Restoring the Climate by Building with Synthetic Limestone

Restoring the climate requires removing and storing a trillion tons of legacy CO2 by 2050.

Nature has stored 99 percent of all the CO2 on earth in the form of limestone, made of calcium and CO2 by shellfish and other marine organisms.[1] Nearly half carbon dioxide by weight, limestone is an ideal, permanent storage system for this greenhouse gas.

Recently, scientists have learned how to make synthetic limestone, on a far accelerated timescale, by mimicking how oysters build their shells. Processing plants now produce synthetic limestone aggregate and sand for concrete. Uniformly high-quality, the synthetic version directly replaces, and eliminates the environmental harm from quarried rock. The market is potentially huge: Today the world uses 55 billion tons of quarried rock each year.

The synthetic limestone industry has the potential, if needed, to scale up enough to remove all trillion tons of excess CO2, sequestering it in our built environment. Thus climate restoration would be financed by the sale of synthetic limestone for building and paving. Demand for concrete and buildings is expected to soar as billions more people move to urban areas, and we raise coastal cities above the rising seas.

Synthetic limestone: A climate restoration solution that pays for itself

Synthetic limestone meets all three criteria for climate-restoration solutions: it can scale as required; store carbon permanently; and be financed through the marketplace, via construction.

Each cubic meter of concrete made from synthetic-limestone aggregate sequesters about half a ton of CO2. Substituting 55 billion tons of quarried rock with carbon-negative synthetic limestone would permanently store 25 gigatons of CO_2 a year. Consumption of rock is doubling every 12 years, so potential carbon removal could be as high as 60 Gt a year by 2035.

The business case for investors is compelling, as rock is already a trillion-dollar industry and the customer base grows constantly. Synthetic limestone is cost-competitive with quarried rock, partly because it can be produced near construction sites–eliminating the cost (and emissions) of long-haul transport.

Blue Planet™ Systems, based in California, licenses the process for making limestone. It uses CO_2 captured from fossil-fuel-plant exhaust or directly from the air, and calcium from demolished concrete, other waste materials or common minerals. Synthetic limestone stores so much CO_2 that Blue Planet concrete is strongly carbon-negative even when used with ordinary cement.

In 2016, San Francisco International Airport built a terminal with Blue Planet's carbon-negative concrete. The quality was so high that the airport has purchased the next two years' output from a Blue Planet subsidiary, for new terminals and runways.

Next steps— Policy support and investment

This new industry could achieve the needed scale of between 25 and 60 Gt of carbon removal per year by 2030 if other solutions do not.

Policy can promote faster adoption of carbon-negative materials for building and paving. For instance, the U.S. Government recently instituted a procurement rule requiring government contractors to use low-carbon concrete as it becomes available. This rule is fostering more investment, which is accelerating the scale-up of carbon-negative concrete.

Climate Restoration: Reclaiming a Pre-Industrial Climate by 2050

Everyone wants to restore a "safe harbor" climate, one that humans have actually survived and thrived in long-term, with CO_2 levels below 300 ppm.

Reaching a safe climate will require pulling a trillion tons of legacy carbon from the atmosphere by 2050. We can do this by copying nature. Nature pulls massive amounts of CO_2 from the atmosphere by two major pathways: Boosting photosynthesis in the ocean and forming limestone from the calcium carbonate shells of sea animals.

For more info: Peter Fiekowsky, pfieko@gmail.com; Carole Douglis, cdouglis@gmail.com