

# PROPOSED GEOENGINEERING TECHNOLOGIES

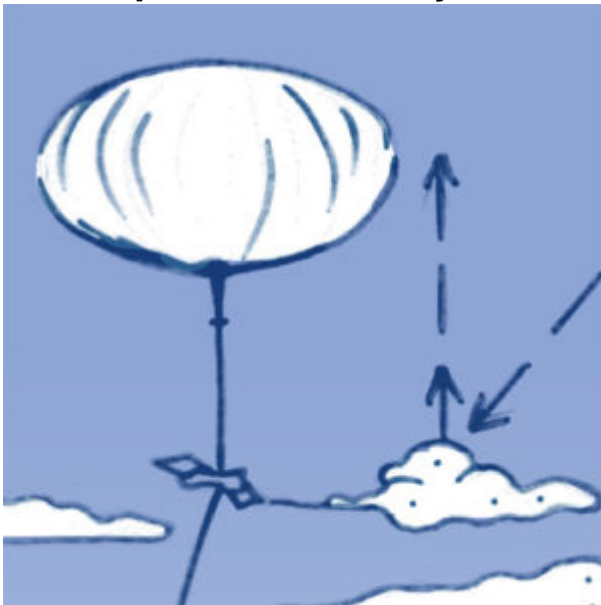
November 28, 2014

The following “technologies” are mostly hypothetical proposals advanced by various geoengineering advocates. Nonetheless, we are keeping close track of each one.

Geoengineering technologies can be categorized by different approaches (solar radiation management, carbon dioxide removal, weather modification), or by where they seek to intervene in the planetary ecosystem (land, air, water). For more background, see: [What is Geoengineering?](#) and [Reasons to Oppose](#).

Filter by keyword:

## Stratospheric Aerosol Injection (SAI)



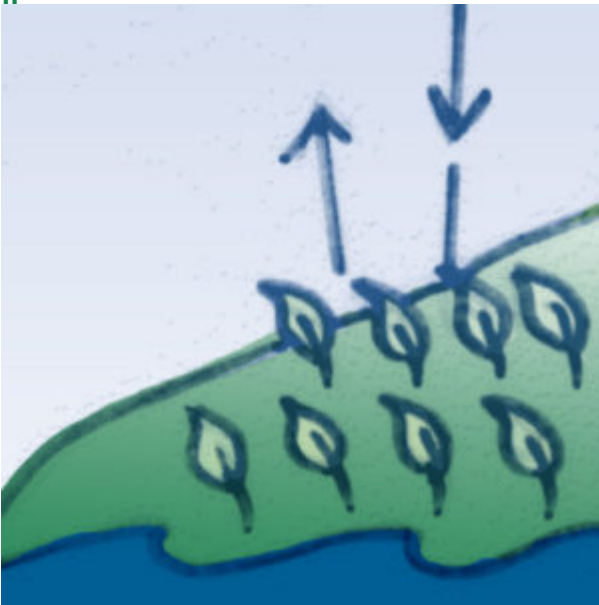
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SAI proposes to spray large quantities of sulphur particles (e.g. sulphur dioxide) into the stratosphere (the upper layer of the atmosphere) to act as a reflective barrier against incoming sunlight. Proposals range from shooting particles from artillery guns, using large hoses to the sky or emptying particles from the back of aircraft. The design of self-levitating particles, as well as the use of particles of other reflective minerals (e.g. titanium or aluminum) have also been considered.

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## Surface Albedo Modification

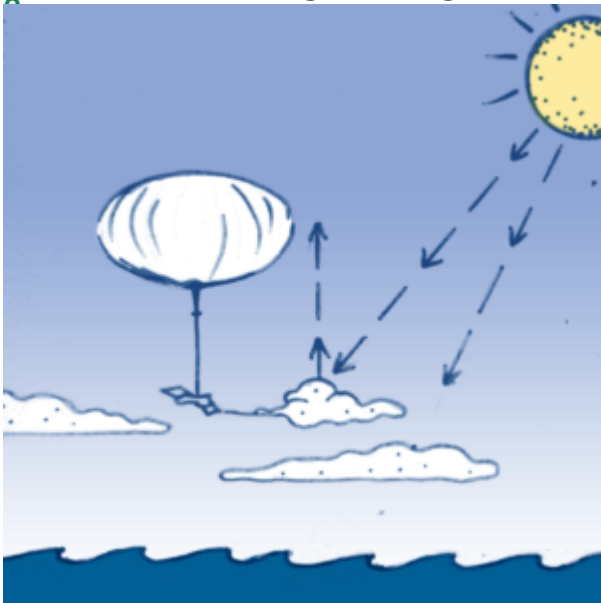


A wide range of proposals fall within the category of surface albedo modification – from genetically engineering crops to reflect more light, to the clearing of boreal forest in snow-covered areas; from covering large desert or ice areas with reflective materials to whitening mountaintops and roofs with white paint – all with a common goal: to increase the earth’s surface albedo.

