CleanLaw 53: Joe Goffman Speaks With Katharine Hayhoe about Climate Change Attribution and Communicating the Reality of Climate Change to the Public, December 15, 2020

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Robin Just: Welcome to CleanLaw from the Environmental and Energy Law Program at Harvard Law School. In this episode, our Executive Director, Joe Goffman, interviews climate scientist Katharine Hayhoe, Director of the Texas Tech Climate Center and Professor in Public Policy and Public Law in the Department of Political Science. Professor Hayhoe talks about the cutting edge science of climate change attribution, how she tries to help the public understand the reality of climate change, how to best assess and report the impact of it, and why she is hopeful. We hope you enjoy this podcast.

Joe Goffman: It's not just a pleasure but a privilege for the CleanLaw Podcast to have as a guest today Professor Katharine Hayhoe of Texas Tech University. Professor Hayhoe's accomplishments and her contributions are nonpareil and I think she is one of our guests who really needs no introduction. One of the things that I think we're very grateful for, and I think is notable about you, is your generosity. I'm really glad that the CleanLaw Podcast is getting to benefit from that generosity by your spending time with us. I was hoping to have you speak to us about three issues.

Joe: One is what you've learned in your substantial amount of effort communicating with various audiences about climate science. The other thing I'd like to ask you to talk about is the National Climate Assessment report process. Looking back two years ago, November of 2018, when the fourth assessment report was issued, and looking ahead, the fifth assessment report, process for which is sort of just getting started. And then the third thing I'd love to hear you talk about is what's going on in climate science right now that you find most intriguing, and you can talk about those three topics in any order you wish.

Katharine Hayhoe: All right. Well, those are all great topics. Why don't you ask the question that you're most curious about first?

Joe: Well, what I'm most curious about is what's new in climate science that has caught your attention?

Katharine: Ah. Well, it's interesting because I speak to people all the time all over the world, thanks to the magic of the internet, and what has struck me is wherever I talk to people, no matter whether it's young or old, whether it's other people in science or community groups, whether it's here in North America or in Europe

or in Asia or beyond, one of the biggest questions I get is where do you find hope?

Katharine: And my first answer to that is I don't find it in the science, because what strikes me when I follow the latest scientific results is that nearly every time we're seeing that climate is changing faster or to a greater extent than we thought, or that some solutions that people have proposed might not be as effective as they originally hoped. And as a scientist, of course, it's fascinating to learn that the massive ice sheets, for example, on Greenland and Antarctica are being eroded from beneath where we couldn't see them. And as a result, Greenland is now melting six times faster than it was in the 1990s.

Katharine: So as a scientist, you immediately think, wow, that's really interesting. What's happening there, what's causing it to do that? But then as a human you think, oh my goodness, two thirds of the world's largest cities are within a few feet of sea level rise. What does this mean for the future of civilization as we know it in some of the cities where we have visited, we know people who live, we might even have family living there. So it's an interesting time to be a scientist because while we are fascinated by all the new results that are coming out looking at, for example, how much methane is coming out of the permafrost in the Arctic, or how ocean circulation is changing by all the freshwater inputs that are happening as land-based snow melts, or how the hydrological cycle is accelerating, making heavy rainfall more frequent – or we're learning a lot about hurricanes. How hurricanes are powered by a warm ocean water. We know that over 90% of the heat being trapped inside the climate system by the heat-trapping gases that we produce is going into the ocean. So we now know that not only are hurricanes getting bigger and stronger in a warmer world, but they're also getting slower. They also have a lot more rainfall associated with them. And I think at the very cutting edge of climate science today is a field called attribution, which specifically refers to how we can put a number on how much bigger or stronger or more damaging or more frequent climate change made a specific event.

Katharine: Ten years ago we could say, yes, heavy precipitation is getting more frequent, heat waves are getting more intense, hurricanes are getting more damaging, but we couldn't put a number on a specific event. Well now, thanks to the field of attribution, we can do that. And I think that that relates directly with the field of law, because if you can say that the best scientific estimate is that two thirds of the economic damages that resulted from Hurricane Harvey – which, as you know, had damages over $100 billion – if we can actually say the best science says two thirds of those economic damages were because of how human-caused climate change enhanced a natural event. And on the other side, you can put numbers on how much carbon has been produced by specific countries and specific corporations since the dawn of the industrial era. Putting those two together, you can actually start to estimate the liability of specific countries and specific corporations for real damages that are happening today.

