Can solar geoengineering save the world?

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The concept of solar geoengineering—blocking the sun's radiation to slow Earth's warming—is no longer just the realm of science fiction. In 2023, the U.S. government and the UN released reports on the topic. Whether or not solar geoengineering can save the world is up for debate, and Tony Harding, an assistant professor in the School of Public Policy,

is contributing to the conversation.

Harding is an alumnus of the School of Economics and returned to Georgia Tech after a postdoc at Harvard University. He studies the impact of innovative technology on climate change policy and governance, focusing on solar geoengineering. In the eight years he's been researching it, Harding said it's the scale of the conversation that's changed the most: not what the researchers are speaking about, but who they're speaking to.

"A lot of people in the climate policy and academic realms were hesitant to talk about solar geoengineering, and I think that's starting to change," Harding said. "There's definitely wider acceptance of at least talking about it, and in that way, pathways to having spaces to talk about it and research funds are opening up."

As the idea of solar geoengineering picks up steam, Harding invites everyone to join the conversation, starting with learning about what it is, how it works, and whether or not this once-niche proposition really can save the world.

What is solar geoengineering?

The most commonly proposed method of solar geoengineering, which also goes by names such as solar radiation modification or climate intervention, uses sulfate aerosols. When injected into the Earth's stratosphere, they reflect a small amount of the sun's radiation—less than 1%—and reduce Earth's surface temperature.

This option is the most popular, and the one Harding studies, because we have natural examples, he explained. Volcanoes release sulfates when they erupt, and the largest ones are strong enough to push them into the stratosphere.

"So we have evidence from the past that if sulfate aerosols make it up to the stratosphere, there's a cooling effect," he said. "This natural analog gives us a bit more belief that it's going to work at least in some of the ways we expect it to in the real world and not just on a computer."

The other two types of solar geoengineering researchers consider most seriously are marine cloud brightening to reflect incoming sunlight and Cirrus cloud thinning to let light escape more easily. Each one has pros and cons. For example, marine cloud brightening would only occur over the deepest and darkest parts of the ocean, Harding said, "which would have a non-uniform cooling effect and could lead to certain adverse outcomes."

Stratospheric aerosol injection has a more uniform distribution and cooling effect that better mimics the warming we're experiencing. However, it comes with its own concerns, one of which is that the cooling isn't permanent.

"If something happened to stop the deployment of the aerosols, whether it was for political or technological reasons, we would bounce right back and experience a rapid heating that we've never experienced before, and could have catastrophic impacts," Harding said.

What are the costs and benefits of solar geoengineering?

This question is where Harding's research makes the most impact. As an economist, he examines the costs and benefits of solar geoengineering to highlight the tradeoffs involved. Harding has published articles on how solar geoengineering could impact other climate change mitigation policies, how it affects income inequality, and the value of reducing uncertainty around solar geoengineering.

"Making it clear what the different tradeoffs are around climate policies is super important for informing decision-making," he said.

"On one side, we have these really, at their core, basic scientific questions around whether solar geoengineering will work and if it can scale up. But it's also an interesting question from a governance and economics perspective. Solar geoengineering has global repercussions; the decision will affect the entire world. How do we develop governance structures, conversations, and inclusivity to ensure we're making a choice for the collective good?"

For example, one of the downsides of using sulfate aerosols for solar geoengineering is negative health effects. But it also has the benefit of preventing temperature-related deaths. So, how do they compare? Harding's recently submitted paper, which is not yet peer-reviewed, finds that the benefits of reduced deaths outweigh the adverse health effects of solar geoengineering "by at least an order of magnitude—if not two orders of magnitude," he said.

Harding notes that a more comprehensive comparison of risks and benefits is still required, but in the context of the two health impacts he examined, "Yes, it's a concern, and something we should consider, but we need to put it in perspective that the benefits are significantly greater than that negative effect."

Why is solar geoengineering controversial?

Uncertain health outcomes? Check. What else makes solar geoengineering so controversial that some academics want to ban public funding, experiments, patents, deployment, and support for the technology in international institutions?

There is a running theme in climate conversations that discussing

adaptation policies reduces the focus on cutting emissions, Harding said, and the concerns around solar geoengineering are the same: not just that it will pull research funds from mitigation efforts, but that it will pull attention from dealing with the source of the warming as well. (His 2023 paper examines this problem.)

Although he disagrees, others believe that researching solar geoengineering also makes it more likely that we deploy it, Harding explained. So, for those against the technology, disrupting research efforts to prevent the idea from moving further makes sense.

What's next?

As with any unfamiliar and emerging technology, questions arise, such as, will this go horribly wrong and destroy the planet? Or, will it be the solution to all of our problems?

"Putting my realistic hat on, it's probably somewhere in between," Harding said. "It's always hard to predict the future, but I can propose what I think is a realistic hope for where it can go."

Harding anticipates more research and is hopeful for continued discourse between academics and the public.

"The first and most important thing to do is make people aware of this technology and educate them about it," Harding said. "We have to understand how general people, outside of policymakers, feel about it—because that matters a lot."

He also wants to see more serious international policy discussions around governing solar geoengineering to prevent a situation where one person or country deploys it independently. Whether it's a moratorium on its use or another agreement, international guidelines would help legitimize

research without fears of a rogue actor, he explained.

Final takeaway

To package it all up into a neat little tagline, "Solar geoengineering is a really new technology that could alleviate a lot of suffering in the case of climate change. But there's a lot of uncertainty, and it needs a lot more attention to quell any concerns about catastrophe," Harding said.

"The most salient concern is that we put a lot of faith in solar geoengineering, invest a lot of resources, and slow down emissions cuts because we think we have a silver bullet. And then we get to 2080 and realize it doesn't work as expected. That's a very real concern."

"But the one that receives less attention is if we put solar geoengineering aside and don't spend the resources investigating it. Then we get to 2080 and realize, 'Wow, this technology could have worked and relieved a lot of suffering.' I think it's important to understand the flip side of that."

Provided by Georgia Institute of Technology

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