



07 JAN 2009: INTERVIEW

Geoengineering: The Prospect of Manipulating the Planet

Although he finds the possibility unsettling, Canadian climate scientist David Keith believes large-scale geoengineering will eventually be deployed to offset global warming. In an interview with Yale Environment 360, Keith explains why scientists must begin researching an "emergency response strategy" for cooling an overheated planet.

BY JEFF GOODELL

Geoengineering, which is usually defined as the deliberate, large-scale manipulation of the earth's climate to offset the impact of greenhouse gas emissions, has long been a taboo subject among top climate scientists and policymakers. At first glance, the whole idea reeks of technological hubris ("It's the Frankenplanet solution," as one beltway environmentalist put it).

And yet, because of our failure to cut global greenhouse gas emissions, as well as growing alarm about how quickly our climate is changing, the taboo is fading. In 2006, Paul Crutzen, who won a Nobel Prize for his work on ozone chemistry, published a widely read paper that basically announced that geoengineering might be needed as a last resort against global warming. Ralph Cicerone, the head of the U.S. Academy of Sciences, has also given the idea cautionary support. Last fall, the British Royal Society launched an in-depth study to explore various methods and potential risks. All this activity might be best seen less as hubris than desperation.

Geoengineering is really a catchall term that applies to two very different ideas: one is carbon engineering, which covers everything from dumping iron in the ocean to stimulate plankton blooms to building stand-alone scrubbers that can pull CO₂ out of the atmosphere. The second is albedo engineering, which refers to technologies that might be used to cool the planet by changing the earth's albedo (i.e., reflectivity) by creating what amount to artificial volcanoes that shoot tiny particles into the stratosphere, for example, or building cloud-generation machines. Carbon engineering is the least controversial of the two approaches, in part because it's slow-acting and essentially mimics the earth's natural carbon cycle (you could argue that reforestation is a form of carbon engineering). In contrast, albedo engineering — or "climate intervention," as some scientists now prefer to call it — is a far more ethically fraught option that might be deployed only if we get into a climate emergency and need to cool the earth in a hurry.

The technological, political, and moral complexities of all this are profound, and few scientists have given them more consideration than David Keith, who holds the Canada Research Chair in Energy and the Environment at the University of Calgary. Although Keith spends most of his time working on carbon capture and storage (he's currently overseeing a large CCS demonstration program in Canada), he has been thinking and writing about geoengineering for more than 20 years. At a recent meeting of the American Geophysical Union in San Francisco, where Keith delivered a talk called "Climate Engineering and Climate Stabilization," I interviewed him for *Yale Environment 360* and asked

about some of the controversies and complexities of geoengineering.

Yale Environment 360: Geoengineering has long been dismissed as a crazy and dangerous idea. But in your talk yesterday you said that geoengineering should be part of “our toolbox” to use as a response to global warming. Why?



David Keith

David Keith: The central argument has to do with the uncertainty that has persisted for decades and still does about just how bad the climate problem is. It comes down to a parameter that climate scientists call “climate sensitivity” — how much the climate will warm if we, say, double the amount of CO₂ in the air. And the answer is that's still uncertain by factors of two or three, which is just gigantic. So if we are very lucky, it might be that we could double or triple the amount of CO₂ in the air and have relatively small climate change, some of which might be beneficial.

On the flip side, if we're unlucky, we might see 5 or 6 degrees [Celsius] globally — and you can double that if you're in the middle of a mid-latitude continent — which is just stunning. That's as big as the change between the glacial and the interglacial state and that would certainly, over a few hundred years, melt big sections of the ice caps. It's really quite horrific stuff. And we don't know which of those two it is, and we're not going to know in time.

So we're making decisions every day by continuing to put CO₂ in the air — decisions that we cannot easily reverse. And so the culmination of the CO₂ in the air, and that uncertainty about how dangerous it is, that means you need a backup plan.

e360: One of the first things that comes up in many people's minds when they think about geoengineering is the idea of moral hazard. As you know better than anyone, the need to cut emissions to deal with global warming is one of the hardest tasks human beings have ever set their shoulders to, and geoengineering is seen by many as a dangerous distraction.

