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Direct air capture: An emerging necessity to fight climate change

Michael B. Gerrard

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The Paris Agreement of 2015 declared that we must keep global average temperatures well below 2.0°C (3.6°F) above preindustrial levels, and as close to 1.5°C as possible. However, a 2018 report from the Intergovernmental Panel on Climate Change (IPCC) showed that even 2.0°C would be catastrophic; 1.5°C should be the firm goal. We are now around 1.0°C and are already seeing wildfires, hurricanes, inland precipitation, and other events of unprecedented magnitude.

Most scientists agree that, tragically, the prospect of keeping to 1.5°C has all but slipped away. Had global greenhouse gas emissions peaked around the time of the Kyoto Protocol of 1997, or even a few years later, we might have made it, but emissions have instead relentlessly increased. Even the most aggressive plausible reductions in emissions (that is, those that do not assume global economic collapse) would not keep us under 2.0°C. For that, we need those aggressive reductions plus an added element—net negative emissions. In other words, we need to be pulling more carbon dioxide from the atmosphere than we put into it, and probably by the middle of this century at a large scale.

The IPCC assumed in 2014 that this could be achieved by a technology called bioenergy with carbon capture and sequestration (BECCS). Massive quantities of certain fast-growing plants would be cultivated, taking in carbon dioxide from the air. These plants would be cut down and burned to generate electricity. The exhaust, rather than going up a smokestack, would be captured and stored underground, hopefully forever. But it has become clear that, at the needed scale, the amount of land this approach requires would be prohibitive—perhaps around the equivalent of half the land area of the United States. It would also require prodigious amounts of water, fertilizer, and other inputs, and would compete with food supplies.

A more attractive approach would be “natural solutions” such as reforestation and changing agricultural crop and soil management practices. Here, too, there is a major scale problem. It is challenging, to say the least, to find and acquire the land to plant all these trees, and doing so could displace the increasing amount of land needed to feed a growing global population, in the face of a reduction in habitable land due to sea level rise and drought. Inducing hundreds of millions of farmers around the world to change their traditional ways is also daunting. Moreover, these techniques are not permanent; the trees eventually die and release their carbon back into the air. Preliminary work is devoted to “enhanced weathering”—grinding up rocks that absorb carbon dioxide and spreading it on cropland, grassland, and forests—but that is very early and poses its own risks of land disruption and large energy demands.

Increasing attention is now turning to direct air capture (DAC), which is defined by Professor Tracy Hester of the University of Houston Law Center (with whom I coedited a 2018 book, *Climate Engineering and the Law: Regulation and Liability for Solar Radiation Management and Carbon Dioxide Removal*) to include "any industrialized and scalable method to remove GHGs from the ambient atmosphere and either store or reuse these gases, especially (although not always) in a way that does not allow them to escape back into the atmosphere."

Except for one small facility in Iceland built by a Swiss company called Climeworks and powered by waste heat from a nearby geothermal plant, DAC does not exist at a commercial scale. However, several laboratory-scale models exist, and more are on the way. Research and development of these technologies has been severely underfunded, given the importance of direct air capture in addressing the climate problem, but it has been encouraged in the United States by a 2018 tax act that extended the "45Q" tax credit program to DAC. California provides credits for DAC under its low-carbon fuels standard and Texas gives state tax exemptions for the capture and use of carbon dioxide in energy production. Widespread adoption of DAC would require a much larger financial boost, such as an economy-wide carbon tax with credits for DAC.

A major issue is what to do with the massive quantities of carbon dioxide that would be captured. Techniques are being developed to incorporate the gas into building materials and to transform it into synthetic fuels and other useful products. However, these tactics could probably handle only a fraction of the amount. Most of the carbon dioxide will have to be buried. Certain common igneous rocks, namely basalt and peridotite, readily absorb carbon dioxide and turn it into inert solids. Massive amounts of basalt lie (among many other places) under the seabed not far from the Atlantic and Pacific coasts; legislative changes would probably be needed before carbon dioxide could be disposed there.

A large federal program to build DAC units would require review under the National Environmental Policy Act, but the units themselves might not require approvals beyond conventional zoning and building code compliance. The geological storage has more regulatory complications, but the rules already developed by the U.S. Environmental Protection Agency for carbon capture and sequestration (which involves capturing emissions from power plants rather than the ambient air) should fit nicely.

DAC has two particular advantages. First, it can be scaled up. If enough of the devices are built—perhaps millions of them—they could capture enough carbon dioxide to make a real difference. Second, since it doesn't matter where in the world the carbon dioxide is captured, the DAC devices can be put anywhere there is enough cleanly generated electricity to run them and suitable geology to dispose of the gas so as to not need a huge pipeline network.

If the world gets serious about fighting climate change, construction and deployment of DAC devices and the associated carbon dioxide sequestration areas could become a major industry, perhaps using some of the same factories and workforce that had manufactured the internal combustion engines that will have become a thing of the past.

Developing sites for sea-level-rise and climate-change resiliency

Kevin Reid Murray

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Successful real estate developers and development attorneys must effectively anticipate and manage risk. Managing visible and known risks seems simple; what separates the great from the good is the ability to anticipate, plan for, and develop contingencies for unknown risk scenarios. Failure to account for these risks can be catastrophic. Hurricanes Harvey and Katrina unveiled the stark consequences of the failure to adequately plan for catastrophic events, showcasing chemical-plant explosions, flooded buildings, and lost real estate assets. Extreme weather conditions are increasing in severity and frequency, and oceans are rising, so resilient real estate developers must adapt and engineer buildings and site configurations that are sustainable under changing climatic conditions.

Scientific journals document the existence of rising sea levels and extreme weather conditions. For example,

> Data collected since 1980 by the insurance industry provide one indicator of trends in extreme events. Although these are not direct measures of extreme weather events *per se*[,] and may not have recorded all perils in the earlier record, they show weather-related catastrophes recorded worldwide . . . have increased from an annual average of 335 events from 1980 to 1989, to 545 events in the 1990s and to 716 events for 2002–2011.

O. Hov et al., *Trends in Extreme Weather Events in Europe*, EASAC Policy Report 22, European Academies' Science Advisory Council (Nov. 2013). Further, journals report that these changes continue to directly impact land occupation and use:

> Weather disasters have increased in number and intensity in recent decades and damage caused by extreme weather events has been on the rise in Europe. This finding results from the increase in the number and size of settlements in areas exposed to extreme weather events, the