Hello everyone, and welcome to the inaugural seminar of the Yale Global Initiative on Climate Change and Public Health Ethics, as a part of the Yale Center for Climate Change and Health.

My name is Laura Bothwell, and I'm delighted to welcome you to this seminar, which is also the first in a series of three virtual, or hybrid noontime seminars this term on various topics related to climate change and public health ethics.

As you've seen this seminar is being recorded and we'll have about 15 minutes starting at 12:45 for questions and answers.

It is such a privilege to introduce Stephen Latham, director of the Yale Interdisciplinary Center for Bioethics.

Dr. Latham has a JD and a PhD. He's a fellow of the Hasting Center and teaches bioethics.

He chairs the Human Subjects Committee at Yale.

Co-chairs the Embryonic Stem Cell Research Oversight Committee.
and does clinical ethics consultation at the Yale New Haven Hospital. He is a former board member and secretary of the American Society for Bioethics and Humanities from which he received a distinguished service award in 2010.

And today we are so lucky to hear from him speaking about geoengineering for climate crisis mitigation, accountability, transparency, and democracy.

It is a more grand title than I would like actually and I’m not sure how much I’m gonna get to talk about democracy, but I certainly will be talking about accountability.

So the topic is geoengineering and there has been in the environmental community a long tradition of opposition to the very idea of engaging in geoengineering as a response to climate change for reasons that I’ll be addressing later.

But I think there is increasingly an awareness that our international efforts to address climate change are pretty feeble and that we are very likely to overshoot...
the one and a half degree temperature goal that was set in Paris. And many voices are saying that no matter how quickly we manage to adjust the way we produce energy and the way we emit greenhouse gases, it won’t be enough to avoid really catastrophic side effects of climate change and that we will need to do some form of geoengineering to get ourselves into a tolerable situation. So let me now talk about a couple of kinds of things that fall under the name of geoengineering. The one that we’ve all heard about is, of course, planting, reforestation and afforestation, the planting of different kinds of crops that will absorb carbon and so on.
where there are other already well established methods of removing carbon from the air, things like biochar, or bioenergy energy use with carbon capture and storage, Becks, which involves burning biomass in a controlled way and capturing the carbon from that burning and then storing that. We have plans to increase the amount of carbon that can be sequestered in soils. We have this idea of sinking biomass so deep in the ocean that it will not be able to degrade there, things like growing lots and lots of kelp and then hauling it out to sea and waiting it down, so it sinks to the bottom of the sea and in theory will not release its carbon for many centuries. We have the idea of enhanced weathering, particularly at the seashore that will, where the action of the sea on certain kinds of rocks will capture carbon. The idea of fertilizing the ocean with bits of iron to increase algal growth, which will capture carbon as well and then sink.
Oh, and the idea of restoration of our coastal wetlands, which are actually really excellent carbon sinks of themselves.

There's quite a wide range of carbon capture techniques and then of course, we have this new-ish idea of direct air carbon capture in factories that withdraw carbon from the air using chemistry of different kinds, there's several different kinds out there now. And then sequester that carbon possibly underground, possibly with other methods.

These things are not terribly controversial, most of them, I think there are some issue with the idea of dropping biomass into the sea because there are questions about where it might wash up and how effective it might be.

There are several problems with these things, most of them are not terribly scalable, most of them are pretty expensive for the amount of carbon that they'll actually succeed in sequestering, but many of them would be susceptible to pretty much local governance, much of their environmental impact for most of these methods would be local.