Joe: That's fascinating. And you just gave an answer that in a way was more than I could have hoped for, which is really bringing us up to the moment on where science is. I want to actually bookmark a couple of things you said in that answer. One is when you were referring to the melting of the Greenland ice sheets, I think you used the phrase "six times faster than we expected." And then of course the other word I want to bookmark is "hope." But let's start with the first one. I've been actually involved in the issue of climate change going all the way back to 1987, and I was involved as a lawyer in an NGO in arranging the Senate hearing where James Hanson said that he had detected the fingerprints – I think that was the term he used – of human activity induced climate change in his work. And immediately after that event, the discussion about climate science was dominated by the word uncertainty, as if hiding behind the veil of uncertainty was some kind of good news, that the uncertainty would ultimately over time reveal the phenomenon of human-induced climate change as far less problematic than it could be. I was lucky enough to work with scientists as my colleagues who kept warning that uncertainty was a sword that could cut two ways. Things could turn out better than we thought we could project in the late '80s or early '90s, or things could turn out worse. And I'm afraid that it's the latter that's occurred – that the surprises, if you can call them that, that the natural world is reviewing, tend to be nasty. And I was wondering if that assessment is overly pessimistic, or if you're looking at the arc of scientific investigation over the last few years or last few decades and what's happening in the real world as portending even more unpleasant surprises.

Katharine: Well, you've been involved in this, then, five years longer than I have! That hearing where Jim Hansen testified to Congress during a record warm summer in 1988, and that statement, which was one of the first prominent statements about attribution – in that case it applied to the global temperature record not to Hurricane Harvey or the California wildfires – but that statement was really what kind of set off the firestorm of awareness, concern, and opposition to climate action. And so ten years after that, Frank Luntz, who's a very well-known pollster, wrote a now infamous memo to then-President Bush saying, "You don't have to show that climate change isn't real. You just have to show that it's uncertain. We don't know. We should study it more. We should learn more about it before we do anything." And that was frankly brilliant, in an evil genius kind of way, because he was absolutely right. You don't have to say it isn't real, you just have to say we don't know and that uncertainty is enough to delay action. Whereas in fact we've known since *the 1850s* that digging up and burning coal at that time, and then obviously later oil and natural gas, is producing heat-trapping gases that are wrapping an extra blanket around the planet; and that's what's causing the planet to warm.

Katharine: By the 1890s, we knew enough about basic physics and chemistry for a scientist, Svante Arrhenius was his name, to calculate how much the world would warm as we increased CO_2 levels in the atmosphere by 50%, 100%, 150%, and more.

So, there's no uncertainty around the fact that climate is changing, humans are responsible and the impacts are serious. The uncertainty revolves around how fast are these changes happening? And yes, the Greenland ice sheet is melting six times faster than it was measured to be melting in the 1990s. So it's accelerating, in other words.

Katharine: We also are concerned about the fact that the climate models we use, as the National Climate Assessment says, appear to be systematically underestimating the increases in heavy precipitation. In chapter 15 of the National Climate Assessment, which is one of the ones that I coauthored, looking at paleo climate records, this is what we conclude. We say the systematic tendency of climate models to underestimate the magnitude of temperature change during warm paleo climates suggest that they're more likely – here's where the uncertainty comes in – they're more likely to under- than overestimate the amount of long-term change.

Katharine: And a study that came out a number of years ago looking at assessments like IPCC and big scientific assessments, found that the conclusions of assessments typically err on the side of being too conservative because we scientists are actually very conservative. People don't realize that. Nobody wants to be labeled an alarmist, so we have erred, especially in consensus statements where everybody has to agree. By definition, a consensus tends to focus on the lowest common denominator, right? And so they tend to underestimate what we see happening. Whereas in fact if you compare the global models that Jim Hanson and early climate scientists were using back in the '70s and '80s, very rudimentary models, it turns out that in terms of global temperature, they were right on what has actually happening today. But when we look at what's happening to the extremes (number one), and when we look at what we expect to happen over longer timescales (number two), there is more evidence than not that we as a community are going to be systematically under- rather than overestimating the impacts of those changes. And a lot of the economic damages and the harm that we're experiencing today is not because of change in average global temperature; it's because of how that affects our extremes: our heatwaves, our floods, our droughts, our wildfires, our coastal flooding, our coastal storms and hurricanes, and more.

