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Michael O'Hanlon [00:04:08] I think we'll go ahead and start. I'm Michael O'Hanlon with the Foreign Policy program at Brookings. Welcome. Thank you for joining us in this conversation with David Victor and Samantha Gross, my colleagues from San Diego and 1775 Mass Ave respectively, about the issue of what to do about the climate and some new strategies for how to address. I think many of you, most of you, all of you may know that this is an event built around David's new book with Charles Sabel of Columbia University, 'Fixing the Climate: Strategies for an Uncertain World.' I'm going to say a quick word about the book and then pass the baton to Samantha, who will ask David to talk through the book, some of its main themes, and then after she's done that, I'll have my turn at the inquisition, but I'll actually ask both of them to respond to some broader questions that also involve some security dimensions of the, of the climate matter. And then we'll go to your questions as well over the next hour.

I think the best thing I can do, just by way of brief introduction— because we're really going to hear from Samantha and David on the contents of the book and the main arguments— is that for those of you who like me are fortunate enough to know David, this book really is infused with his spirit because it is in part a book about climate and fixing the climate. It's also a book about activism. It's also a book about imagination. It's also a book about challenging the status quo and challenging normal ways of thinking through problems, whether it's the Washington inside the Beltway approach or Kyoto or Paris or many of the other big, broad, multilateral fora that have been employed over the last three decades or so to try to get a handle on rising temperatures and changing climate. And this book sort of turns the problem upside down with a lot of local ideas, local energy, experimentalism, entrepreneurship, and really trying to say, you know, if what we're doing now ain't quite working and needs a shot in the arm, maybe the best way to do it is not to impose it from above, but to try to inspire and empower it from below. So anyway, that's my interpretation. They can now correct my interpretation if I didn't get it right. But I just really want to thank you, David, for coming out, for writing the book. And Samantha, over to you, my friend.

Samantha Gross [00:06:26] Thank you very much. And also my thanks to David for joining us today as well. It's always good to see you in person rather than in the little, the little Hollywood squares. But the book is a really interesting one. I enjoyed reading it and I'm hoping that we can sort of help some people get the gist of it here while we're speaking. And in the book, you and Chuck Sabel, your coauthor, focus on an experimentalist approach, as you call it, to environmental problem

solving and use what I think personally is the most successful global agreement ever on environment, on the environment, the Montreal Protocol as an example of such an approach. Can you just walk our audience, those who haven't had the chance to read the book on what an experimentalist approach is and how that played out in practice?

David Victor [00:07:09] Yeah, well, thank you very much and thanks also Mike for that really good kind words in the beginning, I had not known inquisition was going to be part of the discussion, but I will adjust my armor and thanks for organizing this. Really, really great to be here and great to welcome everybody at home on the webcast. So the Montreal Protocol is a really interesting example of the larger argument that we have in the book, Chuck and I have in the book about experimentalism. And the larger idea is that how does society solve problems when there, there's a strong motivation to do something, but nobody really knows what to do. And it turns out that that language and the language of experimentalism is unfamiliar, but actually these processes are quite familiar. You see them all over the place, you see them in how California has successfully cleared up a lot of its air pollution problems where regulators didn't know what to do. And so they ended up collaborating with industry to, in effect, go off and run a bunch of experiments and learn quickly what works and so on. And part of what the book does is it goes back and retells iconic stories in history that we thought we all knew, kind of chestnuts over a warm fire, but through the lens of experimentalism. And the Montreal Protocol is in some sense the iconic example.

So I want to say two things about the Montreal Protocol. One is what actually happened and how does that tell us about how communities solve these kinds of problems and in this case, an international environmental problem, thinning of the ozone layer. And then also a little bit about what everybody thought they learned from that experience, because on both fronts, the, the storied history is just wrong. And what we're trying to do in this book is correct them.

So what actually happened? If you rewind the tape of history and it looks like many of you were too young to know that there used to be these tape machines and there was tape on them, and you rewind the tape and you push play, and then you would listen to listen to the music again. If you rewind the tape of history back to the time when the Montreal Protocol on the ozone layer was being, was being formed, 1987 was a key year, and the problem was really serious. A hole, literally a hole in the ozone layer had been detected. And people, the standard wisdom is, well, we worked on the problem, we set very clear limits through international treaties, the Montreal Protocol, firms knew what

to do, some firms discovered they could make more money in the new chemicals than they had the old chemicals, and so suddenly the industry lined up and they were really excited about solving this environmental problem because they stood to make a lot more money and everybody kind of knew what to do.

So we went back and reread the original documents and people didn't know what to do. The key scientific experiments that that figured out what was causing the hole in the ozone layer, those scientific experiments, actually, they were flown on a converted U-2 spy plane, the ER-2 flown out of Chile into the ozone hole, actually, a month after the, the, the Montreal Protocol was signed. And the key results didn't come in until after, after the agreement. The industry players at the time didn't really know what to do. They didn't know what chemicals would work or not, they didn't know whether they stood to gain or lose financially from this. The industry itself was not a monolith, there were firms from different kinds of interests and so on.

So what happened is that is the treaty set a very ambitious goal, but more importantly, it set up a set of mechanisms whereby industry and government working together could go off and check and see which solutions to, to regulating these pollutants, which solutions were actually working and not working. And then those mechanisms allowed them to adjust, to ratchet tighter or to loosen up the obligations. And so there was always, there were ambitious goals, but there was always a mechanism to keep the goals, that keep efforts connected to the goals and then to adjust the goals. And what we, what we lay out in the book is how these institutions work when they work successfully, when they don't work. And in effect, what they do is they, they decentralize the search process and then they centralize the process of evaluating which of these experiments work and don't work. And that's the key to understanding why the Montreal Protocol was successful.

But if I say one more word about it. Sorry for long answers, but one of the great things about one of the great things about Brookings, working at Brookings and the Brookings Institution, is we have a chance to really look at things in depth. I want to say one more thing about the Montreal Protocol. Almost everybody in the diplomatic community saw this tremendous success of Montreal, and they learned exactly the wrong lessons from it. They learned from that, if we want to solve these kinds of problems, all you need to do is set really aggressive, legally binding targets and timetables and stay firm, and then industry is going to line up. And the lesson from Montreal is actually the opposite, which is it wasn't the legally binding target and timetable by itself that was doing the work. It

was the mechanism for experimentalism and bringing industry into the experimental process in the case and then the lesson was applied in the Framework Convention on Climate Change, on the Kyoto Protocol, and the Kyoto Protocol just failed miserably. And it was applied in a way that that made sacrosanct the binding targets and timetables and ignored all the other institutional machinery, including, frankly, the role of industry in making that machinery work, it ignored all that. And so it kind of launched climate change diplomacy off on this trajectory that was guaranteed to fail. And only with the Paris Agreement have we kind of begun to claw it back and redirect it in a positive direction.

