IMPACT
PUBLIC SERVICE FUND

Transcription details:

Date:	28-Sep-2020
Input sound file:	Impact Climate: Investing For Climate Change

Attendees: Jim Genia, **Bold Business**, Michael Kopko, **Impact**, Rekia Foudel, **Impact**

Tony Lent, **Capital For Climat**e, Elodie Timmermans, **Ernst Young**, Emilie Mazzacurati, **Four Twenty Seven**

Jeff Gitterman, **Gitterman Wealth Management**, Bob Litterman, **Kepos Capital**, Geeta Aiyer, **Boston Common Asset Management**

Transcription results:

Jim Genia: Welcome to Investing for Climate Change with Impact. I am Jim Genia. I'm the editor at BoldBusiness.com. We're very glad that you're able to join us today. Before we start, I have some small housekeeping things to inform you about. Some of you have submitted questions ahead of the event. Thank you very much for that. We will ask those questions of the panelists during the discussion. If anyone has a question that arises during the webinar, there is a chat function at the bottom of the screen. It's the Q&A. Just put your question in there, and time permitting we will relay those questions to the panelists. There will also be a video replay available. We will email it to you. There will also be highlights which you'll also get. If you have any more questions or want more information, you can always go to IMPACTnyc.org. So I'd like to introduce Mike Kopko and Rekia Foudel, our hosts for the evening. Mike is the cofounder and chairman of the Impact Public Service Fund. Rekia is a board member and the organizer of this discussion.

Michael Kopko: Thanks, Jim. And thank you everyone for signing in today and taking on an important topic at an incredibly important time. Thankful to be here as well with you all. And I want to welcome you all. The Impact Public Service Fund is a nonprofit organization established in 2012. We're a non-partisan organization dedicated to understanding today's most pressing social and political issues and promoting viable actions for positive change. We share events and news to educate our community and future public servants of our country on the facts, histories, and statistics behind these issues. Tonight's discussion is an important one, and it's going to be organized in three phases. First, we're going to hear about the science of climate change. What's true and where is there scientific debate? Then we're going to hear from our second panel, which will discuss the future of climate change and what that has in store for us socially, environmentally, politically, and financially. In our last panel, we'll cover the future of investment strategies and private sector approaches to the anticipated change in our environment. I want to thank Rekia Foudel for her focused, tireless, and multiyear journey in bringing this discussion to life. Rekia?

Rekia Foudel: Thank you, Mike. It's a pleasure to be here today. I just want to make sure that we say thanks to a few people who helped us throughout this journey. First of all, speakers and panelists, thank you for being here. Really appreciate your time and your commitment to helping us understand what's going on around us and why climate change is important. I also want to thank Will Kennedy of the United Nation; Deborah

	Stern at Capital for Climate; Sandra Navalli and Hannah Slow of the Columbia Business School; Ed Kopko, Jim, and Brittany at BoldBusiness; and Mike as well. It's definitely been great working and being able to bring this on. So thank you, everyone, for helping us, and I hope you enjoy this webinar today. Thank you for being with us.
Jim Genia	Okay. It's time for our first panel. So science of climate change with Professor Radley from Columbia University. Radley, can you get-- okay. Let me start your presentation.
Michael Kopko	Great. While Jim gets Professor Radley Horton's presentation on screen, I'm going to do a brief introduction. Professor Horton is the Lamont Research Professor at Columbia University. He focuses on climate extremes, tail risks, climate impacts and adaptation. Professor, looking forward to having you share climate science and its background with us. If you don't mind, maybe a brief introduction to yourself and your organization. And then please do take us through the science.
Professor Radley Horton	Sure. Thanks for the chance to be with you today. So yeah. I spent most of my time at Columbia University. My research focuses on extreme weather events and how they're going to change in the future. I work with cities, private sector, as they think about the impacts of extreme weather events in the present climate. But then, also, try to prepare for the future to adapt, if you will, to the extreme weather events of the future. So in my limited time here, I'll spend the first half of my slides doing really a high level sort of climate science 101. Then I'll quickly provide a couple examples of major changes of huge financial importance that are basically a given, that are bound to happen just given what we know about climate unless we adapt. And then I'll end with a couple of slides that are a little more exploratory, about risk, maybe lower probability events. Things that science isn't totally sure about. But if they happen, they could be absolute game changers. So they need to be considered and planned for.
Professor Radley Horton	Okay. So with that, I'll jump in. First slide, The Climate is Changing. If we look at surface temperatures across the planet over the last 112 years, we see major warming trends over that period. Some areas, this is in Celsius, so those areas in purple have warmed about four degrees Fahrenheit. The areas in white don't have enough data. Ocean stations, parts of the tropics, where for the first half of the 20th century, just wasn't much data so we can't show trends. The only places on this map that have had a cooling trend over the last 112 years, that spot below Greenland and tiny bits of the southeast US. And the negative trends in those regions are about an order of magnitude smaller than the large warming trends I just mentioned.
Professor Radley Horton	Going to the next slide. It's Not Just Surface Temperatures. We're seeing a whole series of other changes in the planet. All of them consistent with what we expect greenhouse gases to do, and not consistent with alternate theory, such as what changes in the power of incoming sunlight would do, for example. We're seeing sea ice decreasing extremely rapidly. We're seeing land-based ice sheets melting. We're seeing the atmosphere holding more moisture as it warms and as the ocean temperatures warm. We're seeing permafrost melting earlier. We're seeing vegetation greening up earlier in spring, lasting longer into fall. Those are just a few of the changes we're observing.
Professor Radley Horton	Going to the next slide now. Let's start to link this a little bit to human activities. The basic physics, because all I showed you is trends so far, how do we know that anything that people did had anything to do with that. So there's a whole bunch of lines of evidence here, not all of which we have time to get into. But the most fundamental place to start is that the basic physics of why greenhouse gases should

warm the planet are trivially simple. They've been understood since the 19th century. Basically, just think about the properties of some of the molecules that are in our atmosphere. They've always been there. Now there's a lot more of them due to fossil fuel admissions. They act, essentially, as a one-way blanket, if you will. They are pretty much transparent to incoming sunlight. But they just happen to have the right frequencies, the right vibrations, if you will, and resonances, so that when the Earth attempts to reradiate its heat back to space - this is much lower temperature, much longer wavelength - it just happens that those particles in the atmosphere interfere, to a large extent, with the Earth's effort to reradiate heat. Some of that heat gets sent back down to the surface, which causes warm air. It basically puts the planet out of energy balance.