Joe: It's funny that you just mention the Luntz memo, because uncertainty may have been presented as a tactic, but it almost took on, during the late '90s and the early 2000s, the role as a sort of cultural force, because I think a lot of people heard the word "uncertainty" and pictured sort of the cavalry coming into the rescue – that what was uncertain was possibility that this wouldn't be a problem. And I think that actually made the Luntz memo doubly, if not triply, efficacious in slowing down, and in some cases simply stymieing, any kind of social and policy response.

Joe: I think you said something that is really important for non-specialists to understand when you made the distinction between average metrics, average temperature, and extremes, and elevated focus in your answer on the importance of extremes in understanding what these phenomena are and why we should be concerned about. Do you have anything to sort of guide the audience with, in terms of the next time they hear news, say, "September 2020 is the hottest September on record" or "a certain calendar year is the hottest calendar year recorded?" That's usually expressed in terms of sort of single point average or mean. What you're saying is that may well mask what it is that really counts, which is the extremes. Do you have any advice for the public on how to listen to that when that kind of news hits the popular media?

Katharine: Well, not so much on how to listen to it, but how to share information, I think. This relates to the question you brought up of "what have we learned about talking about science to the public?" One of the biggest things we've learned is that climate change, the way it's traditionally been communicated, climate science invokes the phenomenon called psychological distance. Psychological distance is a term that was coined a number of decades ago to explain how we often think of issues as far away from us in time – so we think about them as something that affects future generations but not us here – or that affects people far away but not us where we live, or it affects people who care about certain things, like "tree-huggers care about climate change, but if I'm not a tree-hugger, then I don't care" type of thing. And also things that are abstract rather than concrete, and global temperature is very abstract.

Katharine: So because of this, one of the greatest challenges that we have is not that people don't agree that the world is warming – because most people do, even in the US – but the people don't think it matters to them. Over 70% of people in the US, over 80% of the people in Canada, agree that the planet is warming. But then when you ask people, do you think it's going to affect you personally, only about 40% of people say yes. That's a huge disconnect. What's the cause of that disconnect? Psychological distance.

Katharine: We are told that climate change is about global average temperature. We're told that it's about the ice sheets and the polar bears. We're told that it's about future generations. And so that enables us to just push it off, especially when we're dealing with much more urgent issues right now like a global pandemic, like an economic crisis, like just trying to keep our kids in school and food on the table. We think, oh, it's just something we can worry about later. So the most effective way to communicate and talk about climate change is not by talking about global records that are being broken, but rather talking about what is happening in the places where we live. If we live on the West Coast, climate change has already more than doubled the area burned by wildfires because it's creating hotter and drier conditions. So when that load of burning trash is dumped into the brush, or when those fireworks go off at the gender reveal

party, or when that faulty appliance is plugged in in the shed and lights the shed on fire, when that fire is ignited, it burns a lot greater area than it would have 50 or 100 years ago. If we live along the Gulf Coast or the Atlantic coast, we're concerned about rising sea level and about stronger, more damaging hurricanes. If we live in the Midwest, we've seen significant increases in heavy rain events and flooding, especially in spring. It's hard to think back this far, but a year ago, last March 2019, a number of counties and even states were under an emergency disaster declaration because of massive flooding. And then of course people who live in Northern areas are very concerned about the thawing of the permafrost because it essentially turns the previously solid ground that their homes and roads and train rails were built on, it turns it into a marsh. So, really emphasizing the local and the relevant and the imminent impacts of climate change is the most essential way to close that gap of psychological distance to where we realize that if we care about our health and the health of our family and our kids, if we care about the local economy, if we care about the safety of our homes, if we care about the air that we breathe and the food that we eat and the water that we drink, if we care about these very basic things here and now, that's the only reason why we care about climate change because climate change affects all of those here and now in ways that are relevant to us today. It's not a future issue. It's not a distant issue. It's here and now.