Samantha Gross [00:12:20] Yeah, that's, that's a terrific summary. As I read the book, a steady theme that I, that I got is as you're dealing with really complex problems, you don't even know beforehand what's possible. You don't know in what timeframe, but you set goals anyway. I mean, you saw that with the Montreal Protocol. When I, when I moved to California in 1993, I looked at the ZEV mandate and said, that's not possible, and yet it worked. And you describe how it worked in the book. Can you explain to us how to think about designing policy in that environment of extreme uncertainty and what worked in those two programs and perhaps what we're not doing in climate today?

David Victor [00:12:58] Yeah, you know, uncertainty's in the title and those who have written a book know that one of the hardest things to do in a book, well, to finish the book is helpful as a precondition for what I'm about to say, but then you've got to come up with a title. So what words really matter? Uncertainty's in the title. This whole book is about uncertainty. In some senses, you can read it as almost as a business book or a government institutional design book. It's about how do these, how do organizations handle deep uncertainty where they're highly motivated to do something, but then they need to figure out how to narrow the uncertainty and so on.

So what do we learn from this process? One, the most important thing is the motivation for government and business to go search for solutions. So take California, for example. California had to clear the air in part because there was a federal national ambient air quality standards that required meeting these goals. And for a variety of political reasons in California, a very strong motivation for the LA basin, other basins to clean up the air because you literally could not see across the street. So that's a problem. And, and people wanted to have solutions to those problems. So you have this very strong motivation that empowered California's regulators to say in this case that the car industry, thou shalt make radical reductions in emissions. And we think the solution to this problem is, is what at the

time were called zero emission vehicles, ZEVs. And they actually thought at the time that ZEV was going to be an electric vehicle, that terms of batteries were not ready for it. And so the solutions were actually totally different from what they thought the original solutions would be. The industry said, you're crazy, California, you know, stop smoking and inhaling all that dope and so on.

Samantha Gross [00:14:32] Bought it too.

David Victor [00:14:33] Yeah, exactly. And then what the regulators did is they, they, in effect, divided the industry. So they found enough automakers that were willing to work with the regulators to devise standards and to test those standards. And so that solved the problem the regulator had, which was not knowing enough about the frontier of the automotive technology because they were then able to work with parts of industry. So then they developed rules. They ratcheted the rules tighter and then sometimes loosened them up. And that ultimately is the success of how California cleared the air. Frankly, that's the success of the early days of, of what became the modifications the Clean Air Act in 1990, the acid rain program. We tend to look back at that and say, you know, we used market solutions for that, and the markets helped but only at the end. Almost all the real work was done by regulators working with industry to figure out what kinds of scrubbers, what kinds of changes in coal could reduce pollution and so on.

So I think this, I think you picked up on the essence of the book, which is it's how to manage uncertainty. And if you, if you have uncertainty that at relatively low levels where, you know, you can, you know, kind of roughly what to do, then you go do it and you adjust a little bit the margins here and there, if you have this kind of profound uncertainty, you don't know what direction to travel, so you have to search widely. Think about this as a probability distribution function. We have lots of different possibilities. You have to run experiments and all tales of distribution to figure out what actually might work.

Samantha Gross [00:15:59] And in your answer to that, a word that I keep hearing a lot in addition to uncertainty is industry. And I feel like this experimental, experimentalist, collaborative approach that you're talking about collaborating with industry is crucially important. I mean, with the chemical industry, with Montreal Protocol, automotive industry for ZEVs, etc. But we see a lot of reluctance in climate circles to collaborate with the industry, given that they're the root cause of the problem, when it comes right down to it. How do you take this experimentalist approach with respect to climate without running into the issue of regulatory capture or almost as problematic, the

appearance of regulatory capture, which could be a big political problem in the environment we live in?

David Victor [00:16:44] I know I think this is a, this is vitally important. And we've seen climate change is a really hard problem. So it's not surprising that it's taking a long time to address it. And luckily, many of the solutions to address the ozone layer problem came up earlier. In the places where the ozone layer problem has proved harder to solve, some halons and some methyl bromide, a few other chemicals. In fact, there's a long tail of kind of inaction and these kinds of concerns about, about industrial capture. I guess I'd say a few things. It's vitally, the incentive for firms to disrupt the status quo is vitally important. And this is where firms collaborating with government by themselves often result in exactly this kind of capture. NGOs play an incredibly important role. You know, when the, when the CEO of the company arrives home and there are people chained to the front gate or they superglue themselves to the headquarters, I think, or their kids, you know, berate the, the leadership of the company on the breakfast table, you know, what are you doing, mom or dad, to solve the climate problem or are you just burning the planet and I'm taking my oatmeal and going to my room, those kinds of things. And we laugh at them.

Samantha Gross [00:17:55] No, but it's real.

David Victor [00:17:56] But the number of times that I've heard from senior leadership, the C-suite that's doing something serious, but they don't know what to do, why are you doing this? They don't think of this as a compliance problem. If you've got existing regulations or you've got a carbon tax at the margin, that's a small number, that's a compliance problem. And so the firm treats that as a compliance problem. You delegate it to compliance authority, you know, the corporate social responsibility people write a glossy report about it, you smile and then you move on. But when, the key to disruption in an industry is do not treat this as a compliance problem, but to treat this as, okay, what might I have to do in my, in my business to radically transform and address this, this problem? And the motivation there ultimately is not just government. It's quite often, it's the activist community. And they're playing, and the parts of it that I think make business most uncomfortable are the parts of it that are actually in some sense most motivating.

So let me give you an example from an industry you know well. Oil and gas, you see this huge variation around the world in how the oil and gas, the incumbent oil and gas firms are responding to the climate change problem. Who's out in front? European headquartered companies.

Why are they out in front? Because I think what was it, BP was told, they're no longer allowed to be a sponsor of the National Portrait Gallery or the Tate, I think it was maybe with the Tate. So, you know, and you'd like to do that. And so that's a sign that, you know, you're losing social license. You've got in the case of the Dutch lawsuit; you've got serious legal liability. In the case of Equinor, the former Statoil and the state-owned oil company in Norway, you've got your shareholder is the government and the government is reliably green. And so they're putting enormous amount of pressure on you. And if you're in senior management, you know that if you don't do something serious about the problem, you're out of a job and your whole firm loses its license to operate.