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## Marine Cloud Brightening (MCB)



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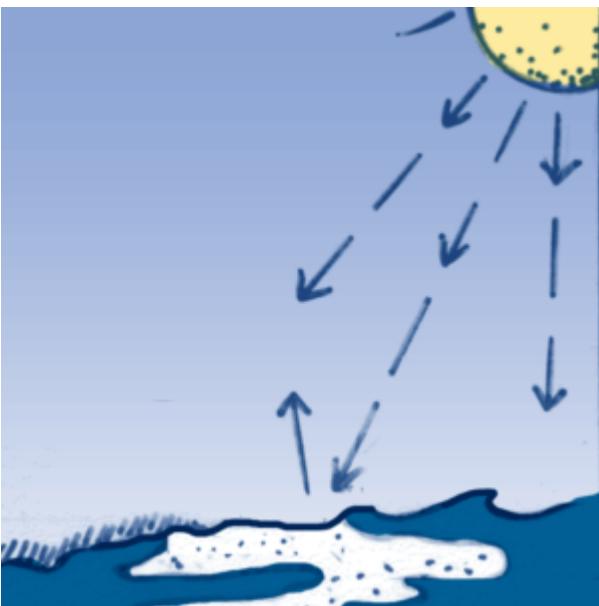
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MCB proposals aim to increase the whiteness of clouds in order to reflect more sunlight back into space. One proposal involves spraying a fine mist (of seawater, for example) into low-lying marine clouds that would create more cloud condensation nuclei (the particles that provide a surface for vapour to condense upon, forming clouds), potentially making the cloud whiter. Others propose seeding clouds with biological or other nuclei.

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## Microbubbles



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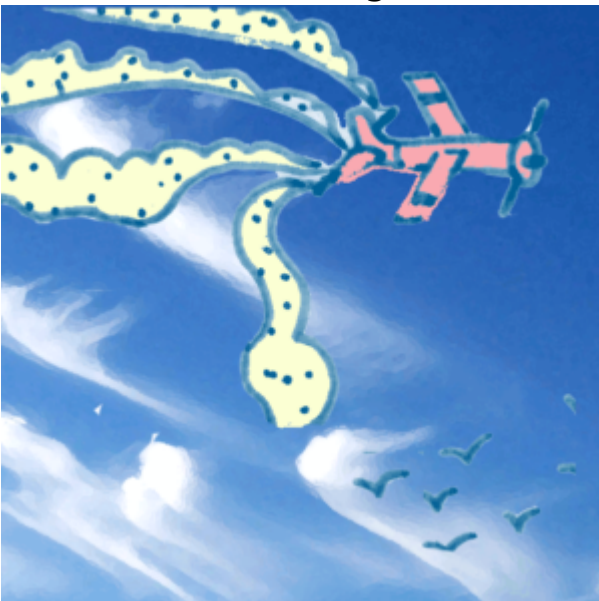
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Microbubble proposals suggest that by generating millions of tiny air bubbles in the ocean, large areas could be made to reflect more sunlight back into space.