Joe: You're reminding me of a cliché that would go something like this: "Climate change: you can distance, but you can't hide." You can run, but you can't hide. That it really is something that arrives in many ways in people's everyday lives in ways that they care about.

Joe: Let me go to the second bookmark in your first answer because you did use the word hope. I was wondering what, if anything, about your experience as a public communicator or as a keen observer of how people are reacting to or understanding the problem gives you hope for how we can, or might, or are responding to the challenges posed by climate change?

Katharine: Well, as I said, I definitely don't get any hope from the science and I really don't depend on politics for my hope either. A lot of people pin their hopes on a specific president or a specific policy, but none of that lasts. We know that from looking through history. What we do see is that when people get behind something, that's when things change. There's a famous statistic that 3.5% of the population – and this is looking back at issues like slavery and issues like civil rights – when 3.5% of the population really gets behind something, goes out to the streets, demands change, that's when change happens. And so my hope comes from looking at what people are already doing today. Very unexpected people in unexpected places, whether it's some of the world's biggest corporations like Microsoft aiming to not only cut its carbon emissions to zero, but take out the carbon it's produced since the 1970s, or whether it's just

individual people like all of the kids who are out with the Fridays For Future strikes, or whether it's people working at cities to prepare their cities to be more climate resilient, like the city of Houston which is home to many of the largest oil and gas companies in the US, or the city of Dallas is already carbon neutral. The Dallas/Fort Worth Airport is the first carbon neutral airport in North America. Fort Hood Army Base is the biggest army base in the US, just outside of Killeen in Texas, and it's been run of wind and solar energy for the last two years saving taxpayers a large amount of money.

Katharine: Just looking at what people are doing and how the world is changing, and recognizing that this giant boulder of climate change is not sitting at the bottom of a hill that we need to get it up to the hill and there's only a few hands on it. No, the boulder is already slowly rolling down the hill in the right direction, but it's not going fast enough. And there's already millions of hands on that boulder, but we just need some more. And so that gives us a sense of – we're not trying to tackle something that's hopeless. We're trying to join something that is already moving forward, that there's already many people involved with, and perhaps I can just make a little bit of difference. I don't have to fix the problem all by myself. The weight of the world is not on my shoulders or your shoulders or anybody's shoulders. We are each, I believe, called to do what we particularly uniquely can do to contribute to that solution.

Katharine: So when I talk about hope, I often actually get a very strong reaction from people. They say, "Oh, you're just saying people should just bury their heads in the sand and say, 'I hope it'll be okay.'" I say, "No, of course not." Because if that's the type of hope we're talking about, it is not going to be okay. The hope I'm talking about is first of all a rational hope. A rational hope that understands it is bad, it is getting worse. We need to act urgently, but the future is in our hands. Our choices are what will make a difference. The second type of hope I talk about is active hope. It isn't a passive hope – kind of leaning back, folding your hands and saying, "I hope it'll be okay." It's an act of hope that says, "I am going to do my part, even if I feel like it's against the odds, to do everything I can to reach that better future."

Joe: That was wonderful to hear you say that because, to put it personally, I'm always looking for sustenance for my own hope, and you've provided that.

I want to go to the third part of your first answer that we bookmarked, and that is attribution, and, if you will, the science of attribution. And by the way, you did a very nice piece of jailhouse lawyer ring with your first answer when you talked about how attribution can lay the groundwork for creating liability, and I'm here to tell you that not every scientist that I've come across is a great jailhouse lawyer, but you've got a future.

Katharine: Well, thank you. I assume that's a compliment.

Joe: I have to confess that I'm a recovering lawyer, but in that context, I meant it as high praise.

Joe: Tell us a little bit more about, from a scientist point of view, what's brought us to this moment where the claim of linkage between certain behaviors and certain actors and outcomes can be established to the satisfaction of scientists. What has that looked like recently, and what are the remaining challenges, and where do you think it's going?