So what are these companies doing? You've got a huge array of responses. You've got Total is trying to become an electric company to some degree. Other companies, Equinor I mentioned is trying to capitalize on their expertise in downhole and carbon capture and storage. You've got BP involved with that activity along with offshore platforms because maybe we'll have offshore wind will be a big part of the solution. So you've got all these experiments that you see are now maybe 10%, 15% of the capital budgets so not zero, not 100%. And, you know, they're still doing the core business, you know, producing oil and gas, that's what freezes core revenue. But they're motivated to run these experiments.

The American business companies, for the most part have been behind. Now more of them are running more experiments and, and so you're see, this incentive to, to run experiments is, is the key to the whole thing. And that helps address this fear of regulatory capture. The fear doesn't disappear because you've got this collaboration that's really necessary. But once the firm has an incentive to run experiments and, and figure out which businesses you can build on new things, and then they suddenly move into a new business. And then you've got members of the industry that have an incentive in disrupting the industry, and then it starts to fall apart. That's what happened in California is you broke, you had a few automakers that broke with the rest of the industry, they worked with California regulators. And then once you got the rules in place, then they have an incentive for those rules to get stronger. You see the same thing happening right now with electric vehicles. Not surprisingly, that Tesla has figured out that, you know, despite all the libertarian instincts of its, of its founder, that they're, they're a business that thrives on regulation and incentives. And so they now have a strong incentive to basically beat up on the rest of their own industry because that disruption is

good for that company. And so the politics here are dynamic, but they're self-supporting once they get going.

Samantha Gross [00:21:30] The difference between the American headquartered companies and the European ones, what is driving those European companies to have a greater incentive to run these experiments, is that European policy is it the European public? Why are you seeing less of that here, you think?

David Victor [00:21:44] Well, I think this is one of those things that gives us analysts discomfort, because we'd like to put a number on it. We'd like to say well the effective price on carbon is X and therefore the company is optimizing by doing Y and Z and you know, yadda, yadda, yadda. I just don't see a lot of evidence that that's true. I think if you looked at all the existing policies and turn them into effective prices on carbon, they don't yet add up to something that's transformative to the business. What's transformative of the business is this fear, as I mentioned, this kind of loss of license to operate is a very, very big motivator, a growing number of companies, it's legal, frankly, a legal liability, Equinor is a special case because it's state owned, it's, it's state owned.

But I think ultimately, it's this concern that when you look at where the— and I guess we're in the hockey season now— so when you look at where the puck is headed, the puck is headed to an industry where if demand for their products starts to decline, we're not yet there, then high-cost producers are going to be left out. These, for the most part, are high-cost producers, whereas the Persian Gulf producers are lower and lower cost, and so you can get squeezed out of your core profitable business. And you're in a market that is demanding something totally different from the energy business and you're not ready for it. And so you've got to figure out what are you good at doing that aligns with this new mission of decarbonization? And I don't think they know. I don't, I'm not sure I know. My guess is that most of the companies that are going to become electric, trying to become electric companies, that that will fail. They're not very good at being electric companies. That's outside core business. My guess is the companies that are doing carbon capture and storage, maybe some offshore that that's actually better lined up with, with core.

It'll be interesting to see what happens in hydrogen. It's a question of how do you wean dependence on fossil natural gas and could you be a hydrogen producer that, using hydrogen in the gaseous pipelines instead of natural gas, that that's a, that's a very attractive it's a risky, but it's a very, very attractive business. There's not a lot of direct subsidies for this. And so you've got all of these

different efforts to try and figure out what is the industry of the future. And when you go back 20 or 30 years from now and look at this, maybe half those companies or more could disappear because of this. They will have bet incorrectly. Yeah.

Samantha Gross [00:23:55] I have one more question before I hand it over to my friend Mike, and that is that it seems like parts of the, parts of the legislation that has passed since you finished your book do embrace your approach. There's a lot of emphasis innovation and early-stage financing running these kinds of experiments, through things like RPE and the DOE loan guarantee program. Do you have any thoughts you want to share about how the recent legislation does or doesn't fit with the recommendations of your book?

David Victor [00:24:21] Yes. And, and Chuck and I wrote a piece for Yale, E360 that is co published on the Brookings website about exactly this issue where we're looking at the Inflation Reduction Act, the IRA and the IRA, exactly as you implied in your question, the IRA is the most visible piece of climate legislation.

Samantha Gross [00:24:39] Not the only one.

David Victor [00:24:39] But not the only one. And there are three major spending bills over the last year. It's really incredible. You've got the Bipartisan Infrastructure Act, which gives a lot of money for hydrogen and hydrogen hubs. So if you want to reduce dependence on fossil methane, you need alternatives, hydrogen may be one of them. It's expensive right now. And so the idea is you build these hubs, they get started, you identify early users of hydrogen, whether it's, you know, ammonia production for fertilizers or making hydrogen and using it to make electricity to help stabilize the grid when wind is not blowing and the sun is not shining, all these different business models. So we could be doing that with a bipartisan infrastructure bill.

And then the CHIPS Act. The Chips Act on the surface is not at all about energy. But when you look behind the surface, the legislative language makes it very clear that some parts of energy, energy efficiency and some other things are in, and it's a huge pulse of spending onshore and also of spending around advanced technologies, systems integration and so on. And the energy business is moving in that direction. Electricity's already there. A lot of oil and gas is already there where you have a huge role for, for information technology and systems integration to make the energy business of the future. So it's really a totally different situation for the United States from, from a year ago, it

doesn't mean we can meet our, the goals, emission goals that we promised the world. But the United States is back, as it were, and it's back in an industrial policy model.

But what's interesting is, is Chuck and I in fact were just talking about this earlier today, the European industrial policy model is let's build the institutions for industrial policy and make some promises about spending, but the institutions are all set up and bring the industry together and do that. And that's happening right now. The American model, if you can call it a model, I think it's more like a dog's breakfast of activity that we now are calling industrial policy, if the American model is you've got a lot of spending that's kind of being held together with a new vision of industrial policy that, frankly, has bipartisan support. And that, I think, is the key to understanding for Inflation Reduction Act for example, is a lot of that money is just going to go out the door through the IRS and tax credits and just be spent on whatever project shows up and qualifies according to the IRS. That's not industrial policy, really. That's subsidizing things that that that are that are your friends.