The business of fertilizing the sea
raises some issues about accountability and international accountability. But I think the biggest, one of the biggest problems in this area is with monitoring and reporting and verification because there are a lot of controversies about the way in which, for example, carbon sequestration in plants is being counted, whether reforestation, for example, is really new reforestation that will capture carbon that wasn’t going to be captured by forests that were gonna be planted anyway. And there are questions about competing values for land use associated with some of these methods, but these are as a group far less controversial than the solar radiation management varieties of geoengineering because mostly what they’re doing is simply trying to remove carbon from the air and the likelihood of having any kind of unexpected disproportionate impact anywhere in the world from these methods is pretty low. Again, the ones that involve the ocean are probably the most controversial of them, but most of these do not pose many difficult governance kinds of issues.
We need better monitoring, reporting and verification. And we need probably some rules about how carbon is going to be sequestered, especially if carbon is not sequestered in the same location where it’s being drawn out of the air. And most of these methods also should involve some kind of involvement of the public in the location where these carbon reduction methods are going to be used. So for example, if you’re gonna do enhanced weathering on a shore line by depositing minerals there that will capture carbon with wave action, you’ll wanna talk to the people who use that shoreline and you’ll want to engage in some kind of public discussion and get the permission from the relevant public authorities. Same thing with carbon sequestration underground in the salt, there’s a proposal now to sequester carbon in bottom of fracking mines, those kinds of things should involve local permission and local governance. There are a few kinds of codes of professional responsibility.
that have been put out there, completely non-binding, just put out by different groups, in one case by single author, there are the Oxford principles, there’s the (mumbles) principles for research in climate engineering techniques. And there’s a single author code of conduct for responsible geoengineering research and the last two of those are very explicit of calling for public participation. So to the extent that researchers in geoengineering voluntarily choose to follow some of these available codes of research conduct, we will see some public participation and some openness and accountability. All of these principles call for periodic reporting of results and transparency in terms of how well the techniques are working, but there is very little explicitly binding law that deals with any of these methods, in all likelihood, the Framework Convention on Climate Change will be able to come up with some monitoring mechanisms,
they are explicitly mentioned in that framework.

And there’s also explicit mention of the need to govern sequestration locations.

So there is some promise of some kind of governance in this area, but again, in general, the is not where the controversy lies.

The controversy really lies with solar radiation management.

There are a couple of major types of solar radiation management.

I’ll say a little bit about each of them.

First, there is marine cloud brightening.

This involves injecting salt possibly from ocean water into the clouds above the sea and brightening them up so that they have greater albedo and will be more reflective.

This looks like it would be pretty inexpensive to do, it would involve a fleet of ships to have an effect at the global level, we would have to have a fleet of many ships spraying salt into the sky above the oceans. That fleet would have to be mobile because the impact of the sun changes as the seasons change and so on, would wanna position the reflective clouds in places that would have optimal effect on global temperature.
It seems to be possibly effective and possibly rather cheap.

And especially if the material used is salt water, there don’t seem to be that many immediate polluting side effects.

Marine cloud brightening also has a great deal of promise as a method of local protection from the sun. So for example, Australia is paying for some research in this area because they believe that they could do marine cloud brightening over the barrier reef to prevent, to lower temperature and the amount of sun striking and prevent bleaching of the coral.

There’s also some possibility that at marine cloud bleaching could be used in the Arctic to prevent certain kinds of runoff and so on. So there’s real possibility of marine cloud bleaching being used all around the world and having an effect on global temperature. I’m gonna talk a little bit about downstream effects of that in a moment, but let me first say a little bit about stratospheric aerosol injection.

Stratospheric aerosol injection involves putting reflective particle of one kind of substance or another, often sulfur related substances,
injecting those into the stratosphere, which is stable compared to the lower parts of the atmosphere. Those particles would remain there for roughly three years and would reflect the sun’s rays back into outer space. It looks like it would be very inexpensive to do, the total numbers are in 25 to 50 billion dollars to have planetary, wide, global temperature reduction of all of the temperature that has risen because of greenhouse gases. The theory is that you could begin to see global temperatures fall even within one year of doing this aerosol spraying. And that the temperatures could be brought down to sort of pre-climate change level in a matter of a couple of years, but then of course the spraying would have to be maintained to keep the temperature level steady. So it has the promise of being stunningly effective and relatively inexpensive, but it has a lot of scientific kind of safety issues. First, many of the particles that are being thought of as candidate particles
for aerosol injection might have the tendency to deplete our ozone layer.

Some estimates say that, for example, the closing of the ozone hole would be delayed by about 40 years by the use of this tactic.