Katharine: Yes. So the advances have been made in understanding what natural variability looks like, because what we have is we have chaotic natural variability on top of a changing baseline. So for a long time, scientists weren't able to effectively untangle the natural variability from the changing baseline except over larger spatial scales, so, you know, the entire world or entire continent, and over longer time scales – so over decades as opposed to years or even days. So, early attribution studies focused, first of all, on showing that global temperature change would not have happened naturally. And then it looked at issues like increases in heavy precipitation at the global scale. And I think it was about twelve years ago that they definitively showed that there was a human fingerprint – that is the word they used, fingerprinting. There was a human fingerprint in the observed increase in heavy precipitation at the global, and to a certain extent at the continental, scale.

Katharine: So that was where attribution first began. But since then, our ability to understand and to disentangle the long-term trend and background conditions from the natural variability has improved significantly, both due to improved scientific understanding as well as improved computational ability because the bigger and the more complex and the better able to represent natural variability our computer models get, and the bigger the machines we can run them on so we can run multiple scenarios, because in a chaotic system it depends very carefully on the initial conditions. So a tiny change in the initial conditions could result in a very different outcome. So running a lot of different simulations at very high spatial and temporal resolution actually helps us to disentangle "what if this happened in a world that didn't have human-caused warming" versus "what would happen in a world that does have human-caused warming." So that's what scientists are doing is they're using these simulated models of the earth to compare what-if scenarios and then look at the observations and see which case fits best.

Katharine: And there is a fantastic book that just came out this fall. It's a book called *Angry Weather*, and it's written by a scientist called Friedie Otto. She's actually head of the World Weather Attribution team at the University of Oxford, who does a lot of this work whenever there's something like the Siberian heat wave in June 2020, or a major hurricane, or a major drought. They actually are the ones who run the numbers to calculate how much more frequent, how much stronger it likely was because of human-caused climate change.

Katharine: She's just written this book called *Angry Weather*, and it's very easy to read. It's not a scientific document or manual. It tells a lot of stories about how all of this came about and what they learned and how they thought about talking about it to people and what it implies and the connection to legal issues that could potentially result from it. And so if anybody's interested in learning more about the field of attribution, *Angry Weather* by Friedie Otto is a really, really outstanding book. It's interesting, it's easy to read and you will leave that book understanding, wow, this is huge the fact that we can actually put a human fingerprint on an individual event.

Joe: That is huge, just intuitively. Let's just stick with the science of attribution, which feels like something that's quite new even if, in reality, scientists have been working out on it for a while. When I was starting out as an environmental lawyer, as I mentioned, I worked very closely with scientists, and one of my mentors said, "The thing you have to understand about science is that the purpose of investigation is not necessarily to come to a conclusion, but to identify the next question worthy of investigation." So for the science fiends in the audience, what's the next question that's worthy of investigation, that attribution scientists are working on right now?

Katharine: Well, originally, attribution scientists were looking at how much more frequent a certain event was. But just over the last two years, they've been able to progress to how much stronger it was. And then just this past April, the very first study (as far as I'm aware) was released that actually moved to how much more money, or basically, how much greater the economic costs were of an event because of human-caused climate change. So, what's happening is this analysis is moving closer and closer to the metrics that our human society – not just scientists, but our society – uses to value things. We live in a money driven society. If you cannot put a dollar value on it, people assume it doesn't matter.

Katharine: And of course we know that the things that matter most in life are things that you can't put a dollar value on. Like a human life, how much is that worth? Human relationships, how much are those worth? Carbon, how much is that worth? We've been acting as if it costs zero to produce carbon over the last centuries, whereas in fact it turns out that carbon is very expensive. That's the number one heat trapping gas that's driving climate change today.

Katharine: So attribution science is closing the gap between information that only really matters and is relevant to scientists on to information that is directly relevant to everyone: to the homeowner who is flooded, to the insurance company, to the government, to FEMA, to the city, to people who make decisions every day based on the bottom dollar. We're starting to actually be able to quantify not just the future impacts of climate change and the future damages, but we're able to look at the damages today, and it's not just here and now. A Stanford study last year found, for example, in terms of economic damages, that climate

change had already increased the economic gap between the richest and poorest countries in the world by as much as 25% in some cases. So not only are we going to be able to look at specific events and how they affect us here and now, we can also start to quantify how climate change is widening the fault lines in our society, increasing inequality, increasing the marginalization of populations, populations of color, Indigenous populations, increasing gender inequality. Also at the cutting edge: just looking at how climate change is driving political instability both within and between countries. And that of course brings the US military into the picture. We're really starting to close that gap between what was, again, only really primarily of interest to scientists, and metrics and factors and relationships that matter to every system that we have on our planet from security to agriculture, to energy, to politics.

