Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.

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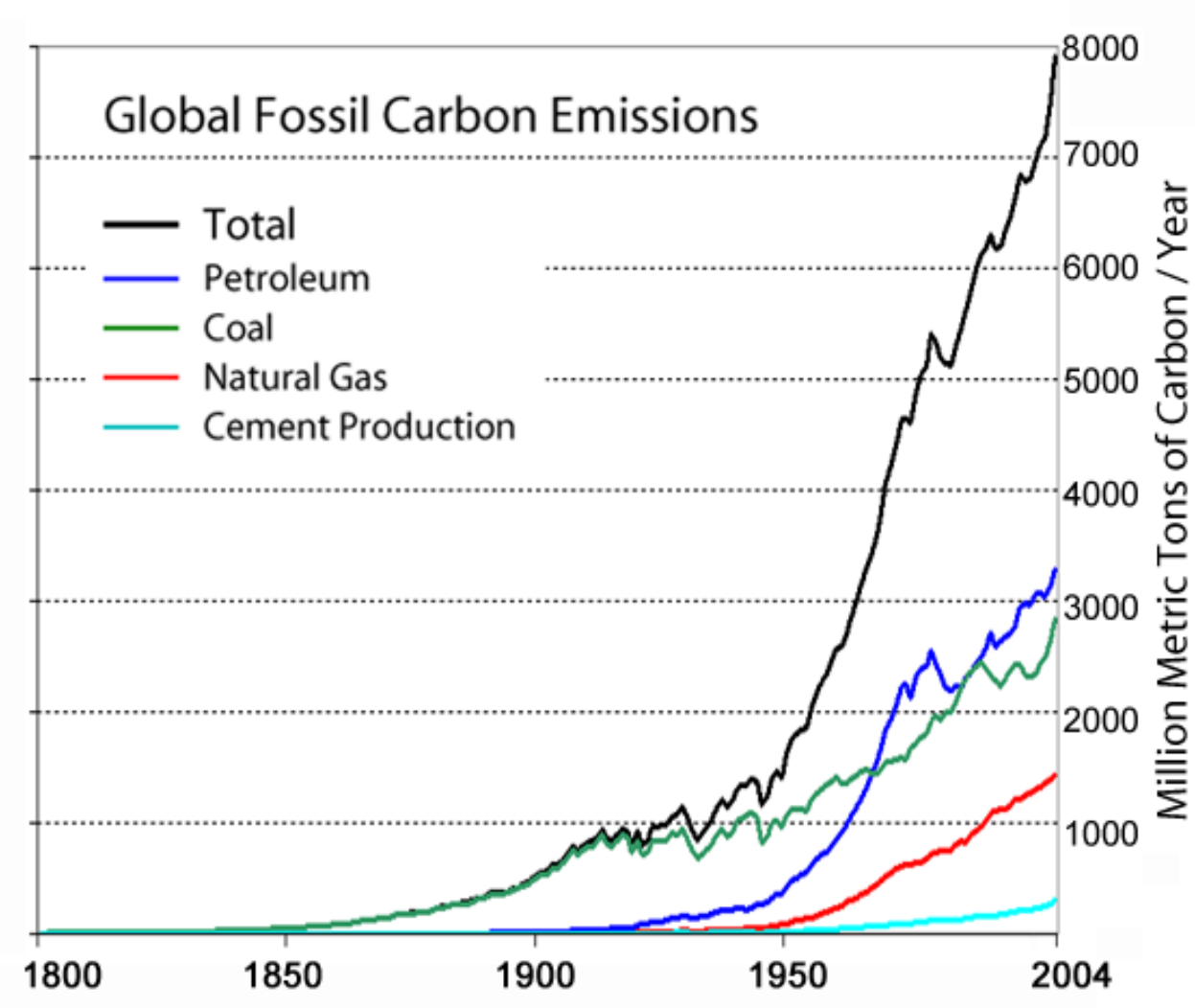
Calera–green cement for a blue planet



Global fossil carbon dioxide emissions for the past 200 years showing burning of fossil fuels but also cement production.

Making cement from seawater? Hearing this for the first time took me by surprise, but after talking to Brent Constantz, who has started a company that is doing just that, it made more sense. It also may go a long ways in helping to resolve a serious problem, that of the impact of the growing carbon dioxide content of the atmosphere on global climate. Brent, who received his a Ph.D. in Earth Sciences

from UCSC, started this company a few years ago as he became more concerned with the impact of increasing $C0_2$ emissions.

Brent's graduate research focused on corals. He was intrigued with how they made such strong skeletons from seawater. Brent's career took him to Stanford where he became a Consulting Professor and began translating his knowledge of how marine organisms formed their skeletons into developing cements for mending broken bones. When he was 27 Brent created a cement that revolutionized the repair of broken bones in hospitals around the world, based on his work on corals.

Concrete is the world's most widely used building material, with about 12 billions tons of it used each year. The primary ingredient of concrete is cement, which is produced from limestone. Limestone, or $CaC0_3$ is just the accumulation of the remains of millions of marine organisms that made their shells out of a few basic elements in seawater like corals do. The limestone under the Westlake neighborhood, under parts of UCSC and also Bonny Doon, has provided the raw material for the county's cement industry for over a century.

At Davenport, limestone is heated up to over 1800° F., which drives off $C0_2$ and leaves lime or calcium oxide, the principal ingredient in cement. This process, however, releases 1 ton of carbon dioxide into the atmosphere for every ton of cement produced. Worldwide, about 2.5 billion tons of cement are manufactured each year, emitting 2.5 billion tons of $C0_2$, about 5% of the world's total $C0_2$ emissions. Brent thought there might be a better way to make cement.

After months of laboratory scale work in Los Gatos, hauling Monterey Bay seawater over the hill from Long Marine Laboratory, Calera's team of chemists and engineers developed a technique for producing small batches of cement from the seawater. They have now set up shop in the old Kaiser plant at Moss Landing, which produced material for bombs during World War II. Right across the street from the plant is the largest power plant on the west coast, which releases large amounts of carbon dioxide into the atmosphere from its enormous stacks. Brent and his team are now well along on the technology that can remove about 90% of the carbon dioxide from the flue gases by bubbling the exhaust from the power plant through the seawater while they are making the cement. For each ton of cement they make, they can incorporate a half a ton of carbon dioxide into the cement. By building cement plants on the coast next to fossil fuel fired power plants, Calera can solve two huge challenges, making green cement by not producing additional $C0_2$, and also removing the $C0_2$ from fossil fuel burning by sequestering it into concrete.