And then some of the money is going through institutions that are really industrial policy institutions. I believe the best example is the DOE loan program where you take relatively small amounts of money, you use that for a loan guarantee, so in effect, you lower the costs of financing for different projects. You figure out what package of projects you want to have go forward because they, in effect were experiments is not the language they use, I think if you said to Congress, I want to run a bunch of experiments and take your money, now that would not happen. So they're using different language, but it's experimentalist logic, and the track record is pretty good there, I'm actually worried they're not taking enough risk because the political blowback after Solyndra and so on is, is high if you take risks and you fail when you're in government. But that I think what we're seeing is the green shoots of a new kind of industrial policy and a whole lot of money behind it.

Samantha Gross [00:27:45] And that's an intriguing place to end this little bit of the conversation, I think. Mike, how about I hand it over to you.

Michael O'Hanlon [00:27:51] I'll hand it over to Joe Sixpack, we've just had a nice little discussion, but Joe Sixpack has a couple of big picture questions. Thank you very much, both of you, for, for how you frame this very innovative set of policies. But let me sort of be Joe Sixpack, devil's advocate. And what I mean to say is not in any way to criticize this amazing book, but to ask, is it offering enough hope given where we are on the climate trajectory? Because whatever I read these days, including by both of you and as I try to track the world's efforts to move away from hydrocarbons

and reduce the pace at which we're warming the climate, it seems like, to be blunt, we're basically failing. We're not going to make any of the goals and we're going to overheat the planet based on the trajectory that we're on.

Now, in one sense, that's a vindication of your argument because we've been trying the wrong things, maybe you're trying the wrong way. But in another sense, aren't we going to have to get, you know, really serious pretty quickly about this problem, including making people do things they don't want to do? I don't want to spend \$7,000 more for my next car, even if I get a \$7,000 subsidy. But the car costs 14,000 more, so I buy another car that burns gas. At what point do you tell me, Joe Sixpack, I have to buy an electric car. Or to put it differently, is it time for a carbon tax or should we do this innovative sort of bottom-up approach, maybe two or three or four or five more years, but then by 2027, start making people do things that we don't necessarily want to do, but we have to do if we're not going to burn up the planet. So how long can we afford the sort of bottom-up approach? If I could start with you, David, then ask you as well, Samantha.

David Victor [00:29:29] Yeah, well, Joe, I think it's a good question. First, I think right now the politics don't let you force people to eat their spinach for better or for worse. The Inflation Reduction Act is a little bit like giving people dessert, giving the kids dessert before dinner, and then saying, you know, later on you're going to actually be required to eat your spinach. And the kids say, I had dessert, give me some more dessert. And so I think that's where we are with the politics. To some degree we're there because unlike in the European market, we have not long enough actually been investing in enough of the experiments. And so almost everything that's transformative looks expensive and disruptive right now because it is and as we do more of these experiments and as we run, you know, do more of the loan program and so on, things will become more familiar, costs will come down, they'll crucially, they'll become familiar, they'll become easier to finance with that finance. And then, then you're in a different world where you can require things.

My guess is that something like an optimal, and its actually some modeling work going on right now to try and model quantify this, and the model, the early results from the models suggest that what we're doing right now is actually pretty close to a first best strategy, which is you run a bunch of experiments, you subsidize new technologies and ideas, and then later you require it. Now, that requires that we actually do that, that we actually do that later and I think the jury's out as to whether we're going to be able to require people to do things. I'm wary about the requirements. I'll take the

example electric vehicles. I'm a little wary about that because in my state, California has a requirement now that no new internal combustion engines be sold for light duty vehicles after 2035. I don't see that the technology is ready and may not be ready by 2035 to go 100%. So I'm actually very concerned they'll have another kind of sagebrush rebellion if you require too quickly people to switch over.

But then that goes to the core of your question, which is when you add it all up, doesn't this mean we're failing? I think we've actually made amazing progress. But those of us in the climate policy analyst world continue to use the wrong yardsticks. The progress we've made is ten years ago, the baseline, the projection, the standard projection for how much warming we were in over the coming century was about five degrees of warming. That's a huge, I mean, so much change five degrees centigrade, real warming, not Fahrenheit, little kids warming.

Samantha Gross [00:31:48] Little degrees.

David Victor [00:31:50] And that's so much change that we didn't really know how to estimate the physical impacts of something like that because it's so disruptive. Now we're on track for about two and a half degrees of warming. So that's still more than, that's, that's a lot of warming, it's more than two, which was the goal written into the Paris Agreement. But because we keep using these crazy goals of one and a half degrees warming or two degrees of warming, and we create this image that the world's going to fall off a cliff, there'll be some tipping point and life is going to be over a little bit of a caricature, but frankly, not much of a caricature that we've set, we set the wrong yardstick for progress. And so we're in for a huge amount of climate change. There's going to be big national security consequences, other consequences from that. But the, this process is actually producing tangible results. One of the reasons Chuck and I wrote this book is that, you know, it's a little bit like somebody's speaking prose for their whole life and not knowing it is that actually the progress is coming out of institutions and industrial organizations and governments that are doing the kinds of things to some degree that we articulate in the book.

Michael O'Hanlon [00:32:50] Fantastic. Would you like to comment?

Samantha Gross [00:32:51] Yeah, I'd love to add just a couple of brief points. One of them is, I completely agree. We're not talking nearly enough about how we have gone from an anticipated five degrees to an anticipated two and a half-ish. That is huge progress. And I feel like a lot of people on the ground think we haven't done anything. Whereas that's completely not true. We've also seen the

cost of technologies come down tremendously, which means there is more and more that is likely to happen because of progress that we've made on the technology side. The environmental movement I feel like it's never good at celebrating victories. I could rattle off a few, but we're always focused on the next problem, and I think sometimes we need to be like, okay, we're not there yet, but we haven't done nothing. And I think it's important that people recognize that. The other thing I'll say is I happen to like spinach, but I think what's happening in.

David Victor [00:33:43] This was not an anti-spinach comment, the spinach lobby—.

