

How Bill Gates is engineering the Earth to resist climate change

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Brightening marine clouds to reflect more sunlight? Coating the Earth with a solar shield of sulphate particles? From the new book *Earthmasters*, how science — and Bill Gates — could tackle climate change.

Geoengineering — deliberate, large-scale interventions in the Earth’s climate system to counter the effects of global warming — is now the subject of extensive research around the world. If nations seem unable to implement plan A, cutting greenhouse gas emissions, then, some believe, we must prepare plan B — schemes such as fertilising the oceans so they soak up more carbon dioxide, brightening marine clouds so they reflect more sunlight, or coating the Earth with a solar shield of sulphate particles.

Although still in its early days, the constituency for geoengineering is now developing around a network of individuals with personal, institutional and financial links. At the centre of the network is a pair of North American scientists actively engaged in geoengineering research: David Keith and Ken Caldeira.

Keith and Caldeira have been dominant voices in virtually every inquiry into and report on geoengineering. They have been prominent expert witnesses at the opinion-forming inquiries by the British and American legislatures, and their views have helped frame the deliberations of the Intergovernmental Panel on Climate Change as it grapples for the first time with the scientific and ethical tangle that is climate engineering.

In short, Keith and Caldeira have become the “go-to” guys on climate engineering. Such is their influence over the global debate that author Eli Kintisch has dubbed them the “geoclique”. While they are not as gung-ho as some other geoengineering advocates, their research and advocacy lead in only one direction. And the truth is the weight of history is on their side. The urge for mastery over nature is inscribed in the climate engineering project, and it is this urge that will overwhelm the best efforts of reluctant geoengineers.

David Keith is a physicist, entrepreneur and professor of public policy. For many years he was based at the University of Calgary before moving to Harvard. Although there is no doubting his brilliance as a scientist, his views are sometimes hard to pin down. While convinced of the validity of climate science, he seems to adopt a nonchalant stance towards its impacts on humans. “I’m not sure that global warming is such a threat to human civilisation ... human beings are a remarkably adaptable species ... If it is just the human race you’re worried about, I’m not sure global warming is such a big problem.”

He expects that humans will be engaged in “planetary management” via climate engineering and what remains of the natural world will be managed like a garden, a development he seems to accept with equanimity. Keith is pushing ahead with plans to test sulphate aerosol spraying in New Mexico.

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Ken Caldeira is an atmospheric scientist based at the Carnegie Institution at Stanford University, to which he moved in 2005 after 10 years at the Lawrence Livermore National Laboratory. At Livermore, a Cold War nuclear weapons facility, he came under the influence of Lowell Wood, the legendary “weaponeer” nicknamed “Dr Evil”. Caldeira too is fully aware of climate science and seems much more alarmed than Keith at the harm global warming will cause to humans.

On the question of planetary management, though, his opinions seem to fluctuate. He says that thinking of geoengineering as a substitute for an emissions reduction is “crazy”, but he has been unable to pinpoint “the one really bad thing that argues against geoengineering the climate”. He is quoted as saying that sulphate aerosol spraying “seems to be a dystopic world out of a science fiction story”, but also that “I am not clear on what the ‘greenest’ path is. Is it better to let the Greenland ice sheet collapse and let the polar bears drown their way to extinction, or to spray some sulphur particles in the stratosphere?”

For some years Keith and Caldeira have been Bill Gates’ principal source of expert knowledge on climate change. From a series of briefings Gates has learned of the danger the world faces and what might be done about global warming. He was persuaded to commit several million dollars to finance research into geoengineering, a fund managed by Keith and Caldeira.

Gates is now the world’s leading financial supporter of geoengineering research. He is an investor in Silver Lining, a company pursuing marine cloud brightening methods. Blurring the boundary between disinterested research and financial reward that increasingly characterises geoengineering, one of the more detailed research papers on marine cloud brightening includes 10 authors affiliated with Silver Lining.

Gates is also an investor in Carbon Engineering Ltd, a start-up company formed by David Keith to develop technology to capture carbon dioxide from ambient air on an industrial scale.

In addition to advising Gates and dispensing his research funds, Ken Caldeira is linked to Gates through a firm known as Intellectual Ventures, formed by former Microsoft employees and led by Nathan Myhrvold, one-time chief technology officer at Microsoft. Caldeira is listed as an “inventor” at Intellectual Ventures. Lowell Wood, once Myhrvold’s academic mentor, retired from the Lawrence Livermore National Laboratory in 2007 to team up with Intellectual Ventures. Gates is an investor.

The company, whose motto is “inventors have the power to change the world”, has developed the “StratoShield”, a hose suspended by blimps in the sky to deliver sulphate aerosols. The device is marketed as “a practical, low-cost way to reverse catastrophic warming of the Arctic — or the entire planet”. Intellectual Ventures has patented several geoengineering concepts, including an ocean pump for bringing cold seawater to the surface. That patent lists Caldeira, Myhrvold and Gates as inventors.