In addition to that, some of the particles when they fall to earth after that three year initial period might be pollutants. Sulfur is not particularly a problem ‘cause there’s a great deal of that in the atmosphere anyway, but some of the other particles might just cause ordinary particle fallout pollution.

Another big worry, and this is a worry both for cloud brightening and for aerosol injection, is this idea of termination shock because neither of these things does anything about the ongoing accumulation of CO2 and other greenhouse gases. When they’re stopped, if they were stopped suddenly, there would be a big rebound effect and the temperature of the earth is predicted to climb incredibly rapidly if that intervention is stopped all at once.

So it would be absolutely necessary to have in place
some kind of international agreement about how and when and how gradually to stop the intervention in order to avoid this termination shock. There have been models that have looked at this and said it’s not gonna be very hard to do, but it does require international cooperation. Another big problem with both the solar management techniques is that they’re both better at controlling temperature than they are at controlling water circulation through the air and in the soils so that the predictions and these are better modeled with the stratospheric aerosol injection. Its prediction is that if we reach an optimal temperature, we will reduce total amounts of rainfall and this reduction is not gonna be uniform across the planet. It would particularly affect monsoon in areas that have monsoon seasons. In other areas it looks like soil moisture, which is what you care about for agriculture would not be that badly affected, even if rainfall reduces, the temperature reduction would make up for the smaller amount of rainfall, but the point is that there would be global winners
and losers in terms of potential for interference with agriculture, potential for drought, potential for reduction of the amount of monsoon rains, potential for reduction of the amount of snow pack in some parts of the world. There would be other effects too, the sky would no longer be blue, the sky would be a kind of diffuse white light. This would have effect on agriculture, it would slow down agricultural growth. On the other hand, advocates for this think that having the increased CO2 would speed up some kinds of agricultural growth. So the effects are upped to be mixed. So this is extremely controversial, the threat of ozone depletion, the threat of termination shock, and particularly the fact that there would be international winners and losers from solar management, makes it quite controversial. The fact also that it seems like it would be incredibly effective at temperature control and that it’s not expensive,
raises other really important kinds of governance issues.

So to make an obvious point,

a single country could do this and affect the entire temperature of the world.

There have been many, many different kinds of scenarios run,

and there’s a big growing literature on governance

of this kind of geoengineering

in which people trot out all kinds of scenarios

of single countries,

or all coalition of countries,

or a widespread diverse group of climate change activists

might actually just do this

without any kind of formal permission

from the rest of the world,

or from the countries that are gonna be most affected by it.

And this poses all kinds of threats to the international order.

Even if we could come up with international governance mechanisms that would control

and manage the use of stratospheric aerosol injection, for example, even if we could do that,

there would be serious political issues.
because different countries are gonna have different views of what optimal temperatures are.

For example, there have been some winners in terms of agriculture in particular from the global warming that we’ve experienced so far.

The growing season has increased in parts of the global north, for example.

And it may be that less of a temperature reduction would be appealing to those countries that have been winners from the climate change we’ve so far experienced.

So there is this risk of a single state actor changing the entire globe, or of small groups of states doing it, or of even of independent actors doing it.

And we have a small story already about this risk of accountability for action in this area in terms of research in the area.

Bill Gates has been funding a study at Harvard, which is a trial of aerosol injection, not of sulfur, but of calcium carbonate.

He had a plan with this Harvard group in the southwest of the United States, to who loft some balloons.
which would spray a small amount of calcium carbonate to the stratosphere enough to cover what’s been described as about 11 football fields. And to then send up instruments to measure the effect of the reflection, the gains to albedo and so on, just to do a kind of trial run of stratospheric aerosol injection, but pandemic related considerations moved this group to decide that they weren’t gonna do the experiment in the southwest of the United States after all and they just kind of up and moved their location to Sweden, they decided they were gonna launch their balloon in Sweden and they didn’t ask anyone in Sweden. They didn’t get permission from any local authorities at all and the indigenous peoples of the Northern part of Sweden, they’re an indigenous group that inhabit the whole polar region, Sweden and Finland and Russia. They heard about this test site movement and even though the first test was just going to be to fly the balloon and test the aerosol injection mechanism
and it wasn’t actually gonna spread any material into the sky,

the Sami objected and wrote a letter to the research group at Harvard and their advisory board and said, "You can’t do this, you can’t alter the skies above us."

