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[00:00:00] **Ted Parson:** Cutting emissions to zero doesn't bring the climate back to where it was. It just stops it from getting even more perturbed. We still need to do mitigation, and if we think about geo engineering, we need to think about ways of making these complimentary and doing them both. A lot of people think this is so profoundly corrupt and wrongheaded that nobody should be thinking about it, but the reason we're thinking about it in part is that up there you can get the climate cooling effect at a much smaller, but not zero risk or harm.

[00:00:37] **Nate Hagens:** Today I am joined by Environmental Law Professor Ted Parson to discuss the uncomfortable possibilities of geoengineering and the geopolitical implications of its research development and potential use in the biosphere. Ted Parson is the Dan and Ray Emmett professor of environmental law, as well as the faculty director of the Emmett Institute on Climate Change and the environment at the University of California Los Angeles, A-K-A-U-C-L-A.

[00:01:09] Ted has spent decades studying international environmental law and policy, as well as the societal impacts and governance of disruptive technologies, including geoengineering, artificial intelligence, and the political economy of regulations. This episode, is a foundational overview of solar geoengineering, including what might drive us to use it, what the climactic risks and benefits might be, and what the potential geopolitical disruptions could occur if a rogue nation or entity were to preemptively use solar geoengineering.

[00:01:46] And Ted provides much needed nuance and balance, to this conversation, which is often fraught with various moral panics. I am agnostic on this issue, but I think over time it will become increasingly obvious that, we're

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leaving the stability of the Anthropocene and humans being humans will probably react in some way that Ted plausibly describes.

[00:02:14] Before we begin, if you are enjoying this podcast, I invite you to subscribe to our substack newsletter where you can read more about the human predicament and where my team and I are increasingly going to share more written content about The Great Simplification. You can find the link to subscribe in the show description.

[00:02:32] With that, please welcome Professor Ted Parson. Ted Parson, welcome Nate. Thank you so much for having me. It's a pleasure to be here. So it was kind of fortuitous. We met, at a, dinner with a mutual friend, a month or so back. We are about to have an in-depth dive on the topic of geoengineering. I will say upfront, I am super skeptical of, and I don't know a lot about it, but I'm super skeptical of humans solving mega problems that then create, further problems in the future.

[00:03:04] But you and others have convinced me you're a world authority on this topic, and I want to understand it. I want to learn about it. Before we get to geoengineering, maybe you could give us an overview of why we even need to discuss geoengineering. What's the state of climate human response to it, et cetera, that will require potentially a geoengineering

[00:03:27] **Ted Parson:** response.

[00:03:28] Well thank you. And it's a great opening and it's a completely appropriate set of concerns and a question to start with. 'cause I actually don't know anybody who's enthusiastic about geoengineering or even much anybody who came to consideration of it, sort of happily or voluntarily. We're in very deep trouble on climate change and we've come to a stage where the severity of the crisis or the looming catastrophes is visible to some people, but not to all,

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because overall it moves slowly and the bad things happen in a Apache way, patchy over space and time.

[00:04:05] So, there's plenty of people and plenty of places in the world for whom climate change is a catastrophe already 'cause of what they've experienced from impacts. So we've been talking and arguing and trying to make progress on climate change for more than 30 years, and there is real progress. There's a lot of difficulty.

[00:04:24] The earth is heated, one and a half degrees from pre-industrial temperatures, and it continues to heat, get hotter. Current projections from authoritative scientific and international bodies are that in contrast to the political targets to hold global average heating well below two degrees and as close as possible to one and a half.

[00:04:44] We are more likely on a trajectory that is headed to at least two, possibly two and a half, possibly even more by the end of the century. And although there's a lot of uncertainties about the particularities, it's really not an exaggeration to say that would be catastrophic. The first response to dealing with climate change is to cut the cause, is to cut the emissions from human activities that are driving it.

[00:05:08] And on this, there's a kind of a good news, bad news story. It's like belatedly. There has been a ton of progress. More than 2% of world economic output is now going to investment in clean energy. That's astonishing. It's double the amount of investment that's going into fossil fuels, and it suggests that we're really on the point of bending the curve on emissions.

[00:05:30] But emissions have to go way down and they have to go way down fast and. You don't move the world energy system and all the technology and capital, let alone the political powers and institutions and capacities and interests.

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On, on, on which they all rely. You don't steer that on a dime. You don't turn it on a dime.

[00:05:50] And relative to world emissions of greenhouse gases, it's happening too late to avoid the severe climate impacts that we're facing and experiencing right now. With more to come in the near term, nobody knows the details of what, where and how much, but quite likely to be quite severe. I mean, I find myself often just sort of feeling like I'm gambling, rolling the dice.

[00:06:14] It's like I wake up in the morning, okay, what bad news is going to come in today? Floods in Pakistan. Heat waves in India are this very, severe impact with very serious consequences for people's livelihoods, homes, communities, and lives all over. Despite

[00:06:32] **Nate Hagens:** the progress getting to the potential need for geoengineering, can you just paint for us a short, brief overview picture of what would a two and a half degrees Celsius above pre-industrial times look like for the United States and the world?

[00:06:47] Just, sketch, what that might

[00:06:50] **Ted Parson:** look like. Nobody can claim to do so with confidence or in details, but if you look around at the, precipitation extremes, floods and droughts that are already happening now at one and a half, and if you consider the fact that with lags in the system, we're not yet living even with the entire consequences of one and a half, two is going to be worse.

[00:07:13] Every 10th of a degree is worse, and each one is an additional amount worse than the previous one. Kinda like

[00:07:20] **Nate Hagens:** the Richter scale on,

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[00:07:22] **Ted Parson:** earthquakes. Oh yeah, Yes, actually, right? It's like each number is actually a bigger increment. nicely put. We don't know in detail, but really bad. Probably loss of major eye sheets and so significant level rise.

[00:07:36] probably continued intensification of extremes and variability and precipitation. for a long time people had a hard time getting their heads around that. What, is it gonna get wet or is it gonna get dryer? Well, yes, both and often in the wrong place and at the wrong time. We're also coming more and more to understand clearly the direct human health impacts of heat extremes.

[00:07:59] It's relatively recent research and data, recent, meaning 10 years or so, about just how severe it is for people to be exposed to extended heat waves, how extreme and effect it has on, acute health, on morbidity and sort of long-term chronic health issues on productivity and economic output. We don't know how bad, and we don't know in what particulars, but as the details emerge from the fog, they're all bad and they're all worse.

[00:08:28] So we have to cut emissions. We have to scale up the removal of old emissions from the atmosphere, and that's called carbon dioxide removal or greenhouse gas removal or negative emissions. That's a way to an additional tool in the tool pet belt to increase the capability of limiting risks.

[00:08:47] We are already and are gonna have to do a great deal more to adapt and it is quite likely that all of those together, even with big intensification of efforts from what we're doing at a lot of success, will not be sufficient to bring near term climate risks to acceptable levels. And that's why I and many others are increasingly coming reluctantly to the view that we have to talk about.

[00:09:12] Think about research, geoengineering and I should say solar geoengineering. 'cause. People get confused and argue over the names. It used to be that people thought of large scale removal of CO₂ and other greenhouse

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gases from the atmosphere as being geoengineering. Generally speaking, they don't call it that anymore.

[00:09:33] So geoengineering more and more means active interventions in the climate system to change the energy balance between the earth and the sun. I like to think of it by referring back to those beautiful earth photographs from the Apollo missions in the late 1960s. Remember the beautiful shining blue globe?

[00:09:51] Well, it shines because the earth reflects rather a lot of the incoming sunlight in the in invisible wavelengths. So what these interventions would do would be slightly increase the reflectivity of the earth, make it a little bit brighter or more reflective. So a little bit less of the incoming solar energy is absorbed in the surface and the lower atmosphere.

[00:10:12] **Nate Hagens:** So over the years I've read of multiple schemes and ideas that might accomplish what you just said, like painting everyone's roofs white or chopping down the forest and kamchatka to have the snow reflect and then the trees grow back. But. When we first spoke, you said that almost all of these schemes either don't scale or they're too expensive, or there's, tail risks except for solar, sulfur emission spraying, et cetera.

[00:10:43] So what are some other things and why have you concluded that there's really only one best shot?