Professor Radley Horton

And just quickly, the next slide, we'll race through. But just to note, that the basic physics have been understood for a really long time. Now, there are legitimate scientific questions about, okay, you got an initial warm air due to these greenhouse gases we're putting in the atmosphere. But what happens next? Because the system changes, once you increase greenhouse gases, once you get that warming, how, for example, are clouds going to respond? Are they going to respond in a way-- depending on what type of cloud it is, it could give you even more warming because it could be a type of cloud that, similar to greenhouse gases, is particularly good at blocking earth's attempt to reradiate. Or it could be a type of cloud that's the opposite; very good at blocking sunlight. So there are some legitimate questions along that type. But they're second order in nature and the balance of evidence suggests that clouds are actually changing in a way that will lead to more warming.

Professor Radley Horton

Let's go to the next slide. So I just want to quickly show another line of evidence. You'll hear a lot about climate models as a tool that is used to make projections about the future. But it's important to note that climate models can be run over a historical period to a hindcast. I don't know if that's the terminology you all use when you test models over a historical period. These are physics-based models. So this isn't just relying on statistical relationships in the past or modeling the actual physics here. So to quickly run through what you're seeing, the black line observed actual global average temperature since 1900; some year to year variability, for sure. But that upward trend, that's shown in black. And then quickly, we can take a whole bunch of different climate models that differ. There are different spatial resolution. They differ in their physics a little bit. When we run those models, starting with the greenhouse gases that were in the atmosphere in 1890 - and this is depicted in that sort of greenish olive color - if we run those models for 110 years, keeping greenhouse gases at those levels that they were at back in 1890, roughly 33% or so less than today, we hold them constant. But have the volcanoes going off in the years that they did, which causes cooling. Have the sunspot cycles, which have a negligible impact on temperature. You get the pattern of temperature shown in green.

Professor Radley Horton

What happens when we run the identical climate models? Again, starting in 1890. But here each year, putting in the actual increase in greenhouse gases that really happened, the experiment that we ran over the last 110 years and the natural factors. Now you get the blue band, not a perfect fit. You can find a few years where there were departures. But from a risk management perspective, this is the model that captures most of the action. This is one way to help see that the statistics are changing the infrastructure we've built, our crop systems, or for a stationary climate; we're into a new world now. And so this is another independent line of evidence that human activities are responsible for this warming.

Professor Radley Horton

Next slide. Okay. And I saw there were some questions about deeper history. So carbon dioxide levels have gone up about 40% since the Industrial Revolution a little more. But if we look at these longer time periods going back 400,000 years or so, we can see times as shown in the top panel, the blue, when carbon dioxide levels were much lower. They were down around 180. Figure at the start of the Industrial Revolution, they were around 280. So sort of near the upper bound of what we've had in the last 400, 000 years. So what we've done now is taken them up another 40, 45 percent. And something that's really interesting here that maybe we can get into in the questions is that, if you look over the long time period for most of that 400,000-year period, it's been more true to say that temperature changes led carbon dioxide levels, than it is to say the opposite, that carbon dioxide led temperature. That's totally appreciated and understood by climate scientists.

Professor Radley Horton

The issue is that there are powerful positive feedbacks right now as we dump all this fossil fuel into the atmosphere. We are causing the temperatures to rise. Over these longer histories, these were like 10,000-or-more-year periods when changes in solar radiation reaching the surface caused temperatures to change. Changing the amount of ice cover, for example, sunlight reflected. Those changes in temperature then fed back. When the air temperatures start to cool, the water temperatures cool, they become better at absorbing carbon dioxide. So the cooler temperatures actually caused carbon dioxide levels to be lower, and vice versa can happen too. But there's a positive feedback there that drove the temperatures even lower. So the fact that the directionality of these different timescales was very different at the past when we weren't dumping carbon dioxide into the atmosphere is not something that should make us feel secured. It's something that should make us feel more nervous because the ancient past shows us these positive feedbacks. And what it tells us is now, when we're the primary driver causing these huge changes in carbon dioxide, we can expect the warming that comes from that to itself change the planet in ways that will lead to even more carbon in the atmosphere, independent of what we do. This is things like forest fires. This is things like permafrost melting. So it's cause for concern, not feeling good about things.

Professor Radley Horton

Next slide. Let's try one more. I wonder if there's-- yeah, there's an animation built in here. Perfect. Let's stop right there. Okay. Couple final framings for the last few slides. I want to show you two paradigms. One, we're basically already baked into some huge changes that I think capital markets haven't fully appreciated. But then also, there are these lower probability but really high consequence events, which are almost impossible to model. But the more greenhouse gases we put in the atmosphere, the bigger the risk of disorderly unwinding, things where we sort of lose the ability to manage all this as things become very nonlinear.

Professor Radley Horton

Next slide. Okay. The simple linear story; a histogram here. Normal distribution, right? That's that sort of bell curve further to the left. Let's say this is New York City, right? Average temperature on a typical day across the year maybe is in the 50s. But we have some days where it can be 100; some days where it can be below 15. Even if the distribution doesn't change at all, if we just nudge temperatures a couple degrees, like when we think about this two degrees or so of warming that we've seen, sounds like nothing. How could two degrees matter, right? One day to the next, we can't detect two degrees. But it shifts these statistics at the tails in important ways, right? And this is the whole story. When it's really hot, that doesn't just make crop yields go down a little bit; it can cause catastrophic off the cliff collapses in crops. When temperature and humidity cross certain thresholds, it's not just a little worse for

people. Suddenly, it's almost impossible to pump out enough electricity to keep those people cool. And people with pre-existing health conditions, literally, can't exercise outdoors, can't work outdoors. So these are these thresholds that we're crossing. A little bit of warming gives you far more heat events and longer duration.

Professor Radley Horton

Next slide. And even more powerful example. We can animate through this a bit, too, in the context of sea-level rise. Okay. So let's first talk about the figure on the left. This is the history. Globally, we've had about eight inches of sea level rise over the last century. Who cares about eight inches, right? It sounds like nothing. Think of the tidal cycle in most places that we all know. It's much bigger than eight inches, right? How could eight inches matter? But when you look at the graph on the left, you see that it's already become a game-changer. This figure on the left is showing you nuisance flood events. These are the times when sunny out, there's no storm, but people right along the coast are getting water in their basements. They can't open their businesses. They can't take their normal routes, roads home. How often in the Y-axis and within this Z-axis, if you will, and color are these events happening? As we move through the decades from 1950 through 2020, and as we look across a whole bunch of tide gauges all along the US coastline, you can see how profoundly things have changed already with eight inches of sea level. We've raised the floor. We now cross these thresholds of nuisance flooding. Not a little more often, far more often. Things that used to only happen say once every five years, every decade, now are happening several times a year.