Gates has been criticised for “dissing” renewable energy and energy efficiency measures like household insulation as solutions to global warming. He is less interested in “old technologies”, even those with proven capacity, and dismissed solar energy as “cute”. He prefers to support “innovative solutions”, breakthroughs yet to be developed by whiz-kids, even though the experts agree the obstacle is not the absence of innovative alternatives to fossil fuels but the policies to ensure they are taken up. Gates sees climate change as a technical problem that requires some kind of “killer app”, magical thinking according to some. Gates epitomises an emerging force in the push for an engineered climate — behind the genuflecting to “mitigation first”, the lure of the technofix is irresistible.

Richard Branson is another billionaire who hopes to save the world with a technofix. He sees himself as “a committed crusader and ambassador of crucial and urgent social as well as environmental issues”. Branson’s Virgin Earth Challenge has offered a \$25 million prize to whoever can develop the best plan to extract carbon from the atmosphere. Of the 11 finalists in the competition, four propose direct air capture methods, and four are based on biochar, a type of charcoal.

Of more long-term significance, oil companies, anticipating a shift in the political landscape, are quietly backing research into geoengineering. Royal Dutch Shell is funding study of liming the seas, a technology aimed at countering the oceans’ acidification so that they can soak up more carbon dioxide.

The chief scientist at the oil giant BP, Steven Koonin, was the convener of an expert meeting for the Novim Group, a non-profit scientific corporation, which in 2009 produced an influential report on climate engineering as a response to climate emergencies. The authors felt the need to declare that in playing a prominent role Koonin had no conflict of interest, arguing, implausibly, that it is not possible to say that promoting research into geoengineering has any bearing on policies to reduce carbon dioxide emissions and thus BP’s bottom line. In 2009 Koonin was appointed Under-Secretary for Science at the United States Department of Energy.

Despite ExxonMobil’s long campaign to discredit climate science — in 2006 the Royal Society felt the need to write to the oil giant asking it to honour its promise to cease funding dozens of groups that had “misrepresented the science of climate change by outright denial of the evidence” — it too has now inserted itself into climate engineering.

The corporation’s point man on geoengineering is Haroon Kheshgi, who leads its Global Climate Change program. A chemical engineer, Kheshgi was recruited to Exxon in 1986 from the Lawrence Livermore National Laboratory. He is equivocal about whether human-induced climate change is anything to worry about. In 1995, ensconced at Exxon, he was the first to propose liming the oceans as a means of reducing acidification due to escalating atmospheric carbon.

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Through Kheshgi, Exxon has begun to influence “independent” reports into geoengineering, such as the 2007 NASA report on solar radiation management organised by Caldeira. The oil company also funded a report concluding that sulphate aerosol spraying would be a much cheaper response to global warming than phasing out fossil fuels. Its CEO, Rex Tillerson, has described climate change as an “engineering problem” with “engineering solutions”.

Regulation moves more slowly than commerce, and in recent years there has been a flurry of patents taken out over methods to engineer the climate. Some of them are so broad that, if enforceable, they would place fertilisation of the oceans in the hands of one man. Another man holds a patent with the description: “Use of artificial satellites in earth orbits adaptively to modify the effect that solar radiation would otherwise have on Earth’s weather.”

Most people would assume that if anyone is to own a technology to control the amount of sunlight reaching the planet it should be government, rather than Franklin Y. K. Chen of One Meadow Glen Road, Northport, New York. The US Patent and Trademark Office disagrees. So does Ken Caldeira, who cannot see that patenting a solar shield is any different from patenting a new drug.

In 2010 Shobita Parthasarathy and co-authors noted a sharp increase in geoengineering patents in recent years and warned that, as in the case of biotechnology, the patents owned by private companies and individuals are on track to become the de facto form of governance of geoengineering. We are approaching a situation in which international efforts to protect humanity from climate catastrophe could depend on whether or not one company wants to sell its intellectual property.

It is clear, even at this early stage, that burgeoning commercial engagement in geoengineering is creating a constituency with an interest in more research and, eventually, deployment. Such a lobby is naturally predisposed to argue that pursuing mitigation is “unrealistic” or “politically impossible” and that therefore climate engineering is the sensible alternative, if only so that we can “be prepared”.

Already the chorus of demands for public funding of research is loud; every inquiry and report calls for large amounts of it. It is fair to expect that if we reach the stage of deployment, any move to terminate it (due, for example, to evidence of unexpected environmental damage) would be fought by the new industry with complaints of asset devaluation and job losses.

Today it may seem absurd that factors like these should play a role in deciding the fate of the entire planet, but the history of environmental policy-making shows that these kinds of decisions are never based solely on public safety. As President Dwight Eisenhower warned in 1961, there is a “danger that public policy could itself become the captive of a scientific-technological elite”.

**This is an extract from Clive Hamilton’s new [Earthmasters](#), published by Allen & Unwin and released this week*

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