Samantha Gross [00:33:45] Not at all. And I'm saying that totally for fun. And the reason why I'm saying it is because I feel like a lot of the things we're working on today are designed to make that spinach tastier. This is like the spinach, you get at Jaleo that's super delicious because the technologies are getting less expensive, they're getting better. Electric cars are fun to drive. Okay, maybe you don't buy an electric car. Maybe you, you buy a plug-in hybrid or whatever that meets your needs better. But the idea, the idea is like it's hard to make people eat untasty spinach in a democracy. So the idea is to prepare that spinach well, to make the technologies better, cheaper and more likely to be adopted, because forcing bad spinach down people's throat in a democracy is really, really hard. And so the things that I think you're focused on and the things I talk about a lot are how, how do we put this forward in a way that's tasty for people? I mean, there's nobody likes sacrifice and people don't vote for sacrifice in a democracy.

David Victor [00:34:39] So there's a whole lot of cool work going on. The field of political science, which is where my training is in, if that's not an oxymoron, your Ph is in political science, too.

Michael O'Hanlon [00:34:50] Yeah, but you know, some physics, too. And so do I. So let's give ourselves a little bit, okay?

Samantha Gross [00:34:54] But I'm an engineer.

David Victor [00:34:55] The whole field of political science was way too slow and getting serious about the climate problem because it didn't map onto the way normal reward structure and the discipline and so on. So very few political scientists worked on the problem, even though the problem is you're not the only problem in the world, but a pretty significant one, that's not changing very quickly. And to me, what's interesting is the part of the, the political science research that has been most relevant to real problem solving here is the political science research that thinks about political interests as dynamic.

So you start off and you've got an incumbent industry that doesn't want to change, and nothing happens, and then you disrupt a little bit of the industry. Somebody invests capital in new technology, they start building market share and then new technology. Then that starts to disrupt the industry, typically not at its core, but around the edges. And then the disruption kind of spreads out from there. And it's analogous for those who study trade economics, the new, new trade theory was doing the same thing, where you have openness of an economy to an international trade that advantages some firms that are good at international trade. They get more powerful, they gain market share, they gain political power, and then they reinforce and adjust the policies. And so what you have is this this dynamic politics or this plastic politics where the politics are changing over time, making the problem easier. So it looks at the beginning, like a prisoner's dilemma or some other kind of impossible problem becomes an easier problem to solve as the technology changes and as the market shares shift and as lobbying behavior shifts.

Michael O'Hanlon [00:36:26] Great. Those are awesome answers. I have two more questions then we'll go to you. And they sort of, I hope, follow sort of logically and sequentially from what you both just said. First of all, thanks for finding a way to talk about this problem with some encouragement and some optimism to both of you. But second, I'm still not totally relieved and I know you aren't either, because two and a half degrees centigrade is a lot and we already, we're about half of that right now, we're already seeing a lot of things change in the world for the worse, for the most, or at least disrupting in ways that are affecting people's lives in the Sahel of Africa and with stronger storms and a number of other problems.

So this raises the question, if the most we can hope for is to get a little bit more creative and entrepreneurial and maybe, you know, keep it to two and a quarter instead of two and a half, do we have to do geo-engineering? And this has been a taboo topic for a long time. The idea of putting aerosols into the high atmosphere or some other way to reflect a certain small fraction of incoming sunlight or otherwise, either cool the planet, if you like to use that phrase, or reduce the warming and at least do this temporarily for the period of time when we're still finding tastier spinach. And so that's my question to the two of you. I know you've both thought about it. Most people have been very wary of the idea of climate engineering because, you know, you're messing with God's handiwork, right? You're imposing one giant problem or approach to changing the earth on top of another, and that doesn't feel too natural or too good. On the other hand, we do know from Mount Pinatubo and other

things how much sunlight you tend to reflect with a certain amount of particulate matter, and we sort of know how to put it up there if we so choose, so should we do it, and if so on roughly what time horizon should we make that decision. Starting again with you, David.

David Victor [00:38:10] I don't know about the should answer yet, partly because we don't really know how to put the pieces together. We also don't know how to do the international cooperation that probably would be necessary because you can do kind of simple geoengineering where you mimic the effect of a volcano. It would probably require a dedicated fleet of aircraft designed to fly in the upper troposphere and put these sort of sulfate precursors up there, refresh them because they fall out of the atmosphere in about a year to two-year time scale, and people have costed that out. What's interesting to me is the cost of that is not very great. Say \$10 billion or \$20 billion a year, which I mean, used to be real money. Apparently, it's not real money anymore. That to me, what's interesting about that is a crude geoengineering program could be inexpensive but would have lots of side effects. You could imagine other kinds of interventions to address some of the side effects, but they then raise the cost enormously.

And my concern is that the incentives for a country that feels it's really suffering the effects of climate change already to go off and unilaterally do a geo-engineering program. Imagine the Chinese for example doing something like this because they're looking at the effects already on the water supply inside China. Look at Bangladesh where that amount of money is maybe 10% of GDP, so not zero, but on the scale of what we spent on other kinds of national emergencies, we're really put to the wall. My concern is that we right now in the Western countries, don't have even enough of a research program that we would know what another country's unilateral deployment of a geoengineering program and what impacts that might have, what kinds of countervailing measures you could take, I mean, this is very quickly actually becomes a problem that it's much more familiar to people who study security systems than people who study environmental systems.

What kinds of countervailing measures could you take outside of shooting at, shooting down aircraft? For a big country like China, the aircraft would be in Chinese airspace, so that's probably not a good idea. Could you counter, counter geoengineering? Geoengineer the system, people talking about that, but we never really demonstrated anything along those scales. And so the kind of, kind of getting ready for what your response would be and also demonstrating what responsible research programs could be to kind of build some norms of responsible research at least, all that could happen

if Western countries had a research program in this area. But because the politics are so difficult, we're not even really doing that. So that's my big concern about geoengineering. I think it's way too early to talk about deployment, but it's not too early to talk about a research program. And I've written a bunch of stuff to advocate for that and the impact of that, certainly on my work in this area has been zero. We just are not doing even the research.

Michael O'Hanlon [00:40:51] Thank you. And before I go to Samantha with the same question, if it's way too early now based on extrapolation and projection and the hope of research programs getting serious, when might it not be too serious? The 2030s or more like mid-century.

David Victor [00:41:07] You could stand up a program over the next five or ten years. My expectation is there is a Chinese program. We just don't know very much about it. There was a Soviet program that then became a Russian program, but it was just terrible. So presumably some parts of that still exist. There have been some research projects here and there, but nothing credible. So the time constants here for running a program that could get up to the point of deployment are on the order of five or ten years. My guess is that we would never, Western, most democracies would not see—and this is a bunch of assumptions about how democracies make decisions that I recognize are fraught to some assumptions—most democracies probably would not get to the point of deployment with the kinds of impacts that we expect or likely impacts over the next decade or two. But they could well get to deployment if we had unexpected and severe climate impacts in the 2040s or so.