Professor Radley Horton

And the panel on the right is showing you under the best-case scenario of sea-level rise. If we somehow only see a foot or two this century, which would be a small acceleration. Significant but not huge. And even if storms don't get any worse. If we just get the hurricanes of the past, and the nor'easters of the past, all along our coastline, different cities have a one in a hundred-year high water level. For New York City, it's kind of like what hurricane Sandy did. And of course, as we know, whether you can get insurance, whether you can have zoning, is based on those high water levels. This figure is showing you, let's not invoke stronger hurricanes; let's take the most conservative sea-level rise scenario you can imagine. How often in the future is that local high water level, that's a one in a hundred-year event today, going to be crossed? Where you see red, there's a hundredfold increase in frequency. So your Long Beach parts of the Southeast Coast, every year you're going to see these high water levels that we like to think of as a one-in-a-hundred-year event. Just about everywhere in this plot, in the lifetime of the typical home mortgage, you're going to be seeing water levels that we thought would just happen once every hundred years. So the nonlinearity has already happened and it's not priced in. I think it's a trivial conclusion.

Professor Radley Horton

Next slide. Okay. So now just wrapping up here. Those are the things that are basically baked in, indisputable from a climate perspective. But there are things that we aren't sure about. And this is the notion of tipping points. If you nudge a system, sometimes it'll behave in a pretty linear, orderly way until all of a sudden it doesn't. And if we warm things enough, coral reef systems, for example, could collapse. We're getting very close to the point we might see a summer where we lose all the sea ice in the Arctic. That could introduce major changes. Other systems are shown here that we don't have time to get into. So not to say that these things are for sure going to happen, but they are risks. The more we add greenhouse gases, the bigger the risk that something like this-- that you really can't adapt to and you can't prepare for.

Professor Radley Horton: Next slide. Another example of this kind of thing is compound or correlated extreme events. Couple of years ago, I had to spend a lot of time explaining this. But right now I can just say, simultaneous fires out West, hurricane in the East, right? There's a risk that we break the bank, whether we're talking about actual financial resources or emergency responders or risk tolerance of people. And we're probably closer to the brink than we think. Climate change can shift the statistics. Things that we used to think weren't correlated, that reinsurers don't think of as being correlated, suddenly can become correlated in ways that could expose us to huge risk, and phrased differently, opportunities for some.

Professor Radley Horton: Next slide. Okay. And this is the wrap here really. Tipping points and nonlinearities can be very frightening but also can cut in our favor. We're heading into a world - we had a conference about this last year - where retreat is something that people are going to be talking about a lot, right? The dialogue has changed so much in the last year or two. It's scary. There's going to be an unwinding for some places. We worry about who's going to be left behind when people start to realize what's happening along some of our coastlines and in somebody's fire zones. But getting people out will protect loss of life, and it'll prevent some of these repeat losses. But how do you do it in a way that's equitable for all and it doesn't lead to just a huge unwinding, is an enormous question. So these are scary topics. But I think clearly, the private sector shows us a model for how we can get positive tipping points, rapid action towards getting away from fossil fuels, towards renewables. And just pricing at a risk; companies not being able to get away with not considering these kinds of hazards I've talked about. Investors are already there, as you all know, beginning to sort of demand this. Companies that aren't addressing it are really at risk of being left behind. And young people are starting to demand this, too, or will be soon when they think about what jobs they want, where they want to go to college; are these companies reducing emissions? And are they really disclosing and looking at their vulnerabilities? That's the path towards opportunities. So that's the tipping point that can still work in our favor. There's a very positive narrative, I think, around the corner if we can get there. So I'll close there. Thank you.

Michael Kopko: Thank you, Professor Horton. That's really a wonderful introduction to this. And these subsequent panels will address some of the comments that you just kind of transitioned on. I guess one more question before we go and we bring on our second panel. One of the questions from the audience was around the data models themselves. In this whole kind of world of uncertainty, you mentioned the ecosystem sensitivity to changes. But what's your view on the data models that everyone's working off of, their accuracy? Is there a lot of uncertainty there as well; the long-running historic record, the most recent data that climate scientists are using? And then does that also compound future uncertainty from your perspective?

Professor Radley Horton: Yeah. That's a great question. There's so many answers to it. A lot of the data is extremely straightforward. But as you start to get into ecosystems, for example, some parts of the world we don't have as extensive a data record. So it's simultaneously true that it's easy to detect all of these climate changes. And it's, I think, a good point that our models are physics-based, right? They're not inherently going to miss changes, right? Whereas if you take a-- my understanding, a lot of the traditional economic models, for example, it's much harder for them to price in true changes in the ways systems work. Climate models and ecosystems, in theory, can capture changes because they're based on physics. But in practice, we have to really ask whether they can or not, right? It's one thing to say we try to put the physics in. We

try to have this be based in actual principles. It's another to say that as we're moving into this unprecedented world, we're actually going to be able to anticipate all these surprises. So I give you sort of a hybrid answer I would say. Some things we know are bound to happen. But there are real uncertainties. But from a risk management perspective, and based on all that we're seeing about climate change happening faster than we thought, and our societal systems being much more vulnerable than we thought, the balance suggests that this is a tail risk that should be ignored. Uncertainty here is not our friend. But uncertainty is real.

Michael Kopko — Great. Well, thank you, Professor. I really appreciate that. And I think we're going to be transitioning to our next panel. So I'll let Jim bring them up. But we want to thank you so much for all the time and the investment helping us kick this conversation off.

Professor Radley Horton — Thank you.

Jim Genia — All right. So the next session, we'll hear from Tony Lent from Capital for Climate, Elodie Timmermans from Ernst & Young, and Emilie Mazzacurati from Four Twenty Seven. Just give me one second while I promote them to panelists.

Michael Kopko — Great. And folks, we are mindful of all the questions coming in. We're going to weed them into the upcoming panels. And if we can't get to all of them, we'll ask our experts to submit some written responses because we know there'll be a lot. So please keep them coming. And we're doing our best to integrate them into the dialogue and the discussion. Our experts also can see them, as well, so they'll do the best they can to address them as we go. Yeah. And while we pull them up I'm going to do just a quick introduction. We do have Tony Lent who is the cofounder of Capital For Climate. He'll introduce himself. Elodie Timmermans from Ernst & Young who helps them manage climate risk and reporting on corporations globally. And Emilie Mazzacurati from Four Twenty Seven, a company that works in risk analytics around climate science and recently has taken a fairly large investment from Moody's. And you're seeing a transition of climate risks starting to make its way into markets. Okay. Elodie, Emilie, Tony, welcome. Tony, if you wouldn't mind just turning your camera on if that's possible? And Elodie and Emilie, feel free to come off of mute as well. Perfect. Okay. Wonderful. Maybe we'll just start briefly by having you all introduce yourselves and a little bit about your passion for this topic. Maybe we'll start with you, Tony?