[00:10:49] **Ted Parson:** So it's a little too stark to say that all the other approaches we know they won't work or they won't scale, or they have side effects, is that there, there are probably a dozen or a dozen and a half different ideas.

[00:11:00] All of them have different, constraints and limits and different advantages. So you can think of, the general. Ambition to make the earth a little

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shinier, a little more reflective as going from the earth up into space. So yeah, if you paint your roof white, it makes the earth a little more reflective.

[00:11:19] It reflects a little sunlight. That's actually a really effective intervention that people think of as part as climate change adaptation. 'cause generally speaking, in big cities, it gets even hotter than it gets nearby. So by the way, if

[00:11:35] **Nate Hagens:** we were to paint our city white, you know, Seattle or Los Angeles and all the roofs there and it's not a global thing, would it actually help,

[00:11:47] **Ted Parson:** the local environment?

[00:11:48] Yeah. if the local environment. So it's funny you said Seattle and Los Angeles and those are very different climates, but let's think of it, Los Angeles, or let's think about places that suffer from heat extremes. In the middle of the city, it's much, much hotter than it is outside in the countryside nearby.

[00:12:05] And that's mainly a consequence of local absorbance of sunlight because the built surfaces are dark.

[00:12:11] **Nate Hagens:** Well, and all these brick buildings, at the end of the day, they're gonna hold heat for a while too, right?

[00:12:16] **Ted Parson:** Yeah. Well they both, they, capture more when the sunlight's initially coming in and then they hold it and reradiate the heat later on.

[00:12:24] So, so if you have a great big brick building that is very dark, it's hotter in the day because it's absorbing more sun and it stays hotter at night because it's soaked up all that heat and it's reradiated. So

[00:12:35] **Nate Hagens:** some of our viewers, might say, gotcha. That's the reason that climate is warming. 'cause our, instrumentation is, oh,

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[00:12:42] **Ted Parson:** no,

[00:12:42] Yeah, Some, might say, but that, argument has been raised for 30 years. Every study you would need to do the comparison and check whether that's really the case. It's like, okay, we'll take out all the thermometers that are in the cities. We'll just look at the ones in rural locations. No, it's getting hotter.

[00:13:00] Yeah, it's not an artifact of measurement.

[00:13:02] **Nate Hagens:** An average person, I, mean, I can only speak for myself because I only know my person, but. It's fricking obvious. It's almost October. It's 80 degrees. I mean, it's, just, it's dead obvious. Yeah. It's dead obvious. Anybody

[00:13:13] **Ted Parson:** with long memory and common sense, sees it.

[00:13:16] Yeah. So, but the thing we're talking about, like painting things white in the city, it's a really good thing to do. In fact, some of my colleagues in Los Angeles have actually worked with city government and county government on a program to encourage, property owners to lighten surfaces in order to reduce what's called the urban heat island effect.

[00:13:36] That it's hotter there because it's darker and it's, a fabulous win-win basically. You reduce heat extremes, you reduce air conditioning costs. People are healthier. It's more pleasant to move around outside for just the

[00:13:48] **Nate Hagens:** cost of paint and the negative externality of, I prefer, red over or blue over white.

[00:13:55] **Ted Parson:** Yeah.

[00:13:55] **Nate Hagens:** But

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[00:13:55] **Ted Parson:** yeah. Yes, It's a great thing to do. And it is an example of solar geoengineering in that Yep. You're making the earth a little more reflective, but. Cities are a tiny fraction of the total surface of the earth. Yeah. And so, lighting lightning roofs, like most interventions that are on the surface that people have looked closely at, I'm gonna say most 'cause people are smart and they come up with new ideas all the time.

[00:14:24] Most of them are too limited in effect to make any difference to the global climate. Okay. You can mess around with clouds at low altitude. There are, there's an intervention called marine cloud brightening that would involve, spraying sea water from the surface to make aerosols tiny particles that help clouds nucleate and could make marine clouds denser and whiter and more reflective.

[00:14:48] That people are considering as a kind of a regional scale climate intervention, but one that you could imagine doing over a large enough area that you might start to get toward a non negligible effect on the whole globe. But the earth is really big and most of its ocean and, so anything at or near the surface is going to be constrained.

[00:15:10] You can go out into space and there's a bunch of people, actually, even entrepreneurs in space businesses who are thinking about technologies to put stuff in between the earth and the sun to shade a little bit.

[00:15:22] **Nate Hagens:** But that's even a bigger problem than the oceans because you have to cover even more

[00:15:27] **Ted Parson:** a area.

[00:15:27] Yeah. Well actually, you know, we're sort of of the same generation. You might have listened to the police when you were Oh yeah. Young, you know?

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Yeah. Do you remember King of Pain? Yeah. There's a little black spot on the sun today. Yeah. Yeah. A Space shield. Would be a little black spot on the sun covering a half a percent.

[00:15:47] 1%. Got it. So, the cost and the technology challenges are huge. It's funny, we're talking about how these things work in a technical sense. I know we're going to get to the policy and law and governance issues, which is what I'm actually expert on. Yeah. I'm an amateur on this stuff.

[00:16:01] **Nate Hagens:** Well, compared to me, you're an expert in this stuff, so I wanna understand it.

[00:16:04] **Ted Parson:** Okay. Which forms of intervention are more promising in terms of being likely to work? technically feasible, likely not to do harm and, likely to be governable in a way that, that, you know, they can be controlled and, you know, sensibly and carefully and legitimately, you know, they're all different and they look different over different time horizons.

[00:16:33] So, space. Maybe, but it's a long way off. And the climate crisis is today. So that leaves us with the one that is most plausible as something that people might actually do in the near term. And that's where you started. it's a stratospheric aerosol injection, so spraying a fine reflective mist of little particles.

[00:16:57] In the upper atmosphere, sort of like your plant sprayer, you know the mist that comes out from your plant spray. Yeah. It's like it blocks a little of the light. It's reflective, it looks right. That could be done at a larger scale. In fact, people are already doing that right now, inadvertently, stupidly and destructively.

[00:17:18] But 'cause we're doing it in the lower atmosphere, a lot of pollutant pollution that we emit, as a consequence of burning sulfur, bearing fossil fuels, mainly coal, but there's sulfur in oil as well, comes outta smokestacks and it is

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making reflective aerosols that are blocking some sun. In fact, it's becoming increasingly clear that pollution down here, which is causing acid rain and causing stratospheric air pollution and killing a few million people a year worldwide due to respiratory illness from the fine particulates is also.

[00:17:54] Cooling the planet estimates of how much it's cooling the planet, maybe half a degree. C So maybe it's offsetting something like a third of the heating load of the greenhouse gases that are in the atmosphere. So the, that's a

[00:18:07] **Nate Hagens:** really hard problem. And we got insights into that during COV, right? When some of our economy slowed down.

[00:18:14] Yes. And did we have a, termination shock sort of mini thing that the temps went up or what happened? So

[00:18:20] **Ted Parson:** let's get to termination chalk a little later 'cause there's a few more pieces of the puzzle please, that we need to have in place. First, there was a reduction of industrial activity during CO but the really clearer thing, well, there's a few things that make us clearly able to see the effective sulfur in the atmosphere.

[00:18:37] The clearest of all is that nature does experiments like this. Now and then in the form of very large explosive volcanic eruptions. So volcanic eruptions emit sulfur. Sulfur in the atmosphere, oxidizes it, gets to sulfate it. It combines with water to form sulfuric acid. Yes, sulfuric acid. Acid rain pollutant.

[00:18:59] And also a very fine reflective, long-lived aerosol that has this radiative effect of reflective more sun. And when

[00:19:07] **Nate Hagens:** a volcano erupts, is it like a smoke stack and it stays in the lower atmosphere, or does it go to the upper atmosphere?

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[00:19:12] **Ted Parson:** Great question. We have both kinds. It depends on how explosive the eruption is.

[00:19:17] Many volcanic eruptions have a lot of sulfur. Most volcanic eruptions don't get to the stratosphere. Occasionally, really big blasts do. The most recent one that did so in large scale was Mount Pinot Tubo in the Philippines in Luon, not far from Manila, which erupted in 1991, over a period of several months.