Joe: You've given a whole new definition to the term generous, which at the beginning of our discussion I said you were, because in answering a question about science, you invited into the dialogue lawyers, economists, philosophers, policy makers, and political theorists. And I think that's just such a great illustration of – maybe that's where the hope comes from, because there's a role for everybody to play in taking on climate change and a role for practitioners of all those disciplines: ways to contribute to actionable understanding. Do you mind if I throw in a bonus question before we get to the last topic, which is the National Climate Assessment reports?

Joe: Without drawing you away from your answer about not looking to politics or government necessarily for hope, we are having this conversation during President-elect Biden's transition. And I'm sure you know that during the campaign, one of the central areas of focus for him as a candidate was climate change and was climate justice. In your extensive experience in interacting with the public and communicating with the public, do you have any general advice to President-elect Biden and his administration just from the point of view not of policy or politics, but of leadership. I dare say – and maybe you don't embrace this mantle but you're entitled to – you've exhibited incredible leadership in this area. I'm just wondering what kind of leadership lessons President-elect Biden and his appointees might apply to fulfill their stated commitments and promises.

Katharine: Well, you're right. There is definitely some hope to be heard from recognizing that there will be a new administration that is not dedicated to silencing scientists, to dismissing them, to suppressing – not only scientific results but clean energy research from the Department of Energy has been suppressed. And it has been a very long, very difficult, very challenging four years for scientists who are in the federal government and for scientists who work in the federal government or with colleagues, which includes me. So there's certainly some hope from recognizing that there's administration that will not only

actively oppose climate action, but is actually officially committed to climate action.

Katharine: But it's not only up to them. They by themselves cannot fix this problem. We can't just all kind of, again, sit back, fold our hands and say, "Oh, great. Let them take care of it." There's only so much that the federal government can do, especially because they will still have conflicts within the House and within the Senate. But what I would say is: look for points of agreement. As a climate scientist, I'm in favor of any policy that cuts carbon and leaves people better off than they were before. But as a human, and a pragmatic one as well, I know that there are some policies that can make a difference that already have bipartisan support.

Katharine: So for example, there's a Climate Solutions Caucus in both the House and the Senate, which a Senator or a Congress person is only allowed to join if they join with somebody from the other party, because they wanted to keep it rigorously bipartisan, and they support carbon pricing. There's a climate leadership council whose members include many Bush-era Republicans and also big corporations from AT&T and Ford to ExxonMobil. And they also support carbon pricing. So look for solutions where you can broaden the tent, where you can get some bipartisan support which increases the chance of not only getting them through and implemented, but with another administration, they would have some people on both sides of the fence saying, "Hey, let's keep this going." And that's really important.

Katharine: I would also suggest too, though, that it's essential not to jump right to the solutions when we realize that 60% of people in the US don't think it matters to them. 60% of people almost are saying, "Oh, you're trying to fix something that doesn't really matter to me." That's why addressing that psychological distance piece is so important in explaining how climate change matters here and now to us in the places where we live, and that feeds directly into the National Climate Assessment.

Joe: Well, that all makes sense, and let's go there. You were an author of the fourth National Climate Assessment report, if I recall correctly.

Katharine: The second, third and fourth, yes.

Joe: The reason that I'm fixated on the fourth is that I certainly recall from two years ago that when that report came out, a great many of its critics offered what at least on their surface seemed like compelling challenges, or at least compelling questions about it, along with all sorts of claims. And I distinctly remember that your communication about the report after it was issued, generally and in response to the critics, was really a tour de force of public communication about science. I would go so far as to say that what the reaction to the report occasioned from you and many of your colleagues in using the response to the

critics as a way of explaining what was significant about the report was intrinsically worthwhile. It made the whole effort of producing the report worthwhile in and of itself.