Tony Lent — Sure. Thanks so much for having me here this evening and for having this opportunity to speak to you all. I'm Tony Lent. I've been investing in low-carbon transition for the last 17 years. Primarily in private equity across renewables and related technologies. And for the last 6 years, building two companies in the space. One, an investment bank focused on that, and the other, a large-scale development investor. Capital For Climate, which is my new platform, is developing open-architecture intelligence to help investors really navigate through the high-leverage opportunities that place capital in climate solutions across the primary decarbonization pathways. The major sectoral pathways that we see in front of us today.

Michael Kopko — Thank you. And Elodie?

Elodie Timmermans — Sure. Thank you. So thank you very much for inviting me to this event. I'm Elodie Timmermans. I'm a senior manager working for EY in our climate change and sustainability services group. I've been working with EY for about 12 years, focused on ESG sustainability, climate-related topics. I actually started my career in the Netherlands and transferred to the US a few years ago. But I focus these days mostly

on the financial sector and helping companies develop their environmental, social, and governance strategies programs, thinking about goals, sustainability, materiality assessments, including ESG within overall business considerations and decisions, and also looking at climate-related disclosures and risk assessments.

Michael Kopko — Wonderful. Well, thank you for being here. Very exciting. And last but certainly not least, Emilie. Welcome, and please introduce yourself.

Emilie Mazzacurati — Hi. Thanks for having me. My name is Emilie Mazzacurati. I'm the founder and CEO of Four Twenty Seven. We are a firm focused on bringing climate data of the like that Professor Horton just presented, put it in the hands of investors and corporates to have them make better decision with regard to climate risk management and adaptation. And I personally have been working at the intersection of financial markets and climate change for over 15 years now with a long history in the carbon markets and climate policy before I founded Four Twenty Seven. And as you mentioned, we're an affiliate of Moody's, and happy to talk about that.

Michael Kopko — Wonderful. I'm going to kick off with some questions. But please all feel free to kind of make this a dialogue. Very excited to have you here together. I'm going to start, if it's all right, with Tony. Tony, we just heard from Professor Horton about the science of climate change. And I think the big question a lot of folks are asking - you can even see it in the Q&A - is what are the implications for us? What does the future of climate change have in store socially and financially? Questions about should people already be moving, safety, and all types of other issues. Wondering what kind of your broad comments are on the space and the change that's coming.

Tony Lent — Well, I'm going to answer that question with respect to the investment side of the equation because that's really the world that I live in. And I would say, what it has in store for us, simply put, is a significant reallocation of capital to support the transition to a zero-carbon economy. And that job, that transition, is going to become more important to, first, thousands of investors, and then tens of thousands of investors worldwide over the next 10 years. As we can tell, the climate problem is accelerating faster than we're investing in solutions. IPCC and the leading research tells us that we have 10 years to reduce emissions by 30 to 50 percent. Obviously, there's tremendous wealth creation opportunities if we do it well. As Professor Horton showed us if we don't do it so well, the future dims pretty significantly. So the question is, well, what could you actually do? And the interesting thing is that there are extremely detailed road maps to decarbonization; decarbonizing the economy that have been produced, but they haven't yet been embraced by investors. Catching up to the climate problem is going to require that we invest in climate solutions, not just in renewables, but in all sectors. Agriculture, transport, heavy industry, the built environment, cities, forests, and natural capital.

Tony Lent — And today, most of the investment is actually focused in renewables and transport. So people often ask, "How big is that financing gap? What's it actually going to take?" Well, we're already investing around 570 billion a year in the low carbon transition. And the gap, by most estimates [inaudible] we need to invest roughly $2 trillion a year. That sounds like a big number, but it's really around 1 and a half to 2 percent of global GDP. That's not insurmountable. To succeed, it's going to take a really focused effort. But the good news is that we actually have some really strong examples of mass mobilizations, both in our past and in our present. In World War II, it only took us four years to redirect most of the manufacturing capacity of the US to the war effort. And in four years, that effort went from about 2% of GDP to 40% of GDP by

1945. And we just allocated 2.1 trillion to the COVID response in the US, 12% of GDP, within really about 90 days of the COVID crisis. Globally, we're allocating 10 trillion to COVID. To put that in perspective, that's 30 times more than the Marshall Plan with today's dollars. So I think to start things off, I would say, these are really big numbers, but they're totally achievable numbers.

Michael Kopko

Thank you, Tony. I'm going to open the floor. But Emilie, I don't know what are your thoughts are in terms of studying this from a professional risk analytic standpoint. Do you agree with Tony's numbers? It sounds, at some level, like this could be almost a war mobilization-type need to solve the problem. And are we actually properly pricing this into our financial models from a risk standpoint?

Emilie Mazzacurati

Yes. Very good question. If you think about the range of impacts from just a physical manifestation of climate change from what was presented earlier in that presentation, think about impacts on a range of sectors, right? Agriculture, manufacturing, real estate, different impacts on different geographies on cities and countries, impact at the property level, at the manufacturing site level, impact at the city level, impacts for entire industries, macroeconomic impacts, impacts on biodiversity, on human migration, on public health. There is just an enormous range of issues that we're going to have to deal with. And preventing them over the long run with investment and mitigation, as well as adapting to those impacts as we are now locked into a certain amount of climate change, is going to require a tremendous amount of investment.

Emilie Mazzacurati

Now, when it comes to whether those risks are well priced in and whether we really understand the cost, it's really a work in progress. But there has been a big shift in the mindsets of a lot of financial institutions and banks in just the past few years. And the questions that regulators, investors, and businesses are wrangling with right now are: first, how do you identify and understand those risks? Right? And how do you take these sophisticated models of the physical interactions with all their uncertainty and use that for business decisions and investment decisions? Second is how do you quantify the economic and financial impacts of those risks? And that's where a lot of the issue lately is. To be able to price the risk appropriately, you need to understand what the cost is. And this is the missing piece in the puzzle right now that I think we're getting a lot closer to having good answers with. Good answers in terms of seeing, first, from an empirical standpoint, how those risks are being priced. There's properties that don't sell as well. There's [inaudible] investors that ask for higher return when they invest in a property, and you can see that across a range of other sectors. But also from a theory and modeling standpoint, really being able to capture systematically how this type of impacts and transition risks can turn into economic and financial impact at the firm level, at the company level. And then third question, right, at this point, is how do you reduce or mitigate those risks? And the balance between the massive investments that are required to reduce greenhouse gases in the long term together with the fact that we also, at the same time, need to invest into an efficient and very much local efforts to mitigate those risks because we're going to have to deal with both at the same time.