[00:19:37] Huge column right up to Thera Stratosphere. It happened to be well observed quickly afterwards. It put about 10 million tons of sulfur in the stratosphere. It had a very clearly observable climate effect. Mount Pinot Tubo cooled the word world between 0.3 and 0.5 degrees Celsius. I, didn't know that for, over what period of time.

[00:20:00] So it erupted for several months. it's sort of a case study. What happens with stuff in the stratosphere, there's actually a lot of aerosols in the stratosphere and sulfate or sulfuric acid is the most common natural species, and most of it comes from volcanoes. So it went up over, a few weeks of the eruption.

[00:20:17] It circled the globe as the air does over a period of a couple of weeks. It mixed through the Northern hemisphere over a month or two, it crossed the equator and equilibrated globally over about six months. And the cooling effect appeared over that roughly six months, and then it attenuated over a couple of years.

[00:20:37] The reason it goes down is that stuff doesn't stay in the stratosphere forever. It gets rained out or, what? It doesn't rain up there. It just settles down by movement of the atmosphere and then it crosses the boundary to the, lower layer of the atmosphere that we all live in where the weather is called the troposphere, and then it either gets rained out or combined chemically or settles dry.

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[00:20:59] This actually gets us to the difference between the pollution we're doing down here. It's funny, it's hard to think about it, but a great big smoke stack is basically at the surface. You know, it's way up relative to me, but relative to the atmosphere, it's, at the surface. Okay? So at the surface, this pollution stays in the air anywhere between a few hours and a week or so, and it comes down pretty fast and it harms the environment, it kills people.

[00:21:24] The same stuff up in the stratosphere stays on average a year or so. So you've got a kind of a factor of 50 to a hundred difference in how long. One unit that you put up there stays a unit here or a unit up there in the atmosphere has essentially the same effect in reflecting sunlight, but it's the rate at which it goes up and comes down that does all the harm or almost all the harm.

[00:21:50] So the acid rain is from the stuff coming down outta the atmosphere, the pollution and the respiratory illness and the deaths is from the stuff coming down and being where people are. So the reason we think about going up to the stratosphere is that it stays longer. So you don't have to put as much up to get a given cooling effect.

[00:22:12] But it still comes down eventually. It still come, it's, yes, it still comes down and it still does harm when it comes down. So no, nobody imagines that these things are harm-free. They are potential interventions. This would be, might be a point to say potential. Nobody's doing this. A lot of people think somebody's doing this, including some members of the United States Congress.

[00:22:35] Nobody is doing active modification of the environment to change the weather at global scale. People do weather modification, farmers and ranchers and others do weather modification locally and at low altitude. And it's, you know, and it's small scale to, you know, cloud seeding to, to you know, move the rain around to reduce hail, stuff like that.

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[00:22:57] That's called weather modification. It uses SI processes that are similar to some ways people are thinking about geoengineering, but it's completely different and it's local and it's been going on for 50 years. Nobody's doing geoengineering to modify the climate. But the reason we're thinking about it and thinking about it in this way in part, is that up there you can get the benefit, the climate cooling effect.

[00:23:26] At a much smaller but not zero risk or harm. What are people saying?

[00:23:31] **Nate Hagens:** What might work? Like, what would be if humanity somehow was able to have governance and recognition and is probably gonna take like, Kim Stanley Robinson, some wet bulb catastrophe and Southeast Asia or something like that, for us to say, oh my God, this is real.

[00:23:48] And it's happening because of the way our brains are. We don't react to something until it's, we're like crisis of complacency. so what would, like, what is the best science say right now of what this type of uhs a i, sulfur aerosol injection, stratospheric aerosol injection, Strat aerosol injection would accomplish?

[00:24:09] **Ted Parson:** So the best science is a combination of. You know, a hundred years of research on atmospheric aerosols, including sulfur and 20 or 30 years of research using climate models to basically do studies that look similar to the studies people do, to project well, what will greenhouse gases do and how will the climate change that?

[00:24:33] how will the climate change under, increased greenhouse gases? People are doing studies where they say, if the climate is increasing like this and somebody injected this much reflective aerosol in the stratosphere, what would that do to the climate? So there's a couple of hundred of those studies that have been done already.

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[00:24:49] It's kind of historically or sociologically interesting that most of them. Have been done. And they were all started by people who were certain this was a crazy, idiotic idea, and were determined to show that was the case. Well, that was their reason for doing the research, their reason for doing it.

[00:25:05] Now, long time ago, 1998, there was, there were a couple of guys who'd been, involved in weapons development earlier in their careers who thought about the atmospheric effect of nuclear weapons, who presented a sort of a seat of the pants paper at a con, at a scientific conference where they kind of did the thing that ev every one of us who thinks about this stuff is like terrified of, we said, you know, get away.

[00:25:29] They said, you know, sulfur cools the earth. why bother with all this emission cutting stuff? We could just put some sulfur in the stratosphere and it'd be fine. And, you know, you know, oh,

[00:25:39] **Nate Hagens:** continue. Business as usual. Add sulfur. Yeah. Yeah. Okay.

[00:25:42] **Ted Parson:** So there were a few. Climate scientists in the audience and they were sort of, you know, mumbling at the back of the room says this doesn't know what the hell he is talking about, you know, and they went back to actually use their climate modeling tools to prove that this couldn't work.

[00:25:55] So the Ken Calera from the Carnegie Institute Yeah. At Stanford is is the person who actually went and did this with his colleague, Govinda Bala. They did the first climate model study of sulfur in the stratosphere. It was published in the year 2000. They did it 'cause they were certain it was going to prove that reflecting stuff, reflecting visible light, could not in any way undo the climate disruptions from elevated greenhouse gases.

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[00:26:25] And they were totally surprised that their result was. It didn't look that bad, right? It's not a substitute. It can't be a substitute. It doesn't change the climate in a way that turns 180 degrees and goes back from what we've, how we've messed it up with greenhouse gases. It doesn't do that. It can't do it that way.

[00:26:44] No modification could make it do that way, so we still have to cut emissions, but it shocked them with how well it seemed to work, and that's kind of been a pattern generation after generation of subsequent studies. They continue, although approached with fear and trepidation, they continue to surprise people that inter.

[00:27:11] Started gradually used only to offset a fraction of the heating from greenhouse gases, not the whole thing. And done temporarily in the context of a program of finally getting serious about cutting emissions and pulling the old emissions back out. And every one of those is an uncertain assumption, but with those assumptions, the research consistently shows you can cool the earth.

[00:27:38] It restores the climate almost everywhere on earth. The almost covers here, variation across different models in different studies, but some of them, it's like 95% of the Earth's area, 98%, 99 and a half. Pulls it closer to what it was before. To the extent that there's an unequal distribution of these benefits, the biggest benefits tend to go to the most climate vulnerable places, which are the low latitude, hot, humid, lower income developing countries.

[00:28:07] So it actually seems to be justice enhancing if done in these ways under all these conditions. And the harmful side effects are pretty well characterized and look a lot smaller than the harms avoided. And the harmful side effects, it messes with ozone chemistry. So under some conditions it can delay the recovery of the Antarctic ozone hole.

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[00:28:30] It makes acid rain, although at about 1% or less the rate that we're already doing from the much bigger rate of emissions we're making down low, it contributes to tropospheric air pollution, which kills people at a level that seems to be much less than 1% of what we're already doing. The climate correction is not perfect.

[00:28:53] So if anybody gets a notion in their head that, oh, we can just keep emitting and do this stuff to cool the planet and we'll be fine, no, that's not what it does. But what it does do or seems to do based on the present research is. Takes the, brutal hard edge off the most severe climate impacts for the near term to give us time to get going on the massive essential job of transforming the world's energy economy, to get away from fossil fuels, to get emissions to zero, to suck old emissions outta the atmosphere, to build a resilient communities.

[00:29:31] And in all the stuff we have to do, we still have to do. But what felt like it was impossible given the lumen looming catastrophe, catastrophe looks possible with the slight extra breathing room or time that could be offered by solar geoengineering. one of my colleagues, led a project where she used the term stopgap.

[00:29:56] People say Stop gap, they say bandaid, you know, it's like it doesn't solve the problem. How much would it cool the planet? potentially based on present work, it looks like, a program to cool the earth a half a degree. C so take a half degree C off the otherwise, heating. So

[00:30:15] **Nate Hagens:** from today's level, we go for one and a half back down to plus one.

