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A mixture of hot gas rises out of a flue stack at the St. Marys Cement plant about 50 kilometres west of Waterloo. But not all the CO2-rich exhaust is vented to the open air.

Some is redirected through a 15-centimetre thick pipe connected to the side of the stack. The pipe carries the gas into a high-tech facility where a species of algae from the neighbouring Thames River uses photosynthesis to absorb the carbon dioxide and release oxygen in return.

"It's a small model of what a big full-scale facility could be," says Martin Vroegh, environment manager with St. Marys Cement Inc., headquartered in Toronto. The algae project, which went live last fall, is believed to be the first in the world to demonstrate the capture of CO2 from a cement plant.

The idea, Vroegh explained, is to turn CO2 into a commodity rather than treat it as a liability. The CO2-consuming algae will be continually harvested, dried using waste heat from the plant, and then burned as a fuel inside the plant's cement kilns. Alternatively, the green goop can be processed into biofuels for the company's truck fleet.

In essence, St. Marys wants to grow its own fuel in a way that's constantly recycling the CO2 emissions from its plant, allowing it to produce what could become "green" cement.

The company, part of Brazilian conglomerate Grupo Votorantim, is preparing for a carbon-constrained future that won't treat cement makers and other energy-intensive industries kindly. That's because producing 100 tonnes of cement releases an average of 83 tonnes of CO2, according to the International Energy Agency.

Considering cement is sold for a couple of hundred dollars a tonne, even a conservative $30 price per tonne of CO2 would add nearly 15 per cent to the final price tag.

"The amount of exposure to carbon pricing we face as an industry is very high," says Vroegh. "If we want to be around tomorrow we have to be sustainable. This project helps us achieve that."

It's not the only cement company thinking this way. Two years ago cement giant Lafarge North America Inc. partnered with a Kingston-based company called Performance Plants, which had developed genetically-enhanced grasses and trees that could thrive on poor land. Lafarge planned to grow its own biomass fuel next to its cement plant in Bath. But the initiative hit a snag when Performance Plants ran out of money and closed.

St. Marys began exploring the idea of capturing CO2 with algae around the same time. Donald "Demi" Rogers, former vice-chairman of St. Marys and member of the co-founding Rogers family, was part of the same shooting club as Terry Graham, chairman of Toronto start-up Pond Biofuels.

That gave Graham an "in" with the cement maker, and the two companies began talking. St. Marys needed a way to reduce the CO2 emissions from its operations; Pond Biofuels needed a high-profile industrial partner to test the algae biofuels technology its founders, Max Kolesnik and Steven Martin, had developed.

Convinced the approach was sound, the cement maker decided last year to make a strategic investment in Pond Biofuels. With some financial backing from the Ontario Centres of Excellence, the two companies ventured ahead on a pilot project.

"This is a made-in-Ontario solution to a global problem," says Vroegh.

Algae technology has emerged in the past few years as a potentially better approach to producing biofuels. We don't eat algae, so there's no fuel-versus-food debate like that associated with corn ethanol. In fact, more than half of the biomass on the planet is algae.

They grow fast – up to 30 times faster than some food crops – so over a year a half-hectare algae farm can absorb the same volume of CO2 as 200 hectares of mature trees. For this reason there are dozens of algae start-ups in the market, many focused on commercializing genetically-modified super algae that can produce renewable fuels, such as biodiesel and green jet fuel.

Pond Biofuels, however, is among a smaller group of companies focusing on the needs of industry first, rather than on pure biofuel production. The purpose of the $4 million demonstration facility at the St. Marys plant is to show that the technology, which right now occupies 1,500 square feet, can be scaled up and profitably deployed.

"To resolve the problem you have to have an industrial solution, not a laboratory solution," says Graham. "In a laboratory you can control everything. But you can't do that in the field."

The algae are grown in sophisticated "bioreactors" that are designed to achieve the right balance of light and CO2. The company has filed patents for its technology, including the automated processes for growing and harvesting the green stuff. Beyond that, Graham won't go into detail for competitive reasons.

Ultimately, both St. Marys and Pond Biofuels envision the entire flue stack stream being diverted to a much larger algae facility. Once the approach is demonstrated at a commercial scale, the hope is that industrial clusters across the continent will begin to take notice.

"Personally, it's nice to be working so closely on a project that can help change how CO2-intensive industries operate," says Vroegh.