

GLOBAL WARMING IS GEO-ENGINEERING THE SOLUTION

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THE UN Environment Programme, in its report titled “*The Closing Window*” confirmed in 2022 that there is almost no credible pathway to limit global warming within 1.5°C above the pre-industrial temperature based on the 2030 commitment. Therefore, it has been suggested to aim at keeping it at 2°C, which only can be achieved if all the countries meet their pledges to achieve net-zero emissions.

However, from the ongoing trend, it can hardly be guaranteed. Moreover, even if we succeed in stopping carbon dioxide emissions today, the long-term impact of the gas already in the air will continue for decades. On the other hand, modelling suggests that any warming above 1.5°C may increase the risk of self-reinforcing tipping points in the global climate system, which are the temperature thresholds at which significant greenhouse gases can be released suddenly, greatly amplifying global warming. An example is the release of frozen carbon dioxide and methane stores from the thawing Arctic permafrost. Therefore, an increase to 2°C may invite such possibilities. For such reasons, it is now necessary to focus not only on arresting global warming but also on reversing it.

The various ways that come to mind to achieve it are extensive tree planting and reforestation, development of technologies to make industries emission-free, and complete replacement of fossil fuels by green and renewable energy sources and some other steps. However, until now, such efforts have been proven to be slow and insufficient in achieving the goal. Therefore, scientists have been contemplating the idea of going for geo-engineering processes, which are visualised to be faster and more effective, not only to arrest global warming but also to reverse it.

The emergence of the idea of geo-engineering dates back to the middle of the 20th century. One of its earliest applications was cloud seeding, a weather modification

process to bring rain by dispersing particles of silver iodide or solid carbon dioxide into the rain-bearing clouds. It was designed to alter the weather and to cause rain on a regional scale. However, present-day geo-engineering has focused on the global scale, particularly in dealing with global warming and climate change, which includes fundamentally different approaches. The first one proposes the use of technologies that would increase the reflectance of incoming solar radiation, thereby reducing its heating effects on the surface as well as the lower atmosphere of the Earth. On the other hand, the second approach focuses on adopting different methods for removing carbon dioxide from the air and storing it in areas where it cannot interact with the Earth’s atmosphere. Of the two, the latter appears to be more appealing.

Increase of Solar Reflectance

It includes stratospheric aerosol injection, the most studied method, followed by albedo enhancement, putting small reflective objects beyond the Earth’s stratosphere, marine cloud brightening, and others.

(i) **Aerosol cooling:** the process proposes to put a layer of sulphate aerosols into the global atmosphere, which would increase the scattering of solar radiation, resulting in a cooling effect similar to a volcano effect. As a result, less of it would be absorbed by the troposphere, where weather primarily occurs. A simulation experiment suggests that using one million teragrams of sulphate per year at a height of 25 km in a Tropical belt would be sufficient to cancel the effect of global warming caused by the doubling of carbon dioxide in the atmosphere.

To produce the artificial aerosol layer, the particles could be shot into the stratosphere by cannons or dispersed from balloons and aircrafts. The idea is based upon the fact that the volcanic eruptions of Mount Tambora of