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## Geo-Engineering Can Help Save the Planet

By THOMAS E. LOVEJOY  
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Carbon dioxide levels in the atmosphere are pushing 400 parts per million (p.p.m.) — up from the natural pre-industrial level of 280 p.p.m. Emissions for last year were the highest ever. Rather than drift along until a calamity galvanizes the world, and especially the United States, into precipitous action, the time to act is now.

The biology of the planet indicates we are already in a danger zone. The goal of limiting temperature increase to 2 degrees Celsius, as discussed at the Copenhagen and Cancun climate summits, is actually disastrous.

As we push the planet's average temperature increase beyond 0.75°C, coral reefs (upon which 5 percent of humanity depends) are in increasing trouble. The balance of the coniferous forests of western North America has been tipped in favor of wood-boring bark beetles; in many places 70 percent of the trees are dead. The Amazon — which suffered the two greatest droughts in recorded history in 2005 and 2010 — teeters close to tipping into dieback, in which the southern and eastern parts of the forest die and turn into savannah vegetation. Estimates of sea-level rise continue to climb.

Even more disturbing, scientists have determined that, if we want to stop at a 2°C increase, global emissions have to peak in 2016. That seems impossible given current trends. Yet most people seem oblivious to the danger because of the lag time between reaching a greenhouse gas concentration level and the heat increase it will cause.

So what to do? One possibility is “geo-engineering” that essentially takes an engineering approach to the planet's climate system. An example would be to release sulfates in large quantity into the atmosphere or do other things that would reflect back some of the incoming solar radiation.

There are serious flaws with most geo-engineering solutions because they treat the symptom (temperature) rather than the cause (elevated levels of CO2 and other greenhouse gases). That means the moment the solution falters or stops, the planet goes right back into the ever-warmer thermal envelope. Such “solutions” also neglect the oceans because elevated CO2 makes them more acidic. Further, any unintended consequences of global scale geo-engineering by definition will be planetary in scale.

It's far better to address the cause of climate change by lowering concentrations of greenhouse gases to an acceptable level. That means going beyond reduction and elimination of emissions to things that can pull out some of the excess CO2. Fortunately, because living things are built of carbon, the biology of the planet is capable of just that.

At the moment, roughly half the excess carbon dioxide in the atmosphere comes from destruction and degradation of ecosystems over the past three centuries. A significant amount of CO2 can be withdrawn by ecosystem restoration on a planetary scale. That

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means reforestation, restoring degraded grasslands and pasturelands and practicing agriculture in ways that restore carbon to the soil. There are additional benefits: forests benefit watersheds, better grasslands provide better grazing and agricultural soils become more fertile. This must integrate with competing uses for land as the population grows, but fortunately it comes at a time of greater urbanization.

The power of ecosystem restoration to reduce atmospheric carbon dioxide and avoid disruptive climate change is great but insufficient. We also need to use non-biological means to reduce atmospheric carbon. The barrier to the latter is simply cost, so a sensible move would be to initiate a crash program to find more economical ways. Some methods can build on natural processes that consume CO<sub>2</sub>, such as the weathering of rock and soil formation. Other methods could simply convert CO<sub>2</sub> into an inert substance. For example, Vinod Khosla's Calera experiment has demonstrated how to pull carbon dioxide out of the atmosphere by mixing it with seawater to produce cement.

All of this must take place as we strive for a future with low carbon energy sources and lower carbon transportation. It is in our own self-interest to manage ourselves, the planet and its climate system in an integrated fashion. We can do so, and there are abundant economic possibilities in doing so, but the window of opportunity is closing rapidly.

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