They had a wide range of objections to this. At the baseline, their fundamental objection was with the idea of tinkering with nature at all.

Their view is that nature is there to be adapted to and that we should not try to manage the atmosphere, or the globe, but they also cited a number of other arguments, especially moral hazard that I’ll be talking about.

And they were joined by some environmental groups from Sweden.

The Sami people were affected by fallout from Chernobyl, which actually killed a lot of the deer. That their whole lifestyle is sort of centered on the herding and management of these Arctic deer herds.

Chernobyl killed a bunch of the deer and even today they have to screen deer meat for radiation.
before they can eat it.
So they have a history of being affected by interventions from other countries and they have been very active in terms of trying to reduce climate change, they lobbied Norway to stop investing in fossil fuels, they sent a group to Standing Rock to protest the Dakota access pipeline. So they have been very active in this area and their activity basically shut down the Harvard Gates project, the advisory board got the letter and said, "These objections are serious. They’re posing a real political problem for us and so we’re not going to do this study yet.” And the study is still on hold. Gates also, by the way, is funding direct air carbon capture and he has been funding a seawater project, which is designed to do a cloud brightening. So he is very much a person who has a great deal of resources and he is very much in favor of these technical geoengineering solutions to the climate change problem and here we have an example of him acting with private researchers to do research in this area, in the sky over Sweden,
without any governance at all, without any political consultation at all, let alone permission or input from the local people. So this is just one lesson about the possibility of abuse of these kinds of techniques. The biggest objection that most people have to geoengineering is the moral hazard objection. Basically they say, "If we can geo engineer, then we will be less motivated to actually reduce our carbon emissions." People will say to themselves, "Look, we can prevent these dramatic results from temperature change and that means we don’t have to worry as much, or we don’t have to act as quickly to reduce carbon, lots of problems with that as an outcome, for example, the CO2 would just continue to build up, ocean acidification would continue and so on, but it’s more than just a kind of an abstract worry that people will feel less motivated, particularly here in the United States, there is a worry that the same forces that have been funding climate change disinformation and have been slowing us down
in terms of changing the way that we produce electricity,

might turn and suddenly start funding research in this solar management.

And might actually, following the lead of Bill Gates, start touting the benefits of geoengineering as a way to preserve our existing underlying greenhouse gas producing economy.

So there’s a great deal of worry about this moral hazard and it’s probably the biggest single objection to the use of geoengineering.

Just last week on the 17th, there was a global group of about 60 climate scientists and some governance scholars who have called for a moratorium and an international non-use agreement on solar radiation management and other geoengineering.

And so there is very strong sentiment to try to stay away from these methods. We do have a little bit of existing international governance and the Convention on Biodiversity is not a party and it’s non-binding.
but the Convention on Biodiversity does mention that we should not be using geoengineering methods that would affect biodiversity on the planet. We have a convention on ozone, which would be implicated if it turns out that solar management would start to deplete the ozone layer. And we have the UN Framework Convention on Climate Change which doesn’t directly address this, but which could be mobilized to put some governance in place. I recommend to you the Carnegie Climate Governance Initiative which is basically trying to foment discussions of governance of geoengineering at all levels, at local levels, in national government and internationally. There’s also been some international movement toward thinking about international government of geoengineering. So for example, the Paris Peace Forum is creating a global commission on governance risks from climate overshoot that is gonna be put together in the coming year.
and it’s gonna have a lot of global leaders in it,
it’s gonna be headed by the former head of the World Trade Organization, I believe.
The UN General Assembly is actually going to talk about governance of international geoengineering in upcoming meetings.
And there has been a resolution that Switzerland intends to reintroduce, it introduced it years ago,
but it’s going to try again to introduce this resolution on governance to the UN Environment Assembly.
So there is a growing recognition of the need for governance in this area.
The most important need is research because none of these methods that I’ve described has been adequately researched at all.
For example, the spray tools that would put the salt from ocean water into the clouds have not yet been developed.
There’s been plenty of modeling, but there’s been no kind of in the air studies of any kinds.
stratospheric aerosol injection.
The Gates thing would’ve been the first real trial. And it does seem as though, unless we are so worried about the possibility of moral hazard, or about some of the scientific risks of doing these, unless we worried about this that we want entirely to rule out stratospheric aerosol injection, we ought to be doing research on it because it has potential to inexpensively buy us time in terms of lowering the globe’s temperature. And right now it is really not researched at all, there is some worry that rogue states, or single powerful states could simply start trying to do it on the basis of inadequate research and that would be a big problem. So there really does need to be some kind of regulation of research methods and some kind of international agreement about how and when the research should be done, unless we wanna make the move to simply say we’re not going ever to do this
no matter how much we overshoot the Paris climate goal.

