

## The powerful coalition that wants to engineer the world's climate

Businessmen, scientists and right-wing thinktanks are joining forces to promote 'geo-engineering' ideas to cool the planet's climate, writes Clive Hamilton

- Clive Hamilton for [OurWorld 2.0](#), part of the [Guardian Environment Network](#)
- [guardian.co.uk](#), Monday 13 September 2010 16.16 BST
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Some geo-engineering techniques, such as filling the sky with shiny dust to reflect sunlight, could curb such temperature rises without the need to restrict greenhouse gas emissions

In August 1883 the painter Edvard Munch witnessed an unusual blood-red sunset over Oslo. Shaken up by it, he wrote in his diary that he "felt a great, unending scream piercing through nature". The incident inspired him to create his most famous work, *The Scream*.

The sunset he saw that evening followed the eruption of Krakatoa off the coast of Java. The explosion, one of the most violent in recorded history, sent a massive plume of ash into the stratosphere, turning sunsets red around the globe. The gases emitted also caused the Earth to cool by more than one degree and disrupted weather patterns for several years.

The cooling effect of large volcanic eruptions has been known for some time. A haze forms from the sulphur dioxide spewed into the upper atmosphere reducing the amount of solar radiation reaching the Earth. It's estimated that the eruption of Mount Pinatubo in the Philippines in 1991 — the largest since Krakatoa — cooled the Earth by around [0.5°C](#) for a year or more.

Now, a powerful coalition of forces is quietly constellating around the idea of transforming the Earth's atmosphere by simulating volcanic eruptions to counter the warming effects of carbon pollution. Engineering the planet's climate system is attracting the attention of scientists, scientific societies, venture capitalists and conservative think tanks. Despite the enormity of what is being proposed — nothing less than taking control of Earth's climate system — the public has been almost entirely excluded from the planning.

The [Royal Society](#) defines geoengineering as "the deliberate large-scale manipulation of the planetary environment to counteract anthropogenic [climate change](#)" and divides methods into two types: carbon dioxide removal from the atmosphere, and solar radiation management aimed at reducing heat coming in or reflecting more of it out.

Techniques ranging from the intriguing to the wacky have been proposed to remove carbon from the atmosphere, including fertilising the oceans with iron filings to promote the growth of tiny marine plants that absorb carbon dioxide, installing in the ocean a vast number of floating funnels that draw nutrient-rich cold water from the deep to encourage algal blooms that suck carbon dioxide from the air, and construction of thousands of 'sodium trees' that extract carbon dioxide directly from the air and turn it into sodium bicarbonate.

Some of the ideas put forward to block the Sun's heat would be far-fetched even in a science fiction novel. One is to send billions of reflective discs to a point in space known as L1 and located between the Earth and the Sun. Another is to launch hundreds of special unmanned ships that plough the oceans sending up plumes of water vapour that increase cloud cover. Or dark-coloured forests could be converted into light-coloured grasslands that reflect more sunlight.

### **Enhanced dimming**

But the option that is taken most seriously is altogether grander in conception and scale. The scheme proposes nothing less than the transformation of the chemical composition of the Earth's atmosphere so that humans can regulate the temperature of the planet as desired. Like volcanic eruptions, it involves injecting sulphur dioxide gas into the stratosphere to blanket the Earth with tiny particles that reflect solar radiation.

Various schemes have been proposed, with the most promising being adaptation of high-flying aircraft fitted with extra tanks and nozzles to spray the chemicals. A fleet of 747s could do the job. To have the desired effect we would need the equivalent of one Mount Pinatubo eruption every three or four years. The emissions from the eruption in April of Iceland's 'Mount Unpronounceable' were less than a hundredth of those from Pinatubo, so to engineer the climate we'd need the equivalent of one of those every week, every year for decades.

More cautious scientists recognise that attempting to regulate the Earth's climate by enhancing global dimming is fraught with dangers. Most worryingly, the oceans are absorbing around a third of the extra carbon dioxide pumped into the atmosphere by humans, which is raising their acidity, dissolving corals and inhibiting shell-formation by marine organisms. Turning down the dimmer switch may reduce incoming solar radiation but would do nothing to slow ocean acidification. The climate system is hugely complicated and tinkering with it might be akin to introducing [cane toads](#) to control sugarcane beetles.

### **Moral hazards**

Although ideas for climate engineering have been around for at least twenty years, until recently public discussion has been discouraged by the scientific community. Environmentalists and governments have been reluctant to talk about it too. The reason is simple: apart from its unknown side-effects, geoengineering would weaken resolve to reduce [carbon emissions](#).