Michael O'Hanlon [00:41:59] Thank you. Any comment on that same question?

Samantha Gross [00:42:01] Yeah, I'll just, I don't have a lot to add. And it's funny that the engineer up here is going to talk about politics, but this is just the granddaddy of global governance problems. And it has become such a taboo that, that sort of Western governments and scientists aren't looking into it to the degree that they should, it's such that it might be available, and we would want to deploy, deploy it. And that's a little scary.

I completely agree with you that we should find a way to look into it and do research collaboratively in ways that make sense. But I think deployment will always be difficult because, I mean, just to greatly oversimplify it, who's going to set the thermostat? Who's going to decide what degree of that you want. Because the climate change is going to have very different effects in different countries and different parts of the world are going to have quite different opinions about where the thermostat, the thermostat should be. And I think we're going to have to be pretty far gone before we

can find any level of agreement that this is worth doing. Because the challenge of where to set the global thermostat and how to work this out is just so, so challenging.

David Victor [00:43:13] Can I just say, though, one of my mentors in graduate school was Tom Schelling, and I think you worked with as well, a master of strategic thinking. And Tom, always, when this topic came up, I would always say that this is also the inverse of the climate mitigation problem, the climate mitigation problem, so you need countries to work together for sustained periods of time to do things that have high up-front costs with distant, uncertain benefits, mostly in other countries.

So not surprisingly, you're not making a lot of progress on that, whereas geoengineering probably is done in a crude way, is it's not, you don't have to have an agreement on who sets the thermostat. One country could go off and say, you know what, the thermostat is too high. So we with this action are going to bring down the temperature. But then there are these side effects and, you know, the monsoon and all kinds of other things people are talking about. Some may be real, others not nobody really knows. And, and that's the opportunity for unilateral action here makes the structure, the game structure, if you like, of the geo-engineering problem much closer to a strategic nuclear exchange than to the kind of giant collective action problems that are typical of climate.

Michael O'Hanlon [00:44:17] So my last question and then we'll go to yours would be with or without climate engineering and now combining your worlds with mine, because I'm from the Strobe Talbott Center on Security Strategy and Technology, and you both work on energy and climate initiatives here at Brookings and in San Diego and elsewhere with the other hats, what's your number one worry about the way in which climate change is going to affect security conditions in one part of the world or another? Do you worry about poor countries having exacerbation of desertification and drought? Do you worry about the glacial feed for India and Pakistan and the rivers diminishing such that India and Pakistan actually have a war over water when that's one thing they've managed to avoid for 60 years? Or is there something else? You know, China taking unilateral action to set the thermostat because it's getting so much flooding in its coastal plains and that exacerbates great power relations. Is there anything that stands out for you as the most threatening aspect of sort of international security? So I'm asking you for help with my world in understanding my, my challenges and problems. But with the expertise you've got on energy and climate, again, starting with you, if I could, David.

David Victor [00:45:32] I do identify one thing I'm really worried about that interface, interfaces with the security world. It's that there's this very insightful essay by Aaron Wildavsky called Richer is Safer, and it points to this maxim when thinking about how do you insulate yourself against various kinds of harms, including in this case climate change harms, is that wealthier countries have more of their GDP, more in the terms of total volume of money and investment at stake, but a much smaller fraction of GDP and a much greater degree of exposure of their welfare, because their economies depend more on agriculture and other kinds of activities or outdoors activities, and because less wealthy countries have fewer resources to anticipate and adapt and respond and so on.

So my number one concern is that you have countries that are fragile already for a variety of reasons, then you add to this a new layer of stresses that create visible failures and political consequences, you know, crop failures and droughts more generally and farm surges, I mean, you look at Pakistan recently and those are never going to be just because of climate. They're going to be a mixture of climate and other factors. But the impacts will be made so much worse by the fact that the society already is failing for various reasons, and so then that produces the kind of classic social failure problem and migration that flows from this and so on. And I think this becomes an national security issue because in part because it gets framed that way when you, when involves migration.

But my concern is that the security apparatus will then view this problem as a problem to solve by hardening as opposed to a problem that you solve by, you know, helping build states and so on. Our track record on state, you know better than I, our track record there is not as mixed, let's say, but that's the way you're going to solve the problem. And so that's, that's where the climate problem intersects with security. And most of the tools in the security realm are not tools that are well-suited to the problem itself.

Samantha Gross [00:47:29] Yeah, I, I it's boring to say what he said, but I completely agree. I am most concerned about the impacts in poor states and fragile states in areas that do not have the ability to deal with the kinds of changes that we're likely to see. And so you end up with, with migration, you end up with failed states, you end up with wars over resources and a lot of things that we're just not prepared to deal with. And this kind of goes back to the question of mitigation of climate harms and our need to do that. And I think one of the challenges that we see here is, is there's a lot of focus on mitigation, but a lot of the focus is in the wealthier world, honestly, because there's more to protect in the wealthier world.

So you see a bigger benefit when you're talking about perfects, protecting infrastructure cities. There's just a lot more to protect here in the wealthy world than there is in the developing world. But the consequences of not doing that mitigation in the developing world, in poorer, fragile states is huge and not just in terms of geopolitics, but just in terms of human suffering. And so that's what I worry about and that we won't make sufficient mitigation, I'm sorry, adaptation investments in places that really need them the most to prevent human suffering.

Michael O'Hanlon [00:48:49] Thank you. Let's take some questions. Maybe two at a time. If we have them from the crowd. Yes. Please wait for the microphone and identify yourself, please, if you could.

Audience Member [00:48:58] Alan Loeb, Washington Lawyer. So this is a question and a little historical that you might respond to. So the question part is, David, did you interview Mary Nichols in doing your case study on California? And if so, did she agree with you and your assessment of how the process, how the project, how the process worked? And secondly, the historical part is speaking of California, California, after Haagen-Smit identified the chemical process for developing urban ozone, spent a decade and a half before finally the Board of Supervisors wrote to President Johnson in 1965 and said, nothing we have tried that's collaborative or cooperative with the industry has worked. We need federal regulation. And so you got the 1965 Motor Vehicle Air Quality Act or forget the exact name, something like that.