Keith: That's a really hard question, and I have different views depending on which side of the bed I get up on in the morning. I guess if you're a total rationalist, the answer is we certainly should *not* put all of our efforts into cutting emissions. We should put most of our current money and work into cutting emissions, but we do need to figure out what to do in this worst case scenario. So you need to put lots of effort into making sure you don't have house fires, but you also need to have a plan in case you do have a house fire.

Listen to the full interview (24 min.)



But of course in the real world, where we don't have a rational, single planner, it's perfectly legitimate to worry that conversations about this will cause people to be less active in cutting emissions. And I should say personally, I do worry about this.

But I don't think science does well by hiding things. Einstein has a beautiful quote that says, "It's a privilege to seek for truth, but that privilege implies also a duty and that duty is to show all the truth that you find." And the idea that scientific elite will try to bottle it up and hide it from the masses so the masses don't get some ideas about how we might actually deal with the problem is really reprehensible — and not one that's really going to produce good policy anyway.

So I think we have to talk about it seriously. What we need is to get out of

the blogosphere hype-mode that it's currently in, and get a real, not necessarily gigantic, but real research program going that will normalize work on geoengineering.

e360: What are the environmental risks associated with geoengineering that you think are most serious?

Keith: Well, the risks depend partly on what methods you actually use doing the geoengineering. If you put sulfur in the stratosphere, there's some possibility you'll decrease the amount of ozone in the stratosphere because we've observed that with volcanoes and sulfur in the stratosphere. And if you put some advanced engineered particles in the stratosphere like I've spent some time thinking about, it might be those particles have some completely unexpected environmental impact that we don't know about. After all, there's a painfully long history of us doing engineering interventions in the earth's systems to solve one problem, and we just end up creating another problem. But despite that history, that's not an excuse for doing nothing.

Just let me say one more thing this moral hazard question. There are lots of things we talk about in the climate game that are pernicious, and that gave people a false sense of security — and it is by no means clear that this is the scariest one. When you buy an airline ticket, you can now check a box that buys you some carbon offsets that makes it seem like your aircraft flight is carbon neutral. That's no more true than it was true that when you bought indulgences from the Catholic Church in the good old days that you really had not sinned. There is no technology right now that truly offsets the carbon emissions in an airplane flight — which after all stays in the atmosphere for millennia.

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And this pernicious idea that the problem can be easily solved, which is sometimes hyped by people in the green power industry who want to make us think that we can solve this problem and get rich all at the same time, is probably more destructive — in terms of weakening people's realizations of how serious the problem is and how much we really have to do — than these conversations about geoengineering.

e360: One of the things that distinguishes you from other scientists who have been talking about geoengineering is that you think this can be a way to save ecosystems like the Arctic — that there is an environmental component to this. *[Ed. Note: Changing the albedo in the Arctic, perhaps by increasing cloud cover above the region or shooting particles in the atmosphere, could in theory stop or even reverse the ice melt.]*

Keith: Well that's certainly my main motivation. I don't think that civilization is at stake with global warming. But I think that loss of the natural world we care about *is* at stake. To amplify that, there are things that can really threaten human civilization. And those things, in my view, are things like large-scale war with chemical or biological weapons. Those are things we should be very worried about, because, after all, we still live in a world where the only ultimate way to actually settle disputes between nation states is by war. And war, with the kind of technologies we now have, is really unacceptable. And I think that that is truly a civilization-wrecking outcome.

As much as I sometimes wish we could find a civilization-wrecking outcome from global warming, because that would force people to cut emissions very quickly, I don't believe there is one. I think humans are amazingly adaptable and have amazing powers of isolating themselves

from the environment by their technology, and those powers are not going to go away. And even human wants are very adaptable. So while I'm not claiming there won't be bad impacts from global warming — of course there will be, I spent my whole lifetime writing on that topic — I don't see it as a civilizational threat.

On the other hand, I do see the combination of very, very rapid warming — such as the Earth has not seen perhaps for 55 million years or even longer — combined with the other forces on the natural world, including human appropriation of land and all the different ways we're chopping up the natural environment, could really be devastating for the natural world that lots of us love. And I think that is one of the reasons to take this seriously.

e360: I know you've thought a lot about what a geoengineering research program should look like. But a lot of people would argue that starting a research program on this begins the slippery slope towards deployment — you don't research these kinds of problems and then let the technology sit on the shelf. Do you agree?