Economically it is an extremely attractive substitute because its cost is estimated to be "trivial" compared to those of cutting carbon pollution. While the international community has found it difficult

to agree on strong collective measures to reduce carbon emissions, climate engineering is cheap, immediately effective and, most importantly, available to a single nation.

Among the feasible [contenders](#) for unilateral intervention, one expert names China, the USA, the European Union, Russia, India, Japan and Australia. Could they agree? It's like seven people living together in a centrally heated house, each with their own thermostat and each with a different ideal temperature. China will be severely affected by warming, but Russia might prefer the globe to be a couple of degrees warmer.

If there is no international agreement an impatient nation suffering the effects of climate disruption may decide to act alone. It is not out of the question that in three decades the climate of the Earth could be determined by a handful of Communist Party officials in Beijing. Or the government of an Australia crippled by permanent drought, collapsing agriculture and ferocious bushfires could risk the wrath of the world by embarking on a climate control project.

To date, governments have shunned geoengineering for fear of being accused of wanting to avoid their responsibilities with science fiction solutions. The topic is not mentioned in the Stern report and receives only one page in Australia's Garnaut report (see [Section 2.4.2](#)). As a sign of its continuing political sensitivity, when in April 2009 it was reported that President Obama's new science adviser John Holdren had said that geoengineering is being vigorously discussed as an emergency option in the White House, he immediately felt the need to issue a "clarification" claiming that he was only expressing his personal views.

Holdren is one of the sharpest minds in the business and would not be entertaining what is now known as 'Plan B'— engineering the planet to head off catastrophic warming — unless he was fairly sure Plan A would fail.

Fiddling with the dimmer switch may prove an almost irresistible political fix for governments. It gets powerful lobbies off their backs, gives the green light to burn more coal, avoids the need to raise petrol taxes, allows unrestrained growth and is no threat to consumer lifestyles.

In short, compared to cutting greenhouse gas emissions, geoengineering gets everyone off the hook. No government is yet willing to lend official support to geoengineering. However, the pressure is building and the day when the government of a major nation like the United States, Russia or China publicly backs Plan B cannot be far off. Then the floodgates will open.

Even now, beneath the radar, Russia has already begun testing. Yuri Izrael, a Russian scientist who is both a global-warming sceptic and a senior adviser to Prime Minister Putin, has tested the effects of aerosol spraying from a helicopter on solar radiation reaching the ground. He now plans a [full-scale trial](#).

## **Strangelove and son**

Two of the earliest and most aggressive advocates of planetary engineering were Edward Teller and Lowell Wood. Teller, who died in 2003, was the co-founder and director of the Lawrence Livermore National Laboratory near San Francisco, described by US author Jeff Goodell as having a "near-mythological status as the dark heart of weapons research". Teller is often described as the "father of the hydrogen bomb" and was the inspiration for Dr. Strangelove, the wheelchair-bound mad scientist prone to Nazi salutes in Stanley Kubrick's 1964 film of that name.

Lowell Wood was recruited by Teller to the Lawrence Livermore National Laboratory and became his protégé. For decades Wood was one of the Pentagon's foremost "weaponers", leading him to be christened "Dr. Evil" by critics. He led the group tasked with developing Ronald Reagan's ill-fated Star Wars missile shield that included plans for an array of orbiting X-ray lasers powered by nuclear reactors.

Since 1998 Wood and Teller have been promoting aerosol spraying into the stratosphere as a simple and cheap counter to global warming. Reflecting the dominant opinion of the 1950s, they believe it is humankind's duty to exert supremacy over nature. It is perhaps for this reason that they have long been associated with conservative think tanks that deny the existence of human-induced global warming. Both men have been associated with the Hoover Institution, a centre of climate scepticism partly funded by ExxonMobil, and Wood is listed as an expert with the George C. Marshall Institute, a Washington think tank that became one of the main centres of climate denial in the 1990s.

It is strange that geoengineering is being promoted enthusiastically by a number of right-wing think tanks that are active in climate denialism. The [American Enterprise Institute](#), an influential think tank also part-funded by ExxonMobil that offered US\$10,000 to academics for papers debunking the reports of the Intergovernmental Panel on Climate Change, has launched a high-profile project to promote geoengineering.

Of course, geoengineering protects their supporters and financiers in the fossil industries because it can be a substitute for carbon reductions and justify delay. But a deeper explanation lies in their beliefs about the relationship of humans to the natural world.

Pursuing abatement is an admission that industrial society has harmed nature, while engineering the Earth's climate would be confirmation of our mastery over it — final proof that, whatever minor errors made on the way, human ingenuity and faith in our own abilities will always triumph. Geoengineering promises to turn failure into triumph.

Lowell Wood believes that climate engineering is inevitable; it's a matter of time before the 'political elites' wake up to its cheapness and effectiveness. In a statement that could serve as Earth's epitaph, he declared: "We've engineered every other environment we live in—why not the planet?"