Joe: And now I guess what I'm wondering about is the organizing the effort to do the fifth assessment report has been in the headlines recently, because the Trump administration appears to have chosen to play, at least temporarily, a leadership role. But I'm wondering if you could explain why these periodic assessment reports are so important. As you already suggested, they kind of match up with shrinking the distance between individuals' perceptions and reality. And what, if you care to speculate, do you think the fifth assessment report will be heading towards?

Katharine: The National Climate Assessment is mandated by law under the Global Change Research Act to be produced every four years. The first one was produced in 2000, but then there was a very long gap before the second one was produced. And in fact a number of environmental organizations, which you may be aware of, sued the federal government for failing to meet its obligations under the act. Since then, they've maintained an approximate four-year interval between the reports and each report has successively gotten bigger and bigger and bigger because there's more and more and more to say.

Katharine: What does the National Climate Assessment look like? It has a bunch of different chapters and the first half of it focuses on the science. So it's got chapters on what's happening in the Arctic, what's happening in the ocean, what's happening to temperature and precipitation, and what are some potential surprises that we might see in the future. That's one of the chapters that I wrote. And then the second half has one chapter for every region of the US. So if you live in the Southwest or the Northeast or the islands or Alaska, you could just go to your chapter and you would learn what's happening where you live, how it's affecting agriculture, food, natural ecosystems, your health, or more. And then you could also see what people expect, what scientists expect to happen in your region in the future. And then there's also one chapter on every sector. So there's a chapter on water, on agriculture, on transportation, on Indigenous peoples, things like that.

Katharine: So that's what the National Climate Assessment is. It brings the science of climate change down to the regional level and it explains why it matters to us in ways that we already care about – again, how it affects our food and our water and our health and more. Now, in my opinion, I don't think that the assessment needs to be produced from scratch every four years. Because the science and our understanding of the impacts is changing so quickly, that what I would like to see is – I would like to see a living document that gets updated every year. So rather than starting from a blank page every four years, you start from what you already have and then you update it with more information on a more regular rolling basis, so that whenever anybody from anywhere around the country

wants the latest information, they know that they're going to get the latest information within a one-year lag from the National Climate Assessment. That's what I've been arguing for.

Katharine: And of course you would have to produce an official document every four years to comply with the law. But I feel like in the age of the internet today where you don't publish *Encyclopaedia Britannica* any more in those 26 bound volumes, I feel like we could be doing things a little bit differently because the National Climate Assessment is such an important source of information for people.

Katharine: And when the third assessment was released under the Obama administration, there was significant investment in resources to get it out to communities, to go have town hall meetings and to reach out to stakeholders, to reach out to groups of farmers or water managers or city planners to make them aware of the information that was there and to connect them with local authors, because there's hundreds of authors of this assessment, and to connect them with people who were nearby so that they could serve as living sources of information.

Katharine: So this happened under the third National Climate Assessment, and it was really productive in terms of helping people understand why climate change matters and get the information they needed at the localized scale to actually start factoring into their decision-making. But with the fourth National Climate Assessment, there was *no* financial support. And in fact, there was no mandate of any kind for outreach. And the only reason why we were able to do any outreach is because, for example, on volume one, they had four authors, literally *four authors*, me and three other colleagues who were not federal employees. And so we were able to speak out publicly about the results of the report. We wrote an op-ed in the New York Times. We did a number of presentations and events. I did a big thread on Twitter that debunked all the myths and falsehoods and misleading statements that were being made about the assessment by politicians, by White House spokespeople, by conservative news pundits. But we were effectively the outreach team because the US Global Change Research Program did not have a mandate to do the type of outreach. It's almost as if you developed a coronavirus vaccine and then you weren't allowed to tell anybody about it. That's sort of the situation that we had with the last assessment.

Joe: It sounds to me like you actually gave part two of the answer to an earlier question, which is "what would your advice be to the leadership that the Biden administration or a future government might assert?" And one of the platforms for that would be the climate assessment report, sort of keeping it almost in a continuous beta format so you're always improving it and always updating it. And the other is to make it not a static communication document but actually put it in service of ongoing outreach and communication. On that first

suggestion, do you think it's manageable for something that's mandated by law and which the government is responsible to do that continual update?