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## Cirrus Cloud Thinning



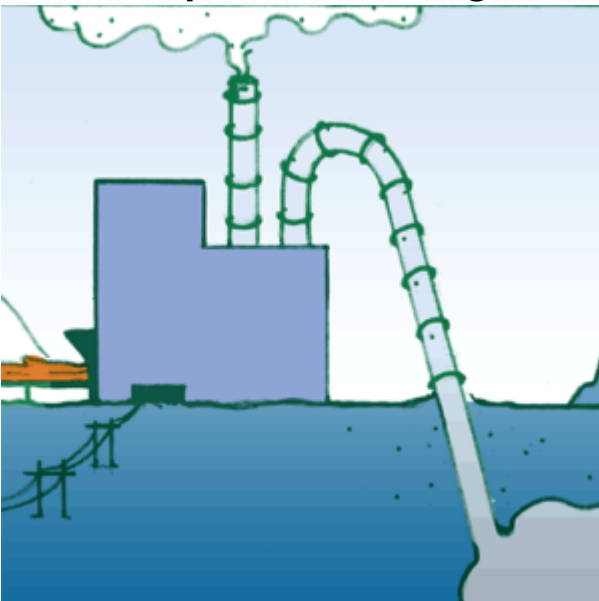
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By thinning cirrus clouds (wispy, elongated clouds at high altitudes), some researchers have proposed that more heat could be allowed to escape into space, creating an overall cooling of the climate.

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## Carbon Capture and Storage (CCS)



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CCS usually refers to the mechanical capture of CO2 emissions from power plants or other industrial sources. The CO2 is typically captured before the emissions leave the smokestack, generally with a sorbent chemical. The liquified CO2 is then pumped into underground aquifers for long term storage. CCS is not regarded as geoengineering under the UN Convention on Biodiversity's definition.

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## **Direct Air Capture (DAC)**



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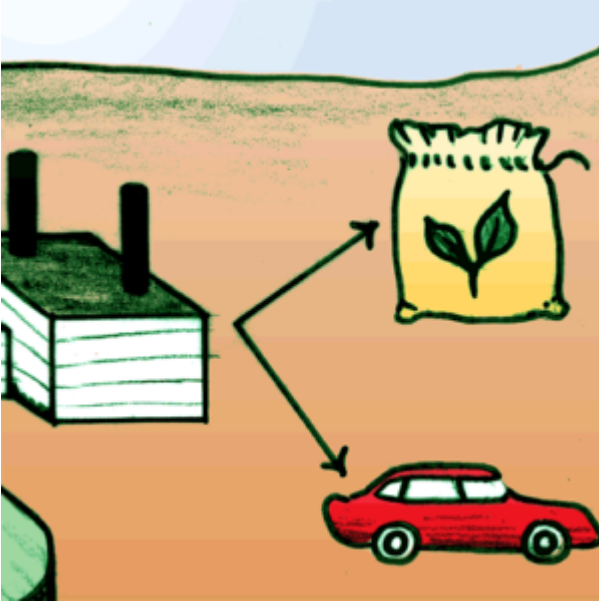
Extracting CO2 or other greenhouse gases from the atmosphere by chemical and mechanical means, generally using a chemical sorbent and large fans to move air through a filter. The CO2 is then available as a stream of gas for CCS or EOR or other uses.

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# Carbon Capture Use and Storage (CCUS)



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The idea that captured CO<sub>2</sub> from either industry or the atmosphere can be used as a feedstock for manufacturing, resulting in CO<sub>2</sub> stored in products. One hypothetical example involves feeding captured CO<sub>2</sub> to algae which produce biofuels; another is reacting CO<sub>2</sub> with calcifying minerals to produce concrete for building purposes.

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# Bioenergy with Carbon Capture and Storage (BECCS)



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Capturing CO2 from bioenergy applications (e.g. ethanol production or burning biomass for electricity) and subsequently sequestering that CO2 through either CCS or CCUS. The theory is that BECCS is “carbon negative” because bioenergy is theoretically “carbon neutral,” based on the idea that plants will regrow to fix the carbon that has been emitted. Many critics say this overlooks emissions from land use change and life cycle emissions.

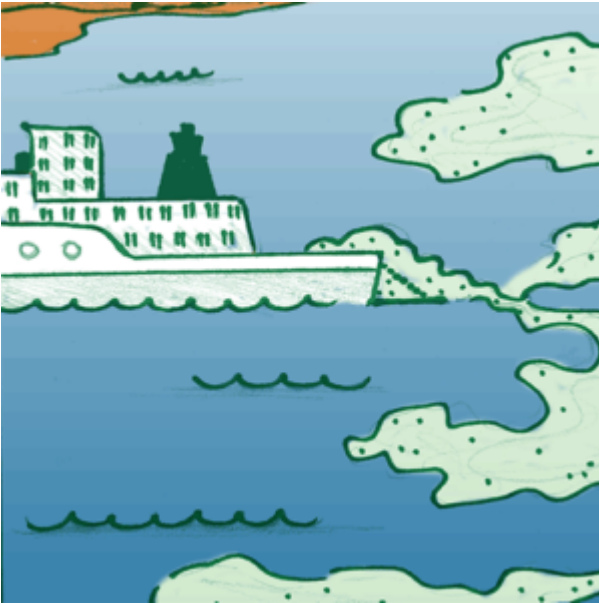
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# Ocean Fertilization



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Ocean fertilization refers to dumping iron (as powdered iron sulphate) or other nutrients (e.g. urea) into the ocean in areas with low biological productivity in order to stimulate phytoplankton growth. In theory, the resulting phytoplankton draw down atmospheric CO<sub>2</sub> and then die, falling to the ocean bed and sequestering carbon.