[00:30:18] Exactly. Yeah.

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[00:30:19] **Ted Parson:** Could be accomplished with a fleet of one or 200 modified airplanes. They'd have to be modified from present airplanes because they have to fly higher with full payloads than current airplanes do. They, look kind of like current airliners, you know, long range things, but they have fatter bodies, longer, thinner wings.

[00:30:40] They go higher, they take full loads higher, distributing something like five to 10 million tons a year of sulfur. And what was Pinatubo put in the atmosphere? Pinatubo was 10 million tons of sulfur from an eruption that lasted a few months. Okay. So it was sort of a more concentrated pulse intervention.

[00:31:03] And although Pina Tubo tells us a lot about what a program of intentional intervention would look like, it isn't perfectly matched. And so it doesn't tell everything. I mean, my, my view of this, which my science expert friends don't. Quite shut down is Pinot Tubo puts a kind of a lower bound on how bad it could be, like how bad the consequences could be.

[00:31:25] 'cause we've seen nature do it with 10 million tons. We saw the effects. We actually understand them pretty well. So a couple hundred airplanes, delivering five to 10 million tons a year,

[00:31:36] **Nate Hagens:** couple

[00:31:36] **Ted Parson:** hundred airplanes

[00:31:37] **Nate Hagens:** at once, or you put 60 up and there's three shifts and they're 24, 4 7. It would be,

[00:31:41] **Ted Parson:** you know, people have looked at all kinds of different ways of distributing it.

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[00:31:46] and the models say, the best way to do it involves uniform distribution, balanced between the two hemispheres with sort of a continuous program of flights. one guy says the airplanes are operating like dump trucks. It's like they go up, they dump, they come down, they reload at 10 and 10 and 30, north and south degrees latitude.

[00:32:08] So

[00:32:09] **Nate Hagens:** I'm gonna interject here, Ted. You and I have mutual friends. we're here in New York. We're talking to people that are telling us very concerning things. Yeah. About the state of the world. But given the universe of humans on the planet, even the, smaller universe that have the internet, even the smaller universe that would tune into a program like this, most of them will listen to this and think we are batshit crazy having this discussion.

[00:32:35] And I've, I would too. I've, been told that with the exception of we've talked to enough, incredibly credible, serious people that tell us what's in store. The next 30, 40, 50. Yeah. A hundred years. Thousand years. 20,000 years. So that's the reason I'm not completely discarding this as crazy because the alternative.

[00:33:02] Maybe worse, which is why I'm at least wanna learn about this.

[00:33:05] **Ted Parson:** Yep. What we're facing with climate change over the next 10, 30, 50 years may well be fair to describe as batshit crazy. Well, we're doing geoengineering right now.

[00:33:15] **Nate Hagens:** We've been doing it for a couple centuries.

[00:33:17] **Ted Parson:** Yes. And tragically we don't get to get back the climate we had and already messed up.

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[00:33:25] Yeah. And so you can't responsibly evaluate things we might do to respond to the crisis by saying I'd rather have the climate we had before we messed it up. That's not an option on the table anymore, sadly. No. Now, in terms of capability and governance, the program I'm describing, people have started to look at this.

[00:33:46] There's even a couple of papers that are tried to cost it out. So

[00:33:48] **Nate Hagens:** there are lots of scientists working on this question.

[00:33:51] **Ted Parson:** There are hundreds. Maybe the number's over a thousand yet it might or might not be. It's still a very small fraction of all the climate scientists in the world, but there are many serious, credible, highly respected climate scientists who are thinking hard about this and doing studies, and that's how we know what, we know that's how somebody like me who basically consumes and sits on top of this scientific research, can come and talk to you and say, with this confidence, you know, we actually know pretty well how to do it and what it would do.

[00:34:22] The program I'm talking about. Doesn't sound that hard. In fact, in early days of investigating this, so the current estimates of how much it would cost to do this, the, this sort of standard unit of, solar geoengineering of like cool the earth half a degree, sea. The current estimates of how much that would cost are between 10 and \$20 billion a year for kind of an ongoing half a degree.

[00:34:48] C cooling with a hundred trillion economy. Exactly. Relative to all the other numbers we talk about with climate change, that sort of rounds to zero. And actually in some respects, it's like if there's something you think it might be worth doing and you learn it's dirt cheap, normally that's a good thing.

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[00:35:05] In this case, dirt cheap is actually not necessarily a good thing. It does mean. That a program like that would be within the technical and financial capability of some number of world actors, including something like half a dozen major powerful states. You know, there's details that people seriously argue about.

[00:35:26] Like, well, you'd need different jet engines, and there's only a small number of capable jet engine manufacturers in the world, and so maybe only those states are capable. But if you're talking about something that it pertains to a sanctuary scale crisis, the set of actors who could do it is actually more than you'd think because there's a, you know, there's more states that could develop a capability.

[00:35:51] So there is a real worry about. Unilateral deployment in early days, and I think this has been very decisively refuted. People worried about a scenario that, my colleague, David Victor called Green Finger, basically a rogue billionaire, you know, doing it out of his own pocket. You know, maybe that's perhaps a little less implausible now than it was when he first said it.

[00:36:13] But it would have to be continuous. It would have to be continuous and it would have to, it would have to be done by a state that has geopolitical statures such that they could do it even if others really were opposed to it. So some people say only two states could do it. Some people say have a dozen states could do it.

[00:36:33] If it were two, what would the two be? The two remaining world superpowers as one goes up and one goes down China and the United States. Okay. So.

[00:36:42] **Nate Hagens:** I think there's two ways that this could happen. One, which I don't think there's any chance of it would happen is all the countries in

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some new United Nations get together and say, look at us, US earthlings on this planetary spaceship that.

[00:36:56] Is heating up, we have to do something. This is what the best science is. Let's agree to try this out and do it. I just don't see that happening because it's gonna not have a, an equal effect. we can argue about that, but that's my opinion. The second is, like you said, some areas, maybe India or somewhere like that, that people are dying and their way of life is being destroyed.

[00:37:21] They may try to do this unilaterally and in paradoxically it might actually solve for climate change because it would kick off World War ii.

[00:37:31] **Ted Parson:** I don't think so. I don't think it would kick off World War iii. So you've nicely laid out the ends of the debate on how it might happen and how it might be governed.

[00:37:38] Okay. And one end, I'm actually gonna caricature it even be a little beyond what you said. So there's the model un notion of how global governance happens, which is, you know, people of good faith and goodwill and good sense all get together and, you know, adopt a solution that works for all. And then they make a set of decisions and they make laws and then they go out and do it.

[00:37:57] I agree. There's an end point there that is naive and implausible. Yeah. There's an end point at the other end, which is a great power that doesn't care what the rest of the world thinks to, decides that it's suffering from extreme climate risks and it's just going to go do it on their own. There's actually a lot of space in between those, and I think it's in between those that the plausible governance and geopolitical scenarios are.

[00:38:21] So it really matters that no state is powerful enough to exert complete control over this. It also really matters that there's no possible way of making a

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non-trivial intervention in the world climate that doesn't take a many year, and maybe it's a 10 year, or maybe it's a 20 year buildup of technical capability to make new airplanes that can do stuff at scale with smaller interventions in between.

[00:38:51] So a state moving toward doing this couldn't do it in secret. These things are observable and whatever the configuration of great power dynamics is in the world at the time, they couldn't avoid having the awkward conversations about what is this stuff? And you know, who's doing it and under whose control.

[00:39:12] There's a ton of risks in this space, in my opinion. They don't actually extend toward this being an important incremental trigger for World War iii, I think. I think there are things in the space we're seeing around us that could be incremental triggers for World War iii, and they're very

[00:39:27] **Nate Hagens:** frightening.

[00:39:27] Well, what I meant was if India, just to pull that, I know nothing about what India is doing, but if India were to send up planes to do this, I'd just have to believe the United States would shoot 'em down immediately and then we're off to the races in some sort of escalation.

[00:39:43] **Ted Parson:** Yeah. So,

[00:39:45] **Nate Hagens:** I mean, that's what my common sense reaction is

[00:39:48] **Ted Parson:** to, I can't make a confident guess about what the United States would do.