Katharine: Yes. I've laid out a whole plan of how you could do it. And the key is that you want to go through and you want to identify the figures and the text that is going to be reviewed every year. And that's only going to be a tiny fraction of the overall document. And then what you do every year, too, is you have a small committee that meets and says, "Is there anything new where we've got a sufficient balance of information, scientific studies, data that you could actually write a new section?" And so you could consider writing a few new sections every year. And again, this is a massive document, 2,000 pages.

Katharine: So a couple of sections is not a big deal, and updating some key figures like global temperature change, US temperature change, those types of things, that's not a big deal either. And then what you would do is every four years, you could do more of a massive overhaul. You could say, "All right. Here's what we have. Do we need a new chapter? Should we be getting rid of any large chunks or sections? Should we be introducing any new figures?" So do a large overhaul every four years, but from year to year, it would be really nice to have a figure of temperature change in the US that doesn't end in 2017 when we're sitting here in 2020.

Joe: Wow. That would be...Maybe it's already obvious, but as a climate science nerd, if not a climate scientist, what you just said sounds wonderful. I do hope that they listen to you and follow your plan.

Katharine: I hope so. And what I would add if I could is, I would add that communication is really important. And I feel like past administrations have only really dipped their toe into the pool of potential that is communication. Because again, you can do the best science in the world, you can make the best National Climate Assessment in the world, you could develop the best COVID vaccine in the world, but if you don't tell people about it in ways that are relevant and that matter to them, explaining how it affects their health, how it affects their lives, their homes right here and now today, and explaining how they can contribute to solutions, then it's not going to make a difference.

Katharine: So I think a renewed emphasis and a much broader emphasis on all of the social science that we have learned over the last decade and more, a lot of it really digs into: how do we as humans process information? How do we relate to information? How can we effectively communicate this information to people? And most of us scientists are not the best people to do that. There's people who are really good at framing messaging and communicating. And instead of applying their skills to selling new running shoes, we can take some of those skills and apply them to helping people understand why climate change matters and why we need to fix it.

Joe: I'm sure I'm not the first person to say this to you, but in case you're looking for a new line of work, I think you can sign yourself up for the role as communication. Because as I said, you've just done such a fabulous job of over the last several years as the premier, at least in my experience, communicator about this. And I think this interview is yet another strong example of that.

Joe: So I want to end where I began, which is thanking you so much for your generosity in spending time with us and the overall generosity with US society and global society in terms of sharing your insights and your discipline and your many gifts. I started out this interview feeling a little sense of awe and a very large sense of gratitude for the work you do, and those two feelings have only grown in the last 45 minutes. Before we sign off, is there anything else you'd like to add by way of a last word?

Katharine: Well, you are too kind, Joe. Thankfully this is a podcast so nobody can see me blushing. But I think it's important to end this with just a reminder, again, that every single person already has reasons to care about climate change. They may not be the same as ours, but that's okay. We don't all have to care for the same reason. And so when we approach people with the attitude of, "Of course you care about climate change. Even if you don't think you do, it's just because we haven't connected the dots, so let's talk about what you care about and let's see if we can connect the dots." That's a very different attitude than approaching people with, "Oh, you don't care about climate change because you're a (blank) – judgy, 'you don't have the right values,' 'let's sort you out.'"

Katharine: When we approach people with respect, when we approach people on the basis of shared values, when we approach them with the idea that we're all in it together, and together it matters to us, together it poses a risk to us, and together we can fix it; I feel like that's where the big change happens.

Katharine: So last night I was speaking to an audience at Western University in Ontario, and I asked people a question that I've never asked before. The question I asked them is: what is *the* answer to climate change? And it was a bit of a trick question because I don't think there is any single answer to climate change, but I wanted to see what people would say. And I was absolutely fascinated to see that the number one answer that the most people came up with independently as the answer to climate change was collaboration, working with people. My TED Talk is called "The Most Important Thing You Can Do About Climate Change is Talk About It." I love that because by talking, that's the first step towards collaboration. It's not sufficient, but it's the first step towards working together, towards advocating for change in our spheres of influence, towards ultimately changing the world one step at a time.

Joe: Wow. And thank you very much. And if you were looking for another word that rhymes with the collaboration, try inspiration, because I think that's what you've given us.

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