Wood is contemptuous of the ability of world leaders to reduce emissions (which he dubs "the bureaucratic suppression of CO<sub>2</sub>") and of their ability to reach a consensus on trialling geoengineering. He predicts that necessity will overrun popular resistance to the idea of fiddling with the atmosphere.

Faced with this resistance, Wood speculates about getting private funding from a billionaire for an experiment. "As far as I can determine, there is no law that prohibits doing something like this". Wood is right: there is no law against a private individual attempting to take control of the Earth's climate.

### **Regulating climate regulation (Global Geoengineering Governance)**

This goes to the heart of the push to develop the tools for climatic manipulation. The debate over climate engineering is at present confined largely to a tight-knit group of scientists, some of whom want to keep the public in the dark and fend off regulation of their activities. In his book, [How To Cool the Planet](#), Goodell describes a series of three private dinners in early 2009 that brought together the main players. Convened by two of the leading advocates, Ken Caldeira of Stanford University and

David Keith of the University of Calgary, they were "a turning point in the evolution of geoengineering as a policy tool".

In March this year a [private meeting](#) of leading climate engineers, held in Asilomar, California, aimed to develop guidelines to govern research and testing. The invitees wanted a voluntary code of conduct that would forestall regulation by governments and the international community so that the experts could work unhindered at their task of understanding how to control of the Earth's climate system.

[David Keith](#) argues that an international treaty may be unnecessary because the use of solar radiation management could be regulated by unwritten "norms". This is despite his acknowledgement that the threat of unilateral action is very real; any one of a dozen countries could begin it within a few years. Indeed, one wealthy individual could transform the atmosphere and, with enough determination, bring on an ice age.

Perhaps the wealthy individual he has in mind is [Bill Gates](#), who has covertly been funding geoengineering research for three years with advice from Keith and Caldeira. They now oversee Gates' research fund, which has spent some \$4.5 million to date, including funding the three private dinners. Keith will not reveal what the money is being spent on, downplaying it as "a little private funding agency". Right—the world's richest man has a little private funding agency devoted to researching ways to manipulate the Earth's climate system. Conspiracy theory anyone?

Gates is also an investor in a firm named Intellectual Ventures that is promoting a scheme called "[StratoShield](#)", which would pump sulphur dioxide into the upper atmosphere through a 30-kilometre hose held aloft by V-shaped blimps. Intellectual Ventures is run by Nathan Myhrvold, former chief technology officer at Microsoft, and includes Lowell Wood among its associates.

Gates is not the only billionaire lone ranger who wants to save the planet. Richard Branson has set up his own "war room" to do battle with global warming. The battalions he wants to mobilise on "the path to victory" are successful entrepreneurs—like himself—and their weapons are "market driven solutions to climate change", including geoengineering.

The [Carbon War Room](#) — where inspirational quotes from Branson are mixed in with those of other titans like Churchill, Roosevelt and Einstein — represents the type of rich man's folly common amongst modern entrepreneurs with a Messiah complex.

The War Room site promotes a paper co-authored by Lee Lane of the American Enterprise Institute and published by the centre run by "skeptical environmentalist" Bjorn Lomborg. It argues that the benefits of geoengineering vastly outweigh the costs and shows how to set an optimal temperature for the Earth for the next two hundred years.

The authors worry that ethical objections from environmental advocacy groups may block the deployment of solar radiation management, before noting with relief, "in reality, important economies remain largely beyond the influence of environmental advocacy groups." They expect deployment of solar radiation management will be led by nations with weak environmental lobbies—which of course means dictatorships.

## Blue-sky dreaming

More vivid sunsets like the one Edvard Munch saw in 1883 would be one of the consequences of using sulphate aerosols to engineer the climate; but a more disturbing effect of enhanced dimming would be the permanent whitening of day-time skies. A washed-out sky would become the norm.

If the nations of the world resort to climate engineering, and in doing so relieve pressure to cut carbon emissions, then the concentration of carbon dioxide in the atmosphere would continued to rise and so would the latent warming that would need suppressing. It would then become impossible to call a halt to sulphur injections into the stratosphere, even for a year or two, without an immediate jump in temperature.

It's estimated that, if whoever controls the scheme decided to stop, the back-up of greenhouse gases could see warming rebound at a rate 10-20 times faster than in the recent past, a phenomenon referred to, apparently without irony, as the "[termination problem](#)".

Once we start manipulating the atmosphere we could be trapped, forever dependent on a program of sulphur injections into the stratosphere. In that case, human beings would never see a blue sky again.

• **16 September update:** Projects supported by the Gates' fund are [now fully disclosed online](#)

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