And then the second thing is with regard to lead in gasoline, which is really the archetypal environmental problem of the 20th century, everything sort of springs from that as the example, the industries knew from the beginning that it was a pollutant and it was harmful to individuals and they spent a lot of time playing the same game they've played with climate change, same companies, same logic, and they, they basically avoided climate change and avoided regulation until the end when finally the hammer came down and then they solved the problem and they had been telling people, oh, it's going to, it's going to ruin the industry, it's going to cost \$0.20 a gallon. The actual refining cost of getting octane from gasoline or from petroleum was half a cent a gallon. And it wasn't, I mean, that option was there from the beginning, but it wasn't until they were forced to take it that they actually did something.

So my follow up question to that is do you think that the experimental process that happened during the Montreal Protocol would have had, had even a chance if it wasn't for those targets and timetables?

Michael O'Hanlon [00:51:19] Maybe we'll go to answer answers right now, since that was a good, complex set of questions.

David Victor [00:51:25] A lot of moving parts there. So first, I've talked to, I know Mary well. I'll let Mary Nichols speak for herself. I think the California Air Resources Board in the last decade or two has now been basically running two worlds, one world they're very good at one world they know nothing about. And the world they're very good at is classic regulation. It's using regulatory tools which ultimately go back to federal statutory authority that are the stick here, that force industry to change. And they're very, very good at that. And that's the, that's the story going back to cleaning up the L.A. basin originally, that's the story of that you mentioned the zero emission vehicles in the 1990s and on and on and on. Extremely good at that. It's hard. It's steeped in deep uncertainty and so on. It's exactly we're talking about this book.

The other thing the California Air Resources Board is doing is running a market cap and trade program, which is, which is a joke, because they believe that the market can be used to create the right incentives for everybody, for firms to go off and internalize the externality. And so they in some sense, have given away the core skills that they have, which is to use regulatory tools in favor of a market, a market mechanism. There's another book that Danny Cullenward and I wrote that's about the history of using cap and trade programs and carbon tax programs and so on. These programs are good when you know what to do or a regulator knows what to do and you know how to set the cap and how to bring, how to bring the emissions down.

But when you don't know what to do, then these market-based systems don't work very well. And I think that actually shades into the answer for the lead program. The lead program was highly effective and actually one of our earliest you know, one of our early examples of, in effect, a kind of market-based strategy, because the regulators knew enough, sure, the industry lied about what the real costs would be and so on, there's always some combination of lying and information asymmetry in the early stages of dealing with any kind of regulatory problem like this. But the regulators knew enough about the likely cost structure and about the speed at which you could then make reductions in lead, that they could phase down the lead. And then as that began, we learned we could phase it

down even faster. And then we had a trading program that made it possible to kind of optimize squeezing out the last little bit of lead in gasoline, lead in a variety of other sources and so on.

Almost everything that's interesting in climate is unlike the lead problem. Much deeper levels of uncertainty, because what you're doing, we phased out lead and gasoline is our, one last word on this, and we phased out lead and gasoline, but we didn't change the structure of the industry at all. Almost everything that's really interesting in terms of deep decarbonization, is you're changing the technology and then you're also changing the industrial structure. And so intrinsically, you don't know ex-ante what's possible because you can't predict the industrial organization responses.

Michael O'Hanlon [00:54:10] Great. Samantha, you care to comment on that?

Samantha Gross [00:54:12] That answer was perfect.

Michael O'Hanlon [00:54:13] So we'll see if we have another round of questions from the audience and then we'll cut. Samantha may have a couple also by email that folks have have written in. And so we could go here in the front row and then Courtney towards the back on this round.

Audience Member [00:54:29] Hi, I thank you for a very interesting discussion. Sorry to arrive late. I would very much like to, my name is Sophie Smith, I work a lot with the World Bank and the Climate Investment Fund, and I'm very focused at the moment on the calls Secretary Yellen has made to the World Bank and other multilateral development banks to basically get their act together on climate change. And I'm very interested to know, I'm sure you know, you would you'd be aware of that call, but what would you say? Any of you, you're all so versed in this area. You know, if you had the ear of Secretary Yellen, what would you be saying to her? You know, please get the, you know, get, get the World Bank to take a look at this, to do this, to do that. What, would your, each of you, maybe, what would your top issue be to suggest for change?

Michael O'Hanlon [00:55:23] And we'll take this other question from Courtney, please, before we go to the panel for responses.

Audience Member [00:55:32] Thanks. Hi, I'm Courtney. I'm a research assistant also at Foreign Policy. So this kind of ties, I'm going to go back to solar geoengineering for a second just to kind of jump into my question, but the sense that I kind of got from your answer, David, is that we're just like not ready to implement that technology, which I think is really interesting because a lot of the beginning of your talk was focused on how experimentation is so crucial to our efforts. And I think that is interesting just because that same philosophy can be applied to so many of the technology. Right.

Like you mentioned, like California is trying to implement electric cars by 2035 and we just might not be ready. And so my question kind of takes on more of a humanitarian approach. And I'm just curious about your thoughts as to how much wiggle room do we have when it comes to considering the ways in which we implement these technologies and whether or not they're ready to be implemented because they might affect communities, especially ones that might be disproportionately affected by climate change. And so really just looking to get your thoughts again on like do we have the wiggle room to wait until these technologies are fully ready or is it more of like, no, we're, we've made progress so far, but we need to keep making more. And it's kind of like implement at our own risk as we try to make the spinach tastier.

David Victor [00:56:48] Well, mindful of the time, I would compact answers. First, I think the wiggle room question is really critical because a lot of folks say, hey, we, we only have eight years left or whatever it is. And so you have to run on a faster schedule, even though you don't know which direction you're running and what to do and what shoes to put on, or even if running is what we're doing, maybe we're on a pogo stick. And I think the reality is that alternatives to experimentalism that that overstate what we know result in massive investment in things that have a high probability of getting, of being stranded assets or a high probability of not being credible. The industry doesn't believe. Take the California 2035 rule about electric vehicles and internal combustion engines. My guess is that rule will get adjusted. Exactly when we have to, we don't know. It could be that we discover it's easy to do or not. And so this is just the reality of having spent 30 years pretending to work on the problem, but really only making progress in the last decade or so. And it's probably because we drew the wrong lessons from the Montreal experience going back to the very beginning.

What would I advise the World Bank, well, I say, what I've advised, which is I think the the Multilateral Development Institute banks and the World Bank in particular need to remember that although they're big, they're actually small in terms of the overall deployment. And so the single most important thing that an institution like that can do is do things that have a higher failure rate and a higher risk rate and in effect, are a much more diverse array of experiments that the CIF Investments Fund is kind of pointing in that direction. But the organizational incentives at the bank, like most organizations, are to avoid risk when in fact you want to be doing the exact opposite.