[00:39:50] It's like I've worked in the United States government. I think I know this country rather well, but I make no confident guess point taken. Okay. But if I were in a position to advise the political leadership of the United States, and we saw,

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it's like suppose India developed a program. They went through the five years of development.

[00:40:08] The United States was dozing and didn't pay attention, and so they were shocked. Shocked when India sent up planes to the stratosphere. So that's a little implausible already. I hear you. Okay. But then. If I'm advising United States political leadership, India sent up the planes and somebody asks me, should we shoot him down?

[00:40:26] I say, it's, it really doesn't matter. Those planes aren't hurting you in any way right now. You need to have a very frank and open conversation with the Prime Minister of India right now and talk about what they're doing and why, what your views are about it, and how we're going to avoid this being a serious global crisis and there's time to do it.

[00:40:47] People think about like security and military crises as analogies for this stuff. It's not a good analogy. Stuff doesn't happen. Big stuff doesn't happen fast in this space. Even if somebody started an ambitious ramp to develop toward a program, it's. Years before they get to scale to do it, and it's more years before that program has a big enough effect on the climate that you can even see it coming outta the noise of variability of climate and weather worldwide.

[00:41:21] **Nate Hagens:** Is this the appropriate time to ask you what termination shock is and how that, plays in?

[00:41:26] **Ted Parson:** Yeah,

[00:41:26] It's actually, it's, a really good time to ask the question. So a lot of people think this is batshit crazy, and a lot of people think this is so profoundly corrupt and wrongheaded that nobody should be thinking about it.

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[00:41:39] some of the reasons that people advance for those positions don't make a lot of sense. One, you unpack them, but some of them do. And the ones that in my view make the most sense are, first, it really looks like it would be extremely difficult for anybody to do this in a way that gathered the benefits to them and their friends and let the rest of the world go to hell or even worse, harm the rest of the world.

[00:42:06] It looks like it's not regionally tunable. Beyond a tiny little bit. It makes sense. 'cause the it circulates, it's mixing up, it's ing with we're on the same planet. Climate dynamics. Exactly. So what the models say, and all we know is from all we know about the regional impacts is from models so far, is that there's a very limited degree of adjustability of effect by broad latitude bands, but nothing finer than that.

[00:42:35] So people worry. You alluded to a little bit earlier, people worry about winners and losers. Would the technology allow the possibility of intervening in a way to generate asymmetrical benefits and harms in a way that people would fight to control and would use to their own advantage? Reverse colonization.

[00:42:54] That's actually, yes, That charge, that charge has been made. It looks like, nature is being kind to us in this respect. It looks like it would be really hard to, impossible to do certain things that people would be tempted to do if they had this capability and would be really destructive.

[00:43:14] So that's one set of concerns, and it's one that I think are quite well bounded by the research and, so it's really fair to say, yeah, we need to think about this. But don't talk bluntly about winners and losers and fighting for control. It doesn't look like that. The other concern that people have really acutely is they say.

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[00:43:32] This can do some good, but it cannot be a full solution to climate change. But will people believe that? Will people exaggerate what it can do? And so once they are willing to talk about this or even considering doing it, might they overly on it and stint on all the other stuff that we have to do?

[00:43:51] Might this be an excuse to not cut mitigation? That would be the human way. Well, you know, have you ever had the experience of like, you know, paying a lot of money up front for a gym membership and resolving you're going to work out all the time often and then not? Yeah. Yeah. Often. Okay. So it is a widespread piece of human nature to prefer a quick, easy solutions rather than things that take sustained discipline programs and so on.

[00:44:13] So that's universal. And then there's a piece that makes this concern sharper, which is. There's this very powerful fossil fuel enterprise or collection of fossil fuel enterprises around the world who would love to have a justification to keep the rodeo going a little longer. And although they have not weighed in on this question yet, it is a widespread concern and a very reasonable one, that if the prospect of serious emission cuts really harming fossil energy, interest becomes real.

[00:44:45] There would be campaigns of saying, you know, oh, too costly, too difficult. We don't have to do this because this is geoengineering.

[00:44:52] **Nate Hagens:** So fossil fuel companies, only 10% of which are public. By the way, the rest are national oil companies. Yes, they would be in favor of this. Because it gives them a longer runway.

[00:45:01] Many

[00:45:02] **Ted Parson:** people worry about talking about geoengineering based upon the expectation that fossil enterprises got it. Okay. Enterprises and nations

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would be in favor of it. Well, and economies and would use it. And economies, yeah. Yeah. Would use it as an excuse to stretch out the life of fossil fuels. That goes by a couple of people call that moral hazard.

[00:45:20] They call it mitigation displacement. It's a really serious concern. But that concern is so motivating. It's actually, in my opinion, it's, stopped us from having the conversation we need to have about geoengineering in the context of climate risks for a long time. Because it might be that the mitigation dial, the emission cut dial doesn't go to 11 or doesn't go to 13 or 15.

[00:45:44] We can't turn it up fast enough to limit climate risks and then we might need to do this and somehow. Not reject that based upon an apprehension that it would make us take our foot off the gas on mitigation. We still need to do mitigation, and if we think about geo engineering, we need to think about ways of making these complimentary and doing them both together.

[00:46:06] So you asked about termination shock. I'm coming in a roundabout way too. It So termination shock is the endpoint of the nightmarish scenario of a sanctuary long idiotic folly, which is the following. All of a sudden, people start paying attention to geoengineering. We do the research, we deal the capacity.

[00:46:26] We start a small pilot program. It looks like it works pretty well. We do more, In the meantime, we take our eye off the ball on cutting emissions and emissions don't fall. Maybe they even keep rising emissions are sort of poised. Maybe they're peaking. Maybe it looks like they've started to come down, but they're not coming down fast enough.

[00:46:42] They really need to come down fast. If we, God forbid, used solar geoengineering to cool the earth a lot while not doing the essential work of cutting emissions and removing old emissions from the atmosphere. You can get

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to terrifying endpoints where we would be heating the world three degrees with emissions mostly from fossil fuels, but other stuff too.

[00:47:08] And we're cooling at three degrees with solar geoengineering and we're not getting back the prior climate either because the, bigger those pushes in these two not offsetting directions, the bigger the differences. And then something happens politically or socially. A global pandemic, a change of resolution, a depression, a world.

[00:47:28] It'd have to be awfully severe. 'cause it's pretty, it's cheap and easy to keep doing this stuff. Yeah. But we're, doing it that much. We don't do the other essential stuff and then it gets turned off all of a sudden. Yes. Well, remember this stuff stays in the stratosphere a year or two, and so.

[00:47:44] Anything you put up only exerts its cooling effect over a year or two. I mean, it's an exponential decay. So in fact, if you turn it off suddenly and, you've been doing, god forbid, three or four degrees of cooling, then you recapture that three or four degrees of suppressed heating over a decade or so, you know, as the stuff comes down.

[00:48:06] **Nate Hagens:** But that would eventually, I mean. Unless we kept it going perpetually, it would, that would always happen eventually. Oh. Unless it was paired with reduced emissions and then you slowly, instead of sending up a hundred planes, it's 80 planes, then 50,

[00:48:22] **Ted Parson:** then 20, yeah. Reduced emissions and sucking the old emissions back outta the atmosphere.

[00:48:26] 'cause of course, as you know, cutting emissions to zero doesn't bring the climate back to where it was. It just stops it from getting even more perturbed. Zero emissions means the climate stays where it was, so it's cut

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emissions to zero. Suck the old stuff back outta the air. Do that in a sustained way over decades.

[00:48:46] here's I, made fun of like model UN ideas of how the world works earlier. You know, here's, my naive model. UN world. It's like a rational, benevolent world government, you know, decides it's going to cut emissions to zero and build this enormous program of removing greenhouse gases. And in the interim, you know, over the decades, or maybe it's many decades, maybe it's a sanctuary that.

[00:49:09] Climate impacts are too severe. Even with those programs, it gradually ramps up and down a program of solar engineering to hold global temperature to some agreed, tolerable level. That's the student council. You know, I naively idealistic form. The dystopic form is, we don't do any of that. You know, emissions stay high or keep rising aren't cut enough.

[00:49:34] We don't invest in the removals, which is a, it's, that's a nut no one's cracked. Removing is costly and nobody has a model for how to do it at the, and then it gets turned off. That's when you get termination shock. The reappearance of a lot of suppressed heating over a short time termination shock depends on what you were doing before.