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# Enhanced Weathering (EW)



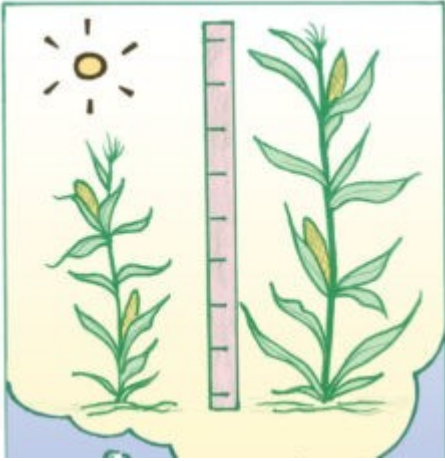
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EW techniques propose to dissolve crushed minerals (particularly silicate minerals) on land or in the sea in order to react with and fix atmospheric carbon dioxide into oceans and soils.

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## Enhanced Photosynthesis



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Enhanced photosynthesis proposes to genetically manipulate plants and algae, especially crops like rice, wheat, cotton and trees, so that they would supposedly metabolize more CO<sub>2</sub>.

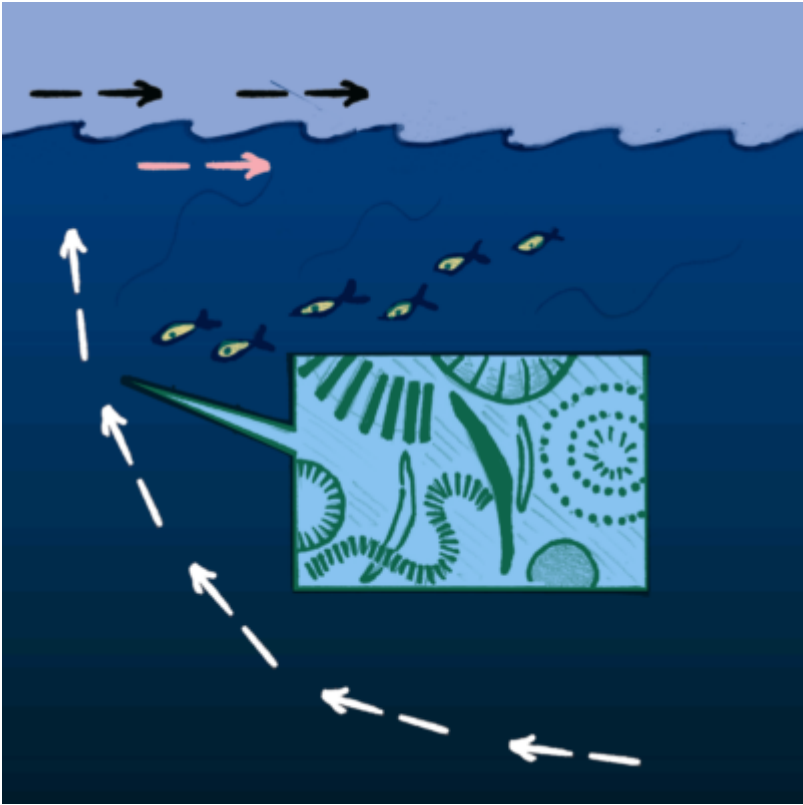
This way of “forcing nature” is presented as a form of Carbon Dioxide Removal, with the assumption that is possible for the plants to store additional carbon in the ground.

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## Artificial Upwelling

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Theoretically artificial upwelling proposes to artificially transport nutrient-rich deep ocean water to the surface, the hypothesis is

that once transported to the surface, new phytoplankton would absorb atmospheric CO<sub>2</sub> and store carbon when the dead phytoplankton biomass sinks to the ocean floor.

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