In the research context in particular, though, it’s gonna be really important to have local and public participation. We need complete transparency because at the research phase this is gonna just be done, it’s not gonna be done at a level where it’ll start to affect global temperature, or global rainfall, but it will be done in particular areas over particular populations and it might have local effects on agriculture. It might have local short term effects on water supply and rainfall, air exchange generally.

So it seems as if, even to find out more about the real risks of this kind of climate intervention, we need to put in place international rules that we really don’t have right now. So I’ve ended earlier than I thought I would, that’s really all I have to say on this subject and I am happy then to open things up for discussion and hear what your questions might be, or what your comments might be. And we also, I know that we already have some questions that were sent in
by people at the time that they signed up for this,
so I’m happy to entertain those.
And I think the way we’re gonna do them
is we’re gonna have you put your questions in
the chat
and Laura will address them to me, is that
the plan, Laura?
Laura, without telling her,
which is, since we’re a small enough group,
I think what you could do is put in the chat
the fact that you have a question
and then Laura can call on people
and you can unmute yourself and just ask
your question live.
But Laura has some questions
that were submitted written as well.
That’s great, thank you so much,
Steve,
for raising so many really challenging points
that are difficult to address,
but you’ve really opened an excellent terrain and
identified a number of the scenarios
in which these questions will be considered in
the future.
So I’d like to turn to Dr. Dubrow for the first
question.
Okay, thanks.
Hi Rob.
Thanks, it was refreshing to have the seminar
without slides, actually (chuckles), that was courageous.

I see the moral hazard question has been huge and my direct question to you is whether the fossil fuel industry has been pushing soil management in any ways as a quote, solution? Not yet that I know of, there is speculation in print that it would happen, but I'm not yet aware of that. The only person I know of who's really been funding it has been Bill Gates and Bill Gates has come in for a lot of criticism. He’s funded this direct air capture project that’s happening in Canada, where they’re actually already sucking a small amount of carbon outta the air and that’s great, but he is really in favor of technical solutions and is not that interested in addressing some of the underlying problems of the way we sort of do business on the planet. And in fact, as Bill McKibben reviewed the Bill Gates climate change book, I think in the Times, but anyway, Bill’s review basically pointed out that Microsoft donated tons of money
to politicians who are climate change deniers.
So Gates seems to be one person
who’s pushing these technocratic solutions
without really wanting to address underlying
kind of political realities
about how we’ve gotten into the situation.
I have not heard of any funding from fossil
carbon or the Koch brothers or whatever it might be
of these interventions,
but there is worry in print in multiple articles
that might be the turn they take
if they lose on preventing action on climate
change,
they might pivot to say, "Here’s what we do.
Let’s just lower the temperature,
we could do it in a year, it’s cheap."
Thank you, the next question is from
Bruce Jennings,
and Bruce will be speaking in the seminar series as well.
Thank you very much, Steve, for a very informative
and clear presentation for sure.
I want to
specifically sort of raise a question about
the aspect that has been discussed and that
you mentioned
concerning public participation and deliberation
in various approvals of various
experimental trials,
or even in climate governance more generally
because it does interest me in general what we say about participation. But before I turn to that one, I just wanted to also note, I think one of the most moral hazard thing is very important, but another thing that’s very important sort of at the level of culture and framing has to do with this sort of eco modernism Gates type of approach, versus what I would think would be closer to the approach that, the name of this indigenous people, Sami? <v Stephen>Sami.</v> <v Bruce>S-A-M-I, yeah.</v> their position, which might be called a sort of eco accommodationist, or adaptationist position if you want to. Anyway, that debate, I think is very important, will the same kind of thinking that got us into this problem in the first place, namely an emphasis on the fact that human beings can do everything that we decide to do. And that does seem to me to be a bit of a paradox
worth noting.

