'Plan B': Seven ways to engineer the climate

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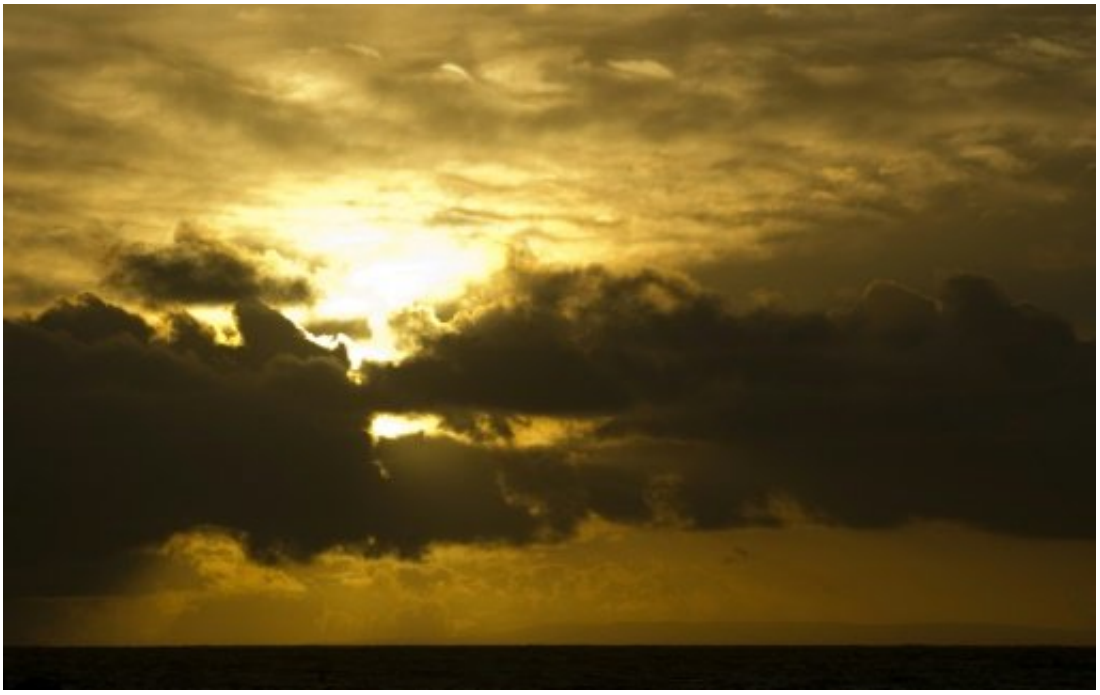

Scientists say that brightening the billowy clouds over oceans could let them rebound more sunlight back into the atmosphere, instead of letting them strike the Earth's surface

Dismissed a decade ago as far-fetched and dangerous, schemes to tame global warming by engineering the climate have migrated from the margins of policy debate towards centre stage.

"Plan A" remains tackling the problem at its source. But efforts to sharply reduce greenhouse gas emissions have fallen woefully short and

cannot, most scientists agree, avert catastrophic climate change on their own.

Here is a "Plan B" menu of geoengineering solutions that can be broken down into two categories: dimming the sun, which remains highly controversial, and capturing carbon dioxide (CO2).

Solar radiation management

The goal is simple: prevent some of the sun's rays from hitting the planet's surface, forcing them instead back up into space.

One idea worthy of a "Star Wars" sequel would assemble giant orbiting mirrors to deflect a bit of Earth-bound radiation.

A more feasible scheme—experiments are scheduled for next fall in Arizona—would inject tiny reflective particles into the stratosphere.

Nature sometimes does the same: Debris from the 1991 eruption of Mount Pinatubo in the Philippines lowered the planet's average surface temperature for a year or two afterwards.

Scientists have also calculated ways to alter clouds that could help beat the heat.

One is to brighten the white, billowy ocean clouds that rebound sunlight back up. Another would thin cirrus clouds, which unlike other types absorb more heat than they reflect.

DRAWBACKS: Even if it works as intended, solar radiation management would do nothing to reduce atmospheric CO2, which is making oceans too acidic. There is also the danger of knock-on consequences, including changes in rainfall patterns, and what scientists

call "termination shock"—a sudden warming if the system were to fail.

Ocean fertilisation

Microscopic ocean plants called phytoplankton gobble up carbon dioxide and drag it to the bottom of the ocean when they die.

Colony size is limited by a lack of natural iron, but experiments have shown that sowing the ocean with iron sulphate powder creates large blooms.

DRAWBACKS: Again, scientists worry about unintended impacts. Die-offs of plankton, for example, use up oxygen, which could create massive "dead zones" in the oceans, something already on the rise.

Enhanced weathering

Natural weathering of rocks—a chemical process—removes about one billion tonnes of CO2 from the atmosphere every year, about two percent of total manmade C02 emissions. What if technology could accelerate that process?

Spreading a powdered form of a greenish iron silicate called olivine across certain landscapes—especially over the oceans and in the tropics—does just that, experiments have shown.

DRAWBACKS: Enhanced weathering could probably be rapidly scaled up, but it would be expensive to mine and mill enough olivine to make a difference.

Biochar

Biochar is charcoal made by heating plant waste—rice straw, peanut shells, wood scraps—over long periods in low-oxygen conditions, for example buried in the ground. It can store CO2 for long periods, and also enriches soil.

DRAWBACK: The scientific jury is still out on how quickly this method could be scaled up, and on the stability of biochar used as a fertiliser.

BECCS

Bioenergy with carbon capture and storage (BECCS) marries a natural process with a high-tech one.

Step 1: Plant rapeseed, sugarcane, corn or "second generation" biofuel crops such as switchgrass, which pull CO2 from the air while growing.

Step 2: While burning the harvested plants for energy, sequester the CO2 produced.

The net result is "negative emissions," with less CO2 in the atmosphere than when the process started.

Virtually all climate change models projecting a future consistent with the Paris Agreement's core goal of capping global warming at "well under" two degrees Celsius (3.6 degrees Fahrenheit) assume a key role for BECCS.

DRAWBACK: Studies calculate that upward of 40 percent of arable land would need to be given over to biofuel crops, putting the scheme in conflict with food crops.

Direct CO2 capture

Experiments have shown it is possible to suck CO2 directly from the air, converting it into fuel pellets or storing it underground.

A Canadian company backed by Microsoft co-founder Bill Gates launched a pilot facility in Canada in 2015, and another company is set to unveil one in Iceland this week.

DRAWBACK: As of now, the technology is prohibitively expensive.

Massive afforestation

Extensive planting of trees could significantly slow the concentration of CO2 in the atmosphere, which currently stands at more than 400 parts per million.

DRAWBACK: Even if deforestation could be reversed—millions of hectares of tropical forests still disappear each year—the number of trees needed to put a dent in CO2 emissions would clash with food and biofuel drops.

More information: As Paris climate goals recede, geoengineering looms larger: phys.org/news/2017-10-paris-cl … -geoengineering.html