Michael Kopko

Emilie, one quick follow-up to that, and we want to get Elodie in as well. But one of the questions from the audience is, how do we address psychology in politics of climate change?. The last comment you made is around the criticality of local institutions. This is a discussion on the private sector. I think you're in an interesting position because you advise private and public sector actors. How should we think

about making sure that climate science doesn't get muddied in the political issue that climate change has become?

Emilie Mazzacurati

I mean, yeah. [laughter] That is also a very big question. I think what we're seeing today is sufficient action from regulators, not necessarily in the US, but certainly, in every other country that has a strong financial system: in Europe, in the UK, in Japan, in Australia, in China, in Thailand, in Malaysia, in New Zealand. You name it, right? All of those countries are sending really strong signals to their financial sectors saying, "This is a risk that matters. We're going to expect you to embed that into your risk management systems. We're going to want to see numbers and disclosures on how you manage those risks." And so it gets to the point where the personal opinion of the management, of the people dealing with those risks inside of company don't matter. Right? It's a regular, true risk and what you believe or your opinions are not really relevant. In the US, of course, it's a much more loaded context because there has been years of disinformation and lobbying and financing of fake science. And so we are still trying to get back into a place where we can have a conversation about science, like what we have today, where we can really look at the facts in terms of what are the right responses, what are the right solutions to climate change. And we are sadly aided by the stream of extreme weather event that we're all dealing with. The reality is that public opinion has shifted, that a lot of businesses see climate as a material risk. And so I think we're moving away from the place where we have been for the past decade or so, and towards a place where we can have a more rational conversation about the science and the risk.

Michael Kopko

Thank you. And Elodie, maybe because you have a much more international approach to this in your work as well, what can you tell us about some of the changes in climate related to policies across the globe? And what are you seeing as some of the main differences between US and European companies and countries in terms of their policies related to climate change?

Elodie Timmermans

That's a good question. And I think the discussion has definitely evolved over the last couple of years, as we just talked about. Climate change is now becoming a real social justice issue. And I think based on what we're seeing here in the market in the US, and what Emilie was saying, it's something that we are seeing changing; the mindset is changing. Globally, what we see is that there are numbers of research and reports being published that call for action and highlight the complexities and interdependencies associated with climate change for businesses. So it's not just about how the company might have its environmental impact, it's also how our climate risk is going to impact the business, its operations, its supply chain, and what are the key decisions that such a company will have to make? Since it is having a financial economical impact, we see that the World Economic Forum, for instance, in its 2020 Risk Report that was released earlier in January, categorizes climate change as one of the biggest risks in the global economy with 5 of the top 10 risks in terms of likelihood and now the environmental risks.

Elodie Timmermans

So going back to the question about policy and how it impacts the differences that we see is where we see that around the world, climate risk and climate change regulation is becoming more strict in certain countries, like in Europe, or in Asia, Oceania, where countries are now asking companies to disclose more information around their climate-related risks and how it's going to impact their companies. They're asking them for more sophisticated data. They're also asking them to follow recognized reporting frameworks, like the TCFD, the Task Force on Climate-related Financial Disclosures. They're still emphasizing some of the regulations, like the European

Union Emission Trading Scheme. In the US, we don't have report disclosures, regulations on climate-related risks. But we do see that climate risk or climate change topics, including ESG topics, are being elevated at the board level and the C-suite level. Because various reasons: one, face investor demands. Investors are asking companies to explain how they are managing the climate risks. But it's also because there is a recognition that climate-related risks may have impacts on organizations from a license to operate perspective, a perspective of attracting talent, but also just pure operations perspective, because if they don't manage the supply chain or the products or just appropriate legislation response, then they might not be able to address those risks appropriately.

Michael Kopko

Yeah. I'm going to switch over to Tony for a second, but if there's anyone that wants to comment on-- and Tony, when you're hearing all of this and these frameworks getting stood up, are you optimistic or pessimistic? And I think some of the questions that have come in-- what are the things that we're not talking about? These frameworks that Elodie's sharing, did they address the issue, or are there big problems that are not coming to light that we have to address in corporate America still?

Tony Lent

Well, that's a good question. I think that to the positive about these frameworks, one of the things that we haven't touched on yet, which I think is really remarkable, is the emergence of these very, very large groups of asset owners - so pension funds, sovereign funds, and the like - that have formed groups specifically focused on climate. So you have groups the net-zero asset owner alliance, which came out of Climate Week last year. You have the IIGCC in Europe, which has got around 36 trillion under management. You have the Climate Action 100, which evidently has around 40 trillion under management in their memberships. And you have the new RMI's Climate-Aligned Finance Center. These groups are important. They represent 20 to 25 percent of global financial assets that are professionally managed. And they're all extremely focused on solving or addressing both the risks and figuring out how capital can be allocated to be part of the solution. What we've noticed is it's gone through an interesting evolution over the last couple of years. They tended to start with, first of all, identifying the risk and what is the risk; secondly, quantifying it; third, engaging with policymakers; fourth, focusing in on this new concept of portfolio decarbonization; and then ultimately asking the question, okay, how are we going to invest in climate solutions in the real economy? And we think that actually a phenomenally important trend that people underestimate how much power it has in the marketplace. It's already having a significant impact on corporate behavior in a number of the high emitting sectors.

Tony Lent

The other thing I would say that's really important is this whole concept that we're seeing spread worldwide of net-zero by 2050 is already being embraced by dozens of very, very large asset owners with billions and billions under management. And that concept itself is now spreading into the corporate sector. And dozens of very large corporations are signing on to some version of net-zero by 2040 or 2050 and purporting out to the investment community about what their strategy is and how they're going to achieve that over the next decade or 20 or 30 years. That's a huge shift in mindset that really has just crystallized over the last, say, 24 months.

Michael Kopko

And Emilie, from your models, when you're tracking these companies making these shifts, what's kind of behind the scenes in terms of how you're screening good from bad in terms of approach? What are the key indicators? And when Tony kind of explains the amalgamation of assets under certain actors, do you think that that's a

net positive or a net negative as it relates to addressing climate issues? Oh, I think you're on mute there.