On the participation side, I guess, I just think, or I ask you about some analogies such as the genetic modification of species of mosquito using gene drives, which would lessen the zonanic transmission of some terrible diseases like Zika and others.

And the controversy on Florida case that concerned a similar kind of effort to essentially a bioengineer mosquito populations for the sake of human health.

The participation experience there was very far from the ideals of deliberative democracy, transparency, inclusion,

so I just sort of look at things like that and I see kind of a problematic track record when it comes to public deliberative democracy.

The participation, visa vi biotechnology.

I'm not sure why we should be any more optimistic along those lines when it comes to geo technology.

<Yeah,>

I'm proud to say that my bioethics center here funded the early days of Natalie Kofler’s project.
Editing Nature, which is now moved to a different university, but she's very concerned with trying to promote more public participation and more transparency around the bioengineering that you're talking about. She's concerned with, there's genetic modification of mosquitoes, but there's also genetic modification of plant life, for example, that might spread. Her whole project is to improve kind of public input and public permission for some of these experiments. But I will say, the reason that she's busy is these things have, the efforts of public participation have not been particularly strong. And I kind of share your pessimism, I mean, I think it is really important as a principle for us to consult with people who are gonna be affected by our research. It's the same kind of thing that we talk about when we talk about research on human subjects in a new population or whatever, but there is kind of a NIMBY problem. You could come up with kind of intervention...
that everybody wants for the globe, but nobody wants to have done on their soil. So public consultation could turn out to be a real block to methods that actually could help us with climate change. And also the public participation if it’s being run by the people who are doing the experiments, is apt to be kind of flimsy and lane on the flip side. So I think you put your finger on a really serious problem. And it’s also, once we think about actually implementing any of these things, these are gonna be global changes brought about and there’s no way to have a full public participation, except if the whole thing is managed by some sort of United Nations international body, in which case there would be some kind of representation involved. As to your first point, I think of it as kind of the Heidegger objection, Heidegger’s essay on technology is all about this idea that we have gotten to where we are by thinking of everything in the whole world as a resource to split open and take the energy out of and...
he is very skeptical in that essay about the idea that all of the kinds of social and other problems this technological attitude have engendered can be technique out of. So it's just another way to put your point that we should be skeptical that we can use the same methods to get out of this climate change problem that got us into it in the first place. I also think that there's something powerful to the notion that we just shouldn't, that it's hubris, not as a matter of actual risk, but just that we shouldn't be engaged in trying to manage the globe, but against that people say, "Well, there's no part of the globe that we haven't already adulterated one way or another. There is no pristine part of the planet, there's no nature that isn't affected by us already." And so maybe geoengineering is not so different from what we've already done by accident. Thank you, Bruce. Thank you, Bruce and Steve.
and I'd just like to ask you very briefly on that point,
in biomedicine we have a very long history of hubris leading to subsequent experimentation proving that there are unpredicted adverse events that lead to outcomes that could not have been predicted. And when this is all experimental, I'm wondering if you'd like to speak to that dimension of the ethics as well.