[00:49:59] If you were cooling the earth, half the degree, there's not a lot of indications that losing that even suddenly would be profoundly disruptive. Pina tubo cooled the earth half a degree, 0.3 to 0.5 degrees at some point of cooling, and at some suddenness of turning it off and nobody restarting it, you start to get to termination shock, shocks and errors that are really scary.

[00:50:25] But I personally find the political assumptions you need to get a really catastrophic scenario there. You know, they aren't naively, optimistically,

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idealistic, but they're sort of naively dystopian On the other side, it's like, how stupid can everyone be for how long? I have

[00:50:43] **Nate Hagens:** two, two feelings, and you're an expert on this.

[00:50:47] My feeling is this is batshit crazy because of the unknown unknowns, but I also have this gut feel that humans will eventually have to do this and we will do some version of this, which is why I wanna understand it. Yeah. So, so what, would have to happen in the, first case that I laid out of an international community actually agreeing that something like this is necessary and they collaborate to get it done.

[00:51:13] Are there any discussions happening right now globally on this?

[00:51:17] **Ted Parson:** So there are a set of discussions that started among scientists and some civil society, like environmental groups and other civil society, groups that are going on internationally and I think are growing more serious and more constructive.

[00:51:31] A lot of people think this isn't just batshit crazy, they think it's sort of out of bounds. It is to be barred and precluded in advance even without doing any research on it. and for what reason? for various reasons. So I've identified the two or three most serious ones. If it were ever used, it would be in the hands of global elites who would deploy it to their own advantage.

[00:51:53] And so there's a kind of a set of really compelling and valid, anticolonial arguments. Human nature being what it is, and political corruption being what it is. Any use of this would surely, as a practical matter, enable continued reliance on fossil fuels and continued high emissions. And so it wouldn't be used as a stopgap to allow a fundamental solution.

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[00:52:19] It would be used to further kick the ball down the field and delay a fundamental solution. And those arguments are quite compelling. And they're compelling and, they're not. So I come down on the other side, but they're not bad arguments. There's a core validity. They speak to some really compelling moral and political concerns and.

[00:52:40] The folks who approach this issue and did so early with these concerns, have had a lot of influence in the debate so far. The debate in particular outside, scientific circles and the circles of the more, sort of scientifically sophisticated environmental groups. So there have been international conversations where this has been discussed in, my view, in a very unhelpful and ideological and superficial way.

[00:53:09] And there have been some decisions taken in international bodies that range between expressions of disapproval and kind of calls for this to be banned. And this means not just don't deploy it, put a moratorium on deployment. It means don't even, don't investigate, don't develop, don't do research.

[00:53:27] Don't talk about it. There's actually one quite influential group that is. Promulgated something called a non-use agreement on solar geoengineering, which non-use I can get on board with that. I think it's premature and reckless to use this stuff. And then you read the details. And non-use effectively means, no research, no development, no discussions in international organizations.

[00:53:49] This is really a hot potato. This issue, it, it really is. It really is. So you asked what would have to happen. It's a really hard question because what would have to happen is something that we don't have any precise models for. So there is no current international organization or international treaty that speaks to this.

[00:54:13] More than really approximately. Right? I mean, we have an ozone regime. Yeah. And this will affect ozone. So you could say that's relevant. We have

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a climate regime, we have a biodiversity regime, we have a law of the sea. These are all relevant, but there's no international body that has the authority and capability to facilitate conversations that of the form.

[00:54:36] what would this mean? Who might do it? Are there conditions under which it might help? How might it hurt? How can the hertz be mitigated? Is this something that governments of the world want to? Take the next step toward. I heard a speaker the other day use the term baby steps in governance. one of my colleagues from Africa.

[00:54:54] And I thought, that's totally brilliant. You know, it's like we don't know how to walk and so what we need are baby steps on governance.

[00:55:02] **Nate Hagens:** Well, in my opinion, governance is the single issue that underpins all aspects of the metris. We just don't have the governance we need for the challenges we

[00:55:10] **Ted Parson:** face. Yes, absolutely.

[00:55:12] And then you can unpack that there are many specific capabilities that aren't capabilities and authorities and levels of trust and social capital and shared knowledge that are not available to address that. They aren't for climate comprehensively, they aren't for other crises that interact with climate, and then specifically they aren't for geoengineering and talking about geoengineering in isolation.

[00:55:36] It's like you have to say the name to have the conversation open at all, but if you're talking about just it, I think you're making a very fundamental error because it's about a response to climate emergencies and climate emergencies sit in the context of other emergencies, but let's draw bands around climate.

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[00:55:52] It's like, no, I don't. I don't want an agreement or an international capacity on geoengineering. I want international agreement and capability and authority on effective response to climate crises and their impact on human welfare and flourishing and the environment.

[00:56:07] **Nate Hagens:** How likely do you think it is that.

[00:56:10] Someone that, that will do this in coming decades, either unilateral or some sort of a, baby step global, yeah. A agreement. So I'm gonna, I'm gonna give

[00:56:22] **Ted Parson:** you an answer, you know, to an impossible question, but I'm gonna make sure that we're clear. You asked exactly the right question, and it's the predictive question.

[00:56:30] How likely do I think it is that someone will do it? It's, not the normative reevaluative question. Do I think, the likelihood that some capable actor, state or collection of states, it won't be private actors, does this within the next 30 years is well above 90%. I think it will happen one way or another, and I mainly work on this to try to push the likelihood of it's happening toward, it's happening in a more helpful and less destructive direction.

[00:57:00] **Nate Hagens:** Lots of planes going up in the sky, spraying millions of tons of sulfur into the atmosphere and the upper atmosphere. You as a considered expert on, at least on the governance of this, you think that's 90% likely? Yes.

[00:57:16] **Ted Parson:** And then if you unpack it more and say, how do I think it's likely, I th. I don't think a Stan Robinson scenario of truly unilateral and sudden program by one powerful and highly vulnerable nation like India is likely, I think, an informal coalition of half a dozen nations doing it collectively and with some degree of consultation, but not waiting for permission from the rest of the world.

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[00:57:44] That's the cer scenario that strikes me as more likely than not.

[00:57:49] **Nate Hagens:** Well, let me ask you, as long as we're in the realm of speculation, how likely do you think a scenario like Stan Robinson, painted in Ministry of the Future there or there was a, large, death event from wet bulb temperatures in the Asian subcontinent in the next 30, 40 years?

[00:58:07] How likely do you think that would be under the default scenario?

[00:58:10] **Ted Parson:** The default scenario, meaning we continue to make a business usual. Yeah, but progress on cutting emissions and building removals, but not fast enough.

[00:58:19] **Nate Hagens:** Progress on, on scaling renewables, but also economic growth continued. Yep. I mean, India's growing coal plants

[00:58:25] **Ted Parson:** very rapidly, et cetera.

[00:58:26] yeah, highly likely. I mean, I mean, I think it's highly likely there will be terribly severe impacts, and I think they will include extreme heat events that have catastrophic effects on the regions that they occur. It's sort of funny. Almost the scenario in, ministry for the future actually did happen a couple of years later.

[00:58:47] There was an extreme heat wave in North Central India, and far fewer people died than died in his fictional scenario. And it was kind of a reflection of less vulnerability and more resilience and adaptive capacity than he thought. And of course, in his scenario, the government of India responded immediately with a program to do stratospheric, sulfur injection.

[00:59:13] And that's just not possible. In fact, he, I mean he acknowledged Yeah, he was a fiction book. He played with fiction book. Yeah. He, they used old Soviet airplanes that can't fly that high. Right? Yeah. and then they did it and took all the

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hostility and anger worldwide and then stopped. And of course, if you do it and stop.

[00:59:31] You get a very short term benefit. You don't get a termination shock 'cause you need to be torquing the system really hard. But, so

[00:59:37] **Nate Hagens:** what would, let's just say your, your speculation is accurate and it's 90% likely that some group of nations in the next 30 years, might attempt this. What would be the geopolitical implications of, such a situation?