Emile Mazzacurati

Is that better? Yeah. Let me take the first question first. The way we look at climate risk is not from a good or bad perspective but is from a: what is the exposure of a certain asset that may be in a company's portfolio? So it's not a judgment call. It's bringing hard science to risk management and looking at whether oil companies and facilities, refineries, exploration, sites may have exposure to extreme heat, to floods, to sea-level rise. And so that's the piece that Four Twenty Seven really brings now. As we're part of a broader set of indicators that are part of what we bring to the market with Moody's, we also look with our partners at Vigeo, another Moody's affiliate, at how companies are responding to, Elodie mentioned earlier, the TCFD, The Task Force of Climate-related Financial Disclosures, which sets a long list of indicators and recommendations or guidance on what companies should be disclosing. And so the work that Vigeo does is looking in a great amount of details of those reports that companies put out to assess how well they're doing at meeting the recommendations from the TCFD, as well as looking at all the commitments and recommendations, targets that the companies may have taken on, how well they're doing at meeting those targets.

Emilie Mazzacurati

So they are much more bringing the perspective of good or bad. Are those companies being good, responsible citizens? Are they doing their job? And I think the value of bringing those different perspectives together and what's really interesting is looking at where you have a gap between the two. We have a report coming out next week that has a little bit of that. Looking at what are the companies that are doing well at reporting; reporting physical risk in particular? And are those the same companies that we find have really high exposure to physical risk or to transition risk, and the answer is "Not necessarily." Right? Which should be a cause for question, and those investor groups that drew this engagement that Tony described is really important. And the hope is that this data helps them ask more pointed questions and maybe scratch a little bit under the surface when companies provide an answer that may or may not reflect the complexity of what's underneath.

Michael Kopko

And just want to do a quick follow-up. We've seen this a little bit with COVID in terms of changes in people migration. And it was one of the questions from the audience as well. The movement of peoples as a result of climate change are going to be relevant for businesses and governments alike. What's your view on that net migration. Do you think it's already happening? How severe will it get? And how do you, as an organization, help entities better understand how that's occurring or not?

Emilie Mazzacurati

So anecdotally, I will say I've seen a lot of email threads amongst friends right now about how long does one stay in the Bay Area when you're smoked in several weeks a year? Right? And I will say it's a little shocking how quickly these conversations take place about, "Oh my God. Is this going to be every year? And do I want to live in this environment?" So there's some studies and some projections of migration. I think it's a topic that's really hard to capture and predict really well because of the complexity of the drivers of why people live in one place and what makes them move or not move. We certainly have historical data showing that after some large hurricanes, in particular, we have locations where the population has not returned to the levels pre-storm. So if you think of Puerto Rico after Hurricane Irma in particular, even looking further back in New Orleans and Hurricane Katrina and a number of other places on the East Coast, you have some of the population get away before an extreme weather event and then don't come back. And in California, where I see it here, we're seeing

some of that too. A city like Paradise that got burned to the ground two years ago, has, I think, a small percentage of its housing and infrastructure that's being rebuilt, and now, it's a few miles from a new fire.

Emilie Mazzacurati

Is this a place that's going to be inhabitable in the long term, is a real question that we need to confront. How do you insure your house if you live there because no insurance is going to pay for that fire insurance, right? So we're starting to see that some of those drivers are really affecting people. I don't think that we necessarily have really figured out the right models, but it's certainly something that we're seeing investors start to look at and cities think about. Coastal cities may think about whether they're going to lose population. I've heard conversations in the Midwest about whether they were going to get more population because of fleeing from the Coast, but the Midwest itself has floods and heat. So there's no perfect place. But I think we're going to see those changes.

Michael Kopko

Thank you. Yeah. And I guess before we end, I want to ask you all for your predictions 10 years out in terms of where we are on this topic. But Elodie, as you kind of look at evaluating companies and coming up with measurements that not only companies can evaluate them, but maybe investors start to care about -disclosure was a big word in your introduction to this - what do you think are going to be the things investors look to more and more from companies they consider placing capital with to see how well ahead of or behind they are on this change, to the extent you'd think it's even real? And what I mean by that is, maybe some of these things are critical to pay attention to and others are a little overblown. Interested in your perspective on that.

Elodie Timmermans

It's a good question, and I could talk about this for hours. But the main thing is it probably depends on the sector and the geographies of those companies. But what we do see investors asking companies is more disclosures around climate-related risk from a governance, strategy, risk management, and targets and metrics perspective, which is basically in line with the climate-related financial disclosure guidelines. Investors, institutional investors, and other investors could agree on the fact that TCFD, when it comes to climate-related disclosures, was the framework that one could use to describe their business strategy, but also how climate is impacting them and how they are impacting the environment. Further down, investors are also starting to go beyond just the checklist exercise, but just looking at what are companies actually disclosing and what are they actually doing?

Elodie Timmermans

And so what we do see is that where greenish gas emissions or your environmental impact might have been a bit in silo in the CSR or sustainability team or maybe your real estate or facilities team a couple of years ago, it's now becoming something that's integrated across the organization or at least it's striving to be integrated across the organization, where, as Tony mentioned earlier, as companies are setting those goals, those goals are actually-- whether it's carbon reduction, carbon neutral, or carbon-negative goals, they are impacting the overall organization where it impacts your operations, but it also impacts the supply chain of those organizations and also just the environmental impacts of the products and services that they deliver.

Elodie Timmermans

So basically those companies are looking at how can we be better stewards of the environment and decrease our environmental footprint across the life cycle of our product, and how can we drive change across our value chain? And that is something, as we think about the discussion about disclosures and market expectations from investors but also your stakeholders, that companies are going to be expected to look at not just a pure risk-management perspective but also looking at the opportunities

associated with innovation and lower-carbon technologies, but also looking at, basically, how will we have better social outcomes but also less environmental impacts as we conduct our businesses?

Michael Kopko — Great. And then a quick follow-up, and I'll ask the rest of the panel before we change to the next section. But in 10 years, what do you think-- where do you think we will be with the private sector addressing climate change? What do you think will be in kind of our reality, and what, maybe, you are hopeful for?

Elodie Timmermans — I don't own a crystal ball. And I would be-- I'm hopeful that private sectors are going to develop a strategy to achieve these sustainable development goals and help towards a lower-carbon economy, and so that will drive change. But there's definitely a lot of work to be done before we can get there.

Michael Kopko — Tony or Emilie?

Tony Lent — Right. No, I'll take it. I think what we're beginning to see, and we'll probably see a lot more of, is the corporate sector reaching out to innovation communities to try to tap those communities to adjust some of their primary mission's problems. And we're already seeing huge amount of self-organization within each one of their primary economic sectors, where innovation communities that are focused on particular solutions are making their solutions better known, helping investors find them, and helping corporates find them. And I think we're going to see a lot more of that going forward. I think we've seen some pretty significant changes already in the investment market. We're going to see massive changes going forward. Green bond market's already $290 billion a year, and I think it wouldn't be at all surprising to see it be a trillion over the next five years.