Well, I think hubris is actually used in the letter from the Sami people. I wanna say that there are two ways of thinking about what hubris is, one is that it’s just a species of overconfidence, that it’s just like, we’re sure we can wade into this problem and solve it. And then we learn time and time again that when we do that we get smacked with unanticipated consequences. And so there that when you say that there’s hubris, what you're saying is we will bring about unanticipated consequences, but there’s another way to think about hubris, which is maybe a
deeper, which is it’s just inappropriate for us to take that role on, even if we could do it beautifully, it’s just wrong for human beings to try to load it over all creation.

So and both those kinds of objections are out there and talked about quite a bit in the literature on geoengineering.

Thank you so much.

Thank you very much.

So my question is, should we be any more optimistic about relying on governmental organizations to change policy that’s going to lead to reduction of fossil fuel consumption, that’s going to lead to temperature reduction?

I think your question about hubris is really a question about trusting scientific method and realizing that science is not without consequences.

And we do our best to analyze the pros and cons of anything before we take it on. But I fear that we are approaching a true existential crisis where we’re going to reach irreversible damage to the planet, significant human health impacts.
from the rapidly progressive climate change. And if we don’t do some sort of mitigation in terms of not just how it impacts us, but reducing the rapid increase spread that we have caused, that we’re going to reach an unsustainable future. And I think your point about the sort of UN type body is a good one because I wish there was a global governing organization that had respect and really credibility throughout the world that could take the lead on this, but I’m not sure that there is. So my question is sort of can we afford to ignore that because my optimism is much lower than that we’re gonna have an governmental solution or an innovative solution? Yeah, I don’t expect it to be govern, governments that are developing and making these things. I do expect governments who are very concerned about climate change to make pots of money available to private researchers to do these kinds of things. But that’s separable from the question of how it should be overseen.
I mean, I do expect it to be independent scientific innovators who come up with the best methods for doing this kind of stuff. And I also share your pessimism, I think we’re close to an existential crisis. And one thing that’s happened in the literature is 10 years ago, if you talked about geoengineering at all, everybody jumped down your throat and said, "No, we can never do that, that’s the wrong solution." What we need to do is change the way we produce energy, change the way we construct our buildings, we need to reduce emissions.” And we’re now at a time when we’ve so failed to do that, even if we keep our Paris promises, which there’s no sign of being able to do, even if we keep those commitments that were made in the Paris agreement, we’re headed toward overshooting the temperature goal. So now talk about geoengineering is becoming more and more common and there are people calling out for it at the same time as there are still a bunch of voices saying we shouldn’t touch it,
particularly the solar management side of it.
So that’s a long answer, but I share your pessimism,
which is why own position
is that we should move very quickly
to develop governance in the United States
and internationally
for the research
so that we can figure out if these things can help us
if we reach a really big crisis in the next decade.
Our next question is to Kyle Ferguson.

Hi, Steve.
Thanks so much for the talk.
So my question’s about the moral hazard argument
when it’s used as an objection to conducting research
on any of these strategies.
I’m wondering if you think that argument,
the moral hazard argument changes shape
when it’s directed at field trials
as opposed to the sort of computer modeling research
that has been taking place for a long time,
Well, I'm not sure that it is stronger, or weaker as an argument, I think the people who are very concerned with moral hazard probably wish that the modeling had been going on. There's one sense in which it might be stronger though, which is that a field trial might show that this would work, it might definitively show, hey, look, this reflects a lot and it stays up there for the amount of time that we thought it would and if we use this material, we're not seeing any ozone depletion. The right kind of field trial might show that this is seriously available as a tool. And just showing that might be enough to, for example, cause the fossil fuel industry to run out and pour a whole bunch of funding into it and start us down this path. So there's a sense in which a field trial, the moral hazard argument is more urgently directed at field trials for that reason. Thank you. I'd like to give the final question to Sappho Gilbert. Hi, it was more a comment than a question, sorry.
I just wanted to say thanks to Steve for a great talk and just make mention of the opaqueness and undemocratic nature of the status quo in representation.

But yeah, looking forward to a brighter future perhaps.

A wider sky.

Thank you, Steve, for a really riveting conversation. This has been fascinating and please do note in the chat that Laura’s gonna give a talk in this series and Bruce Jennings is gonna give a talk in this series. So please join us again.