Keith: I think there are some elements to that that make sense. But what's the alternative? So are we going to not research it ... and then what's going to happen if we find that the climate sensitivity actually is six degrees and we get to a point where we have 550 ppm [parts per million] CO₂ in the air and Greenland is melting? Then what's going to happen is we're going to do it anyway, even if we haven't done research. We're going to do it chaotically and quickly and stupidly. Because it is not true that if we don't do the research, this will never happen.

e360: When we were talking earlier today you said that you thought we will eventually do this, that we will eventually geoengineer the planet. Is there a kind of inevitability to this, do you see it as part of the arc of human progress?

Keith: Yeah, I think it's true. It's not something I necessarily want to see. But I think unless humans have some war that sets back human civilization, we will grow into doing a kind of planetary management. I think we'll end up being in the gardening business with this planet.

But I think we'd be better to do that much slower rather than quicker. And my hope would be we cut emissions enough that we don't need to geoengineer in the short-term, because I think that while technically we might be able to do this, humans are probably morally unready, or society is unready, to figure out how they'd use the power that comes from our technology to manipulate the planet.

One glib way to think about this is to imagine that space aliens come down and land on the White House lawn or wherever — maybe they'll choose to land in Kenya — and they give us some magic tools for controlling the climate, including a box that has a knob for global temperature and a knob for CO₂ concentration. If that happened right now, you can imagine people fighting wars over the place to set the knobs, because we have no global government that's able to figure out what the right answer is. And I don't think obviously that scenario is likely to happen. But the fact is human-sized technology is gradually building us the tools to have that level of control over the climate. And not necessarily in 20 years, but in 100 years, I think it's very likely we'll have the power to determine the global climate.

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And the point is, we should start thinking about what that means now — what it means in moral and political terms — so we can build institutions

that are able to effectively manage this technology. We have seen time and time again with email and cell phones that human technology often moves quicker than our social systems can adapt.

But does that mean we should slow down technological progress? Maybe yes. In some cases, clearly yes. But in a case like this, I don't think you can say that, because we're actually putting CO₂ in the air. We need an emergency response strategy.

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...and they give us some magic tools for controlling the "We will grow into doing a kind of planetary management. I think we'll end up being in the gardening business with this planet." climate, including a box that has a knob for global temperature and a knob for CO₂ concentration...

I'd average the data, set the knob on the number found, see what happens?

Posted by [Debra Burcham](#) on 07 Jan 2009

My question is why haven't they started small tests. I know they have started testing dumping iron in the ocean, but what about the other methods. Why not do some small scale test? And what is the government waiting for to invest more in wind and solar power and algae for biodiesel? We have the technologies right now to not only stop CO₂ release but to lower it literally to the point where we can be below CO₂ levels that we had years ago.

Posted by [Arthritis Help](#) on 08 Jan 2009

Keith asserts climate change by itself will not wreck civilization. He suggests we should be much more concerned about large-scale war with chemical or biological weapons. If the portent of climate change is destruction of the natural world, then the ensuing environmental insecurity and resource scarcity will likely lead to wars that well might destroy civilization.

Posted by [Jan Konigsberg](#) on 14 Jan 2009

This is really troubling, in my opinion. The human race, for all our achievements, will never be as intelligent as the collective environment that surrounds and supports us. I applaud efforts to curb our impacts, but caution such drastic proactive measures, no matter how good their intentions may seem.

Consider this: If science finds a way to "reverse" problem(s) that are identified, will science (prior to implementation) truly know the full spectrum of repercussions? The answer is unequivocally, "no". Will we learn a terrible lesson from experiments gone wrong? The consequences are too great. Furthermore, this will likely encourage pollution because industry will be tricked into thinking we can have science balance things out at will.

Yes, humans are causing serious environmental damage... but the environment will heal over time if we allow it to. Let us curb our impact, as opposed to try and proceed as usual and simultaneously try and counter it with theoretical measures.

Posted by [Parker Jackson](#) on 10 Feb 2009

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