[00:59:53] **Ted Parson:** So acknowledging that we're going far down the path of speculation here. Yes. And nobody knows. So my guess is that if some such sort of coalition of bold or reckless or desperate nations does this Yeah. Desperate probably, most likely many other national governments would be breathing a sigh of relief and say, thank God they did it, and are taking all the heat, even while they stand up at the general assembly, assembly and say, I am outraged at this unilateral in, oh, I hadn't thought of that.

[01:00:24] Yeah. Yeah. So I, I've actually, I've run a few scenario like political scenario exercises on this to try to get more purchase on the geopolitical implications, and I'm shocked at how frequently that is the modal response to a unilateral deployment Now. These are nice, sophisticated people in my room doing simulations.

[01:00:43] Right? And you know, and they're have a sophisticated understanding of climate change, but nobody says shoot 'em down. Many people say apply diplomatic muscle promptly and hard. Make outraged statements in public and say, and then say in private, you're not doing this without us involved. And we're gonna talk about whether and how this continues.

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[01:01:10] And there'll be a lot of muscling for kind of who's in those rooms. 'cause there's. These are interventions that affect the whole world. So there's a compelling moral case, a justice-based case that every country in the world has to be in on the deliberations. And then these are things that require a technical capability and a scale of capability that only a few nations have.

[01:01:31] And so if you view it through a ruthless, great power geopolitical lens, you're gonna say the minimum set of participants in governance looks like four or five or six or 10 countries or something like that. My guess is that both the practical reality and the kind of normative reality is in between. The effects would never be differentiated.

[01:01:52] Finally, it's like one country's not gonna have a different effect than its neighbor. So not, it's not the general assembly. On the other hand, it would be both deeply wrong and unsustainable for Sub-Saharan Africa not to be in the room. So, so put those two together, you know, and I don't know, you come up with something that looks like new bodies with maybe 25 or 30 or 35.

[01:02:19] Deeply briefed and staffed, well-informed, scientifically advised delegations having serious adult conversations, not just about geoengineering, but also about the rest of the climate emergency or the rest of planetary boundaries. yes. You know, how about those promises to cut emissions that you didn't deliver on?

[01:02:40] How about that adaptation support that you didn't deliver, and how about that climate finance that you didn't deliver on? Well, D democracy's out the window. Have you already established that? I'm a delusional optimist? You know, so, so maybe democracy's out the window, or maybe there are conditions of severity and imminence of shared risk under which people come closer to their better selves and care about people elsewhere and collaborate in a way that we often don't see from Apex Predator to apex custodian.

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[01:03:13] I like

[01:03:14] **Nate Hagens:** stewardship and gardening analogies so. Separate from climate, since you're an expert on geopolitics and governance. What is the state of the United Nations and do we really even have collaboration in the world today at the largest broadest levels?

[01:03:34] **Ted Parson:** sorry that, one I wasn't expecting something that vast. There's a lot of international governance that works. Mostly it works on issues where there has, there is a historical record of cooperation at all levels of political authority, and there's sort of state and sub-state and private public interaction.

[01:03:53] So I spent the first 10 years of my career studying, international protection of the ozone layer, how we got the extraordinary success of the Montreal Protocol and the associated regimes that really, it is a, at an extraordinary triumph of cooperative, scientific informed international governance.

[01:04:12] And it still works and it continues to work brilliantly. there are many areas where there is effective international cooperation. You can, get too despairing by looking at the bloviating and posturing and the horrible things kinda set at top political level, whether the UN remains a viable institution and what it would look like to have an alternative way of organizing cooperative global governance.

[01:04:40] Under what assumptions about who are the great powers and how many are they and how rational are they? And I don't know, there, I have a long wish list for better global governance and I try not to let my delusional naive optimism take me all the way to, toward, you know, effective democratic, competent world government.

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[01:05:00] 'cause I think that's some distance off. But I think opportunities for cooperation open up under conditions of crises, opportunities for bad decisions open up. I mean, cri. Yep. You've thought a lot about crises. You know, it screws everything up. It's like. everything's a mess, right? But it would be a mistake not to overlook or deny or ignore all the cases in which you see positivity.

[01:05:29] good judgment, collaboration, care for one's neighbors, care for the future, care for the shared future. Think about the salient political moments over our lifetimes. You've seen where kind of old adversaries have come together and how often it's an old leader of one country and an old leader of another country, and they say, we had a wonderful conversation talking about our grandchildren.

[01:05:54] Right? It's like. Focus on the future. Think about the commitment we have to other stuff that unites instead of divides us. I, it's real. It doesn't always win, but it's, real. So what are the

[01:06:05] **Nate Hagens:** critical areas of research? The, questions that we still don't know about the science and setting governance aside, the actual science of, SAI, like, I can't imagine this would have a negligible effect on, the oceans and, the waters in the world.

[01:06:22] **Ted Parson:** Well, there, there's a lot. And the way I think about it is that there's, the, models have done a lot of great work that involves a lot of simplifying assumptions about what actually happens at a kind of a micro level. So there's an. You know, people say rather glibly, oh, we, you know, we assumed a uniform distribution of sulfate, aerosols in the stratosphere, but what do you actually put up there and what happens to it?

[01:06:47] And how does it mix and, does it, you know, does it stay as long as you think it does? And what effects does it have on chemistry and, photochemistry up there? So in terms of downstream impacts, it's like we have a lot of knowledge

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about climate and climate change and the effects of greenhouse gases, and we have a lot of knowledge about sulfuric acid aerosols in the atmosphere because it's not a new thing.

[01:07:15] It's like this isn't a new idea and it is something that nature does and has done for a long time, and people have been studying for a long time. So we would wanna act like volcanoes using planes. We would want to use what we understand about the atmosphere from observing volcanoes to design interventions aimed at getting the effect with the least possible harm.

[01:07:38] And we, I'm using the rhetorical we, it's like the global we, you know, we would want to proceed. Baby steps is a good image for every piece of this. It's like, it would be madness to undertake a program of a global scale. Ha, even half a degree C intervention immediately, but. There's a sort of thousand fold or 10,000 fold scale up, you know, on the way there.

[01:08:06] So there's a ton of research that does involve small or increasingly, gradually somewhat less small experiments to look really clearly at what happens and calibrate understanding of can you distribute the, right stuff? Does it make aerosols, you know, does it have the intended effect on stratospheric chemistry and climate?

[01:08:25] What happens when it comes down? It's funny. Sulfur pollution does a ton of harm. In addition to this cooling thing, probably with decades of advanced understanding. If people did embark on a program of solar geoengineering, they would find a different thing to do that is less harmful. But in the meantime, while the only candidate near the front of the queue is sulfur, it's really.

[01:08:52] Helpful that there's so much deep scientific knowledge based upon experience from human pollution observing what happens with human sulfur pollution and observing what happens from natural emissions. So you wouldn't

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replicate volcanoes because volcanoes are sudden and abrupt. You'd wanna do something that is more gradual and starts smaller, and you'd want to look really carefully at all the effects at every stage.

[01:09:19] And in governance terms, I totally understand that as soon as anybody does anything, even tiny, there will be attempts to blame them for any bad climate and weather event that happens anywhere in the world. Well, and even

[01:09:34] **Nate Hagens:** if,

[01:09:34] we do cool. And the, cost will be seen by, shrimp grow, growing an extra tail, or I don't know what the impact on warm sulfur in the ocean.

[01:09:45] It isn't

[01:09:46] **Ted Parson:** radioactive.

[01:09:47] **Nate Hagens:** Okay. Well, I, there will be some negative like acid rain. There won't be fish in the lakes in upstate New York. Maybe not.

[01:09:55] **Ted Parson:** I, so there's a line we haven't got to explore, but it's, I realize it's kind of important, this pollution that we're doing from smoke stacks down below, it's like we're in the course of cleaning that up, right.

[01:10:05] It's like. Human sulfur emissions are down almost half. Yeah. Quite from the peak in the eighties. And there was a huge discreet act just a few years ago when the international body that regulates marine shipping Right. Put a limit on sulfur fuel. So, so we're seeing the effects

[01:10:21] **Nate Hagens:** of that. And Leon Simons was on the show showing how temperature has risen as a con on a account of that.

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[01:10:27] Okay. So

[01:10:27] **Ted Parson:** you're, you, yeah. You're all over this. So I wanna push back on your, you know, mutant shrimp. It's like we've been mut if sulfur makes mutant shrimp, we've been doing it for half a sanctuary and we're now in the course of turning it down. And one way of thinking about this, I think it was actually an op-ed by a couple of my colleagues in the Times, a couple of days ago.