Michael O'Hanlon [00:58:31] So now we have two lightning rounds, one with the audience and one with Samantha's email question. So if I could, I think there were two last hands, so I could ask you to pose your question briefly. We'll get responses and then go to the earlier emails. Yeah.

Audience Member [00:58:42] Thanks. My name is Rayan. I'm also a research assistant in economic studies. And my question is sort of about experimentalism again, but experimentalism and technological versus policy experimentalism. I want to ask if you think sort of it's clear that we need to do a lot more experiments to figure out what technologies are best and what the sort of best, you know, least cost future abatement parts are. But as far as policies go, it seems that, you know, with Europe, for example, you can point to, you know, a golden market or something. We might have some might say that there's a consensus about, you know, what the best sort of policy frameworks are. At least I want to know if you sort of disagree with that and what you think the best routes to experimentalism in the policy world might be.

Michael O'Hanlon [00:59:21] Please send, yes to your right.

Audience Member [00:59:22] Thank you. Hi, I'm Catherine. I am a resiliency planner with the Metropolitan Washington Council of Governments here, also a UCSD alum. Go Tritons. I we heard a lot about mitigation and geoengineering today and I just was wondering, is there a role for experimentation in an uncertain world when it comes to adaptation and resiliency work? So maybe this is a question for the engineer in the room or the policy folks. So just maybe just some quick thoughts on resiliency and adaptation, because I think it's actually the third piece of this puzzle that we can't ignore.

David Victor [01:00:00] Great. I think that's a great example of where policy experimentation may be more important than experimentation and widgets. One of the distinctions we make in the book here is the difference between experiments where you're trying to push and change the technological frontier versus experiments where you're trying to understand how new technologies or ideas or policies get applied in context. We have an instinct to think about experimentalism and experiments, as always, and innovation as always about pushing the frontier. But most of actually the innovation that's needed is around learning how to use new ideas in different contexts. How do you run a grid with different kinds of renewables in different parts of the world and so on? And adaptation is a great example of that, where the kinds of policy experimentation that needs to happen is actually running different policies and then comparing them.

And I'm concerned that there are actually a lot of jurisdictions that are doing this now and different mainly it's a local and regional affair because the impacts are local and regional, but they don't do a very good job of comparing notes. They do a very good job of going to conferences and saying we're awesome, but there's almost no institution that really helps them compare their notes. And in the last comment on this is the other area where I think policy experimentation will be very helpful, is what now so many governments are starting to do, which is industrial policy. Those who study climate and want to work on policy institutions and so on, industrial policy's back. This is a place for some really good thinking because my guess is that industrial policy without a lot of a lot of adult supervision and learning is going to be a catastrophe. But industrial policy, that's not like our grandparents' industrial policy is more adept, it's not an anti-grandparent comment, more adept and more designed for learning that that would be good industrial policy.

Michael O'Hanlon [01:01:42] Fantastic. Samantha. Any comments of your, or answers to these questions and then the final questions.

Samantha Gross [01:01:47] Yeah. No, I. I violently agree with everything. Everything you just said. So I'll just throw out a couple of questions that we got from our online audience. And one of them is that most people on the right and left can agree that local projects for adaptation to climate change or local conservation projects are worth doing. But as soon as you put the word climate on those, the right just shuts down on us. How do we engage to make climate impact without alienating the right wing in the United States?

And then the second question is very topical right now. The recent news about fusion, that it could potentially be viable. I feel like fusion's been ten or 15 years away my whole life. I'm but maybe it actually is ten or 15 years away. But, but what do you make of this news? And then how does this like very centralized, capital-intensive technology, how does that fit into your sort of bottom-up experimentalist way of thinking?

David Victor [01:02:43] Well, so first, the particular news is that's very much topical right now. I think the daily communication departments are very busy. So they have achieved a big milestone in the Livermore ignition facility using a laser-based system. So that's good news. It's not actually, to me, what's interesting about fusion is not clear what the right model is going to be. There's a whole bunch of different laser ideas. There's this kind of small-scale tokamak reactors. So these are, you make a plasma with very strong magnets, there's been tremendous improvement in magnet technology, in

particular superconducting wires and control systems, so that you can make keep the plasma stable and on and on and on. So it's not, it's typical, there wasn't really an incentive to do that or to do it in such a big scale, like the ITAR program in France, that that all it did is consumed dollars. What you do is just set the dollars on fire and generate electricity that way is much more cost-effective way of making electricity.

Samantha Gross [01:03:33] At least for now.

David Victor [01:03:34] And but now you've got all of this private incentive to go experiment with stuff. And this, this announcement I see as the government's particular example of that. I don't know if the, if the laser-based approach will be right, because I think lost in this current news cycle is actually all the other different competing, competing ideas. But let me just talk about the right. I'm not the right person to speak on this, but I will say I've been co-chairing for the last year this panel in the American Academy of Arts and Sciences on how you put together and hold together a climate policy in the United States. And it's the most diverse, ideologically diverse in many different dimensions, including ideology, the most diverse group I've ever worked with in my life. Been hugely challenging, but a big part of what we're doing is, is identifying how you communicate with different audiences and make the communication real.

For a lot of folks who are convinced climate is the, is the problem, you talk climate and then people line up. For the rest of the country, frankly, most of the country, climate comes climate goes, right now, climate has just fallen off a cliff in terms of political priorities. And so you got to find ways to speak to different communities. And that's about jobs and local benefits. But so-called co-benefits, you know, do projects that generate lots of other benefits. And then you start investing in those and then people build an interest around them and then they become more supportive. And I think that's, that's not a magic wand and that's not unique to the right. But that's how you actually put together and hold together a political coalition on something that's kind of diverse and sprawling as the climate challenge.

Samantha Gross [01:05:08] I find myself wondering if people are going to come to like the IRA in the way they came to like the Affordable Care Act. Once they realize what's in it for them.

David Victor [01:05:15] I think people have already learned to like the IRA.

Samantha Gross [01:05:18] There you go.

Michael O'Hanlon [01:05:20] Thank you both. This was awesome. What a great way to get fired up and finish the year here at Brookings. At least in terms of my events and anything I was involved in; I learned a lot. Congratulations, David, on the book. Samantha, thank you very much. Thanks to all you. Happy holidays. So please join me in a round of applause.