Tony Lent — Similarly, infrastructure right now is a relatively small part of the private equity landscape. But I think we're going to see the infrastructure asset class double or triple in size, and we're going to see infrastructure in emerging markets become a really important asset class for investors, particularly in countries that are focused on ESTGs. And I think we're going to see, quite likely, a pricing on carbon, and we're going to see the private sector-- and we're going to see the private sector lead, at least for another three to four years, globally on this investment process. And then governments coming in behind them with even more capital and public sector capital to address the challenge, which at that point will be more obviously a crisis.

Michael Kopko — Thank you. Emilie, any thoughts?

Emilie Mazzacurati — Sure. I'd like to, that last point. I don't know what-- [laughter] I'm afraid that yes, you're right. It's going to be even more a [vicious?] crisis. It's sort of a pretty bad crisis today. I think the question of the role of the government is really important. I think corporations can and should do a lot. I think we're seeing a lot of interesting initiatives. But at the end of the day, we need government. We need good policies to shepherd in the right direction. We can't just rely on goodwill from corporations. I don't know if you all saw the-- Business Roundtable released a report on climate yesterday. It's a large swath of very large corporations in the US that are responsible corporations. And their paper on climate is a call to action for policymakers to say, "The climate crisis needs to be addressed and, therefore, we need policy to support that." So my hope is that in 10 years, and even sooner than that, we have strong, robust, sound policies that level the playing field, get us in the right direction, and address those issues at stake. Do I know or do I think, for sure, they will be there? I

don't know that I would get there, but we'll hopefully close the panel on the hope that we can get there and that we can still turn the corner.

Michael Kopko — Thank you, Emilie. And Elodie, Tony, thank you so much for sharing your thoughts and coming with us today. There are a bunch of questions we couldn't get to, but we'll follow up with those and pick up a little bit in this next panel. So thank you. And we're going to transition into our final panel, and thank you for our audience for staying with us. We're in the home stretch of our discussion as we now transition to focus on portfolio strategy in the investment space related to climate change. So Jim, if you want to introduce our speakers and promote them in, that would be great. And Elodie, Tony, and Emilie, thank you so much.

Tony Lent — Thank you.

Emilie Mazzacurati — Thank you.

Jim Genia — Sorry. Next up we have Jeff Gitterman, Geeta Aiyer, and Bob Litterman. Give me one second while I bring them in and push the other panelists out.

Michael Kopko — While Jim does that, I'll do a quick introduction before they join on screen. Jeff Gitterman, we want to thank for helping us organize much of the discussion today. He runs Gitterman Asset Management. Bob Litterman, who's going to be joining shortly, originally a partner as Goldman Sachs, asked to kind of price in risk from a climate perspective and then has started Kepos Capital. He's been a really renowned expert and thinker on this category. And Geeta Aiyer, who runs Boston Common Asset Management and runs a very large portfolio looking exactly at companies and their climate approach and their eco-sustainability. So, Jeff, Geeta, Bob, welcome. Thank you so much for being with us. We're super excited for this final crescendo to a discussion on climate change. Jeff, maybe if you don't mind doing a quick introduction for yourself?

Jeff Gitterman — I'm Jeff Gitterman of Gitterman Wealth Management and deeply interested in climate risk and ESG and sustainability. I've hosted the UN Sustainable Investment conference the last couple of years, and I also host a TV show at Fintech.tv called "The Impact," and actually host of climate week next week at thenestsummit.com. It's all free programming. A lot of great speakers all on climate starting the 21st to the 25th, and that's, again, thenestsummit.com.

Michael Kopko — Yeah. And I wanted to thank you for all the support on this, Jeff, for helping this come to reality, and we're excited to have this event on FinTech TV as well. Geeta, welcome and thank you. Mind introducing yourself to the folks on the line?

Geeta Aiyer — Yes, thank you. I'm Geeta Aiyer, and I'm based in Boston. I run a firm called Boston Common Asset Management. We are global equity investors. We use as you correctly pointed out, environment as well as social and governance criteria in our stock selection. But even more importantly, we are engaged investors in the sense that we are active stewards of our capital. We talk with companies, and we try to move them towards greater climate responsibility and awareness. So I am excited to be a part of this conversation because after listening to the prior panels, I am torn whether to be an optimist or a pessimist. And I'm hoping that we'll end on this note where we will determine to solve the problems that have been so daunting and so apparent and yet seemingly just insurmountable for all of us together. This would be, probably a few years ago, Bob and I spoke together on panels. And yeah, I would love to come back and say, "All right, Victory is in sight."

Michael Kopko

Well, we'll hopefully advance toward that objective. And I'll introduce Bob, who I know you all worked together closely over the years. Bob, welcome, and if you wouldn't mind introducing yourself, we'd appreciate it.

Bob Litterman

Sure. Thank you. It's a pleasure to be here. Bob Litterman, I am a founding partner of Kepos Captial, which is a New York-based investment firm. I just recently chaired the Commodity Futures Trading Commission subcommittee on climate-related market risk. We released a report last week that I hope everyone has had a chance to see, talking about climate risk and its impact on the US financial system. And it's a pleasure to be here. I'm out in California. You can see a nice, sunny, bright day with clear air here. We've had three weeks of horrible air. Last week, on Wednesday, that window was pitch black all day. Never saw anything outside. So we definitely got problems. Geeta, I am an optimist, and I can tell you that when the climate risk subcommittee voted last week to approve its report, we voted unanimously. We had 34 members representing all different sectors of the financial markets ranging from oil companies, ag companies, data companies, banks, insurance companies. We had academics, environmentalists, and we all agree on all the important aspects of climate risk and its impact on the financial market.

Michael Kopko

Well, thanks for being here, Bob. We're really excited to jump into the discussion. We've got kind of the rockstars of climate change in tonight's discussion, and really excited to hear from you all. Let me start with you, Jeff. One of the big questions in a big-picture level, can you just describe a little bit the physical climate risk, the direct risk climate change it's going to have on agriculture, forestry, healthcare, real estate? And how is that going to affect capital markets?

Jeff Gitterman

Yeah. I think the first thing to think about is we think about climate change as this broad subject matter. But if you boil it down, you're really talking about more floods, more droughts, more extreme weather, more extreme heat, water and food scarcity. So you've got six issues that you're dealing with across the board. And if you want to start, in just simple terms, as a wealth manager, or an adviser, and think about what could happen to your portfolio, certainly municipal bond exposure, mortgage exposure, and real estate exposure is kind of the first leg of what is going to start to see priced in physical climate risk. Everything else is kind of going to come after that, unfortunately. You're going to get migration patterns because of food scarcity and water scarcity. You're going to have wars fought over water, kind of like you're seeing in the China-Pakistan borders now. But if you're just thinking as an investor, initially, the data is out there, as you heard from Emilie and plenty of other companies that do what Four Twenty Seven does. But when you start to watch the acquiring of Four Twenty Seven by Moody's, which I know she didn't get to speak that much about, these rating agencies are buying data companies that give you information on physical climate risk around hard assets.

