the goal to reach if you want a livable climate for your children, Dunant said.

"In many ways, that's motivation enough." ■



HEIDELBERG MATERIALS/Photo

This large claw is used to load various forms of waste into kilns at the Heidelberg Edmonton cement plant.



Brent Korobanik explains that producing cement involves heating limestone at 2,000 C to produce clinker, the key ingredient of cement. Doing so unavoidably releases CO2 and worsens climate change.



St. Albert resident Brent Korobanik shows off some of the ingredients of cement at the Heidelberg Materials cement plant in Edmonton on Oct. 10, 2025. Limestone is combined with clay and other ingredients and ground up into kiln feed. After an initial 850 C blast to turn the limestone into lime, the mix cooks at 2,000 C to become clinker. The clinker is then combined with other ingredients to become cement.



St. Albert resident Brent Korobanik explains the operation of the test carbon capture plant at the Heidelberg Materials Edmonton cement plant. Liquids called amines fall down a stack filled with exhaust and absorb CO2 from it. They are then heated in the stack shown here to release their gas for collection.