[01:10:47] One way of thinking about this is that. As we cut back sulfur pollution from smoke sacks, as we must, you know, to save all those lives and say maybe for every a hundred units that we reduce down here, we can put one up there. And I don't think there's any plausible case to say that one is going to make the mutant shrimp.

[01:11:10] You know, we're dealing with a small. Change of direction in a program of aggregate environmental improvement.

[01:11:16] **Nate Hagens:** Well, where I was going with that, the, the mutant shrimp was just a hypothetical is that we, it's vivid. See, we will see something happening that's negative somewhere. Yes. And that will be in our game, theoretical prisoner dilemmas minds.

[01:11:33] That will be the negative. Yeah. And the benefit will be conceptual in the future. Yeah. For all of humanity in the biosphere. And that gets back to our human behavior. Yeah. Steep discount rate sort of thing. So better

[01:11:44] **Ted Parson:** than mutant shrimp. I mean, you need to think about, fires in Spain or California, or floods in Pakistan, or heat extremes in, in the Mediterranean.

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[01:11:53] So there's extreme horrible things happening now. Yeah. Extreme, horrible things happen even under an unmodified climate. The climate's variable and there's droughts and heat waves and everything we're doing with greenhouse gases and making it worse. So as soon as somebody starts doing something like this, there will be floods.

[01:12:13] There will be fires, there will be heat

[01:12:15] **Nate Hagens:** extremes. And if 95% of the world is slightly better, but that one place in the world is worse, that place that's worse is gonna get the airplay and

[01:12:24] **Ted Parson:** or if what you've done. Make a trajectory that's go, was going toward the utterly, absolutely horrible. A little less horrible in the interim, but it's still horrible, than it was 10 years ago.

[01:12:37] Then, yeah, in terms of perception of effects, so, so people have thought about, liability and insurance and risk sharing schemes for climate and weather emergencies. I think it's a mistake to think about those exclusively in the context of geo engineering. I think you need to think about those more broadly in terms of climate and environmental risks.

[01:12:56] **Nate Hagens:** This whole thing is like, and sometimes this entire podcast is like a Twilight Zone episode being unpacked seriously. Yep. Like, I didn't really think about this, deeply, and I suspect 90% might be an exaggeration. It's your guess, but I suspect it's, more likely than I had expected, that this will happen.

[01:13:18] **Ted Parson:** Yeah, it is my guess. Hardly anybody's thought about this. I mean, it's been a, tiny community for a while. let me still with my naive, optimistic,

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delusional hat on. Let me tell you something. I've observed changed, so I've been talking about this for a long time, since I, first learned about this 25 years ago.

[01:13:35] And for a long time, wherever I spoke about it, whether it was an academic seminars or the Rotary Club, the main reaction would be, oh my God, you're thinking about this like sci-fi horrible thing. We must be just completely doomed. The past two years, that's really changed and I see more and more people, especially younger people, but not just younger people saying, I was in such despair over climate change.

[01:14:01] I figured I could never had have children. I was actually thinking about hurting, you know, harming myself. And this is the first really po like, credibly positive thing I've heard. Even if it doesn't mean there's something I could do that would make a difference, it means that the set of possible responses available to people, to humanity includes things that would actually mitigate the harms that are coming soon.

[01:14:26] And, so it's giving me hope. And I don't want to be, you know, naive or simplistic about this, but I want, that's a real thing. And I've seen a lot of that this week. You've seen it. Yeah. the big press, it's really ironic, the press for a serious non delusional. Adult respectful conversation on these is mainly coming from very young people, young, I mean young adults who are sort of able to engage and come to meetings like this and so on.

[01:14:55] But I find the clarity and courage of what I hear from a lot of younger people in conversations today and this week, really kind of moving,

[01:15:05] **Nate Hagens:** well, they're gonna be alive the next 50 years and this is gonna happen on their watch. Yeah. I mean, it's, more salient to than to you and I. So what are the guideposts for the people?

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[01:15:17] Listening and, following your argument, what are the things that we should look for on this topic in the coming, coming decade? So, in terms of

[01:15:25] **Ted Parson:** events to look for,

[01:15:26] **Nate Hagens:** well, just what should we consider as we think about, the headlines? And keep in mind the, progress or lack thereof on geoengineering and climate.

[01:15:36] **Ted Parson:** You wanna see a shift in the conversation about whether this stuff is so off the table, that you can't even do research. So you wanna see a serious increase of people, attention and resources going to research on these interventions. You want to see the start of, non polemical, non-ideological, like serious risks.

[01:16:03] Risk informed conversations in governments and in intergovernmental fora. And my guess is those will start in a kind of a collegial, professional way of sort of officials, you know, interacting with trusted counterparts from other governments and say, what do you think about this? I mean, you know, there's, you know, it's hard to talk about.

[01:16:22] It's frightening, but, you know, and I see some and expect more progress on that, notwithstanding quick press to sort of reflexive, peremptory decisions at some more senior political levels. There's a lot of political risks, and they come from all sides. They, come from all over the world and they come from all over the, you know, the complex political map and there's a lot of serious.

[01:16:52] Progress. So I, I, in a prior conversation, I shared with you my thought. I have this strange intuition that I think much of the leadership on the governance challenges that are related to these is likely to come from middle and lower income countries in the global south. I think there are many countries and sort of

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across the developing and the middle income world where senior officials and political decision makers have, a more pragmatic and informed view of the severity and eminence of climate risks and are less inclined to preemptively try to shut down conversations.

[01:17:28] So I was at a, meeting in South Africa a few months ago on this, and I was. where there were some preliminary regional dialogues with, officials in completely non-official capacity, right? I mean, these were individuals learning and interacting for the first time across the developing world that were really kind of inspiring.

[01:17:47] It's like people saying things like, I can't believe this scientific conversation is so advanced and there's such an important thing, and I and my colleagues have never heard of it. We need to learn more and we need to speak with our colleagues from other countries. so, the more vulnerable the country, the less they, the less officials and political leaders can indulge in the fantasy that, cutting emissions instantly will make this goal go away and everything will be fine.

[01:18:19] **Nate Hagens:** This is so fascinating. I'm, as when we met in person, I'm so impressed by the clarity and wide boundary scholarship, and research you've done on this. It's a scary topic, but I realize it's more real than I had expected. Do you have any closing thoughts, to share with our viewers who, who might be learning about this like me for the first time?

[01:18:43] **Ted Parson:** Yeah. I think it's really important to keep this conversation in context of the climate issue and the set of available responses, so. Climate change really is, a crisis beyond the capabilities of current, institutions and policies and beyond most people's imagining. And although we are finally making really important progress on aspects of it that are essential, near term risks are so severe that it's possible that nothing that we do can mitigate them much.

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[01:19:17] So nobody likes to think about these interventions, but it is essential that we do so. And the little bit of research that's been done more than a little, it's a, it's not enough, but it's, enough to start to have confidence in suggests that if appropriately and prudently used stratospheric aerosol, interventions could cool, the planet, could mitigate many near term climate risks.

[01:19:43] Could do so in a way that. Doesn't create strong winners and losers and opportunities for real material based conflict and does so with risks and harms associated, which are never zero, but look pretty well understood and pretty small relative to the severity of risk avoided. So the biggest challenges are governance.

[01:20:05] They're very difficult. Not in my view, insurmountable, but there's urgent work that has to start with serious conversations and the development of shared understanding and trust across nations and institutions and communities. That's always challenging. It's especially challenging in this environment, but.

[01:20:24] I don't actually see any alternative Professor Ted Parson, thank you very much. Thank you so much for the opportunity to be here. It's really been a pleasure.

[01:20:32] **Nate Hagens:** If you enjoyed or learned from this episode of The Great Simplification, please follow us on your favorite podcast platform. You can also visit The Great Simplification dot com for references and show notes from today's conversation.

[01:20:48] And to connect with fellow listeners of this podcast, check out our Discord channel. This show is hosted by me, Nate Hagens, edited by No Troublemakers Media, and produced by Misty Stinnett, Leslie Balu, Brady Hayan, and Lizzie Sir.