Jeff Gitterman

So this is the first leg. If they're buying those data companies, they're not buying them just to watch. They're buying them because they want to start rating that risk. So right now, in the capital markets, physical climate risk is an unpriced risk. And the data's there to price it. So as a wealth manager, an investor, an adviser, an asset manager, you got to take a pause right now and [take note of?] the fact that, if the data's out there to price in the risk, the only thing stopping it is somebody being a first mover in that space. And obviously, Moody's, with their acquisition, or Fitch with their acquisition, or True Value, they're all kind of fighting to get there first right now. So it's about to get priced in. The data on municipal bonds, you can look at every single piece of number in the United States right now for the VAR or value at risk of that

bond over the length of term. So the maturity of that bond on all the physical risk: heat stress, water stress, extreme weather, rising tidal, everything, you can get an in-depth report on every single CUSIP.

Jeff Gitterman

So right now, if you want to buy a Tampa municipal bond, a hospital bond that's paying 20 years, paying 3 and a half percent, and you compare that value at risk to a Rochester, New York Hospital Bond with 20 years at 3 and a half percent, that Tampa bond's going to have about a 94% value at risk, where the Rochester bond might have an 8% value at risk. And you can manage what you can measure now; you can measure all of that risk. So people are going to start managing it, which means it's going to get priced in literally overnight. It might not be next week, but 3, 6 months, 12 months from now. All of that risk is going to start to get priced into the market. Right now, you can derisk your portfolios at no premium.

Michael Kopko

Yeah. I mean, I want to jump to Bob, because Bob, you're kind of one of the first real voices around properly pricing in climate change, and I did research a lot of videos of you explaining it, but what does Wall Street need to change their models and avoid this next kind of market disaster? Or are you not worried and it's just going to happen, as Jeff's suggesting? I'm kind of interested in what your view is on pricing in this risk, and how do you do it effectively?

Bob Litterman

Well, thanks. When you price risk, I mean you're always forward-looking. So the question is, are investors aware of the risks that are coming? And it's hard to say. Certainly, a lot of us are very aware; some investors more than others. You can look at the prices of assets, the trade. Although a lot of these assets re relatively illiquid. You can look at real estate on the coast and flood zones, and you can see impacts for sure. Academics have seen these impacts. So there have been some. And when you think about transition risk, it's particularly obvious in some of the sectors, such as the fossil fuel industry that has underperformed significantly now for probably 10 years, and it's a very significant underperformance. So the question is, is it all priced in or not? And there, I think the issue is really one of the speed of the transition, and I don't think investors have recognized the speed of the transition because they are looking at what's happened so far, and there hasn't been that much of an impact, although it is accelerating.

Bob Litterman

But I think they probably are not pricing it all in. When you ask me, at the end of the day, do I think it's all priced in, I think the answer is no. And the reason I think that is because right now, emissions are still increasing. And emissions are not the problem; it's the stock of greenhouse gases in the atmosphere. So we have to quickly reduce those emissions to net zero, and then probably go beyond net zero, and that means a relatively high-price emissions. In order to pay for taking emissions out of the atmosphere, it's going to be necessary. That's an expensive task, and that's the margin. Today every kind of carbon dioxide that we put into the atmosphere, we're probably going to have to take it out at some point in the future. So that gives you an idea of where these emissions need to be priced, and I don't think investors have built-in expectations that that's going to happen anytime soon. In fact, I do think it is going to happen soon.

Bob Litterman

The CFPC came out with a report unanimous from everyone, as I mentioned before, oil companies to environmentalists saying, the US has to price carbon. You have the Business Roundtable which represents the CEOs of the largest US corporations saying, "We've got to price emissions." So even though you don't hear that from politicians, who frankly think that it's a losing argument - no one likes taxes - when the election is

passed, I think you're going to have a new conversation, probably have bipartisan legislation introduced for price emissions and whatever conversation that I think will lead to legislation in a relatively short period of time, much sooner than most investors, I think, expect. And by the way, then I think you go to the international arena. And I think the Europe and Asian countries are ready to move forward. They're waiting for the US. So once the US moves, which I think is soon, I think you'll get the globally harmonized incentive to reduce emissions much faster than investors expect. And therefore, I don't think it's all priced in, I think there is an opportunity to derisk portfolios, as Jeff has suggested, or take advantage of opportunities in those assets that will do well in a rapid transition to a low-carbon economy. We can talk about those as well.

Michael Kopko

And in a quick follow-up, because I know we've got a lot of money watching this conversation and others like it, in terms of portfolio and the climate risk element, but can we maybe-- when you're thinking about pricing climate risk, and for the people that are watching, what do they need to appreciate in terms of the size of that potential risk? And then what are the indicators for you that'll suggest it's been reasonably priced in?

Bob Litterman

Well, I think the-- let's take the second question first, which is what indicators do I look at for pricing risk. And the first thing I would say is that you have to look beyond just carbon markets. There are carbon markets out there; there's both cap and trade and carbon taxes. But incentives is a much broader concept. Anything that affects behavior is an incentive, and you've got incentives to reduce emissions that come from, for example, gasoline taxes that might not have been implemented for that purpose. But in the US, that's the biggest incentive to reduce fossil fuel consumption right now, are taxes. In many countries, you have subsidies to fossil fuels, both consumption and production. And then you've got subsidies for renewables for either [speed in?] tariffs, and there's renewable portfolio standards, and all kinds of other incentives in this country and around the world. So when you aggregate those all up, what do we have? And the answer is, five years ago those incentives were basically zero. And today my firm, Kepos Capital has a metric; we use the product carbon barometer. And it estimates that the globally average incentive to reduce emissions is today about $12 a ton, which obviously is a significant increase from zero, but frankly, much too low. They have a significant impact on the emissions in the near term. But we expect that metric to go up very fast over the next couple of years, and that's something that we're going to be watching very carefully. And then with respect to the-- your first question was something about the size of the flows?

Michael Kopko

Size of it. How much are we talking about when we fully price this thing in? What should investors brace for?

Bob Litterman

Well, we certainly are talking about trillions of dollars. Although how much money is required really depends a lot on technology and what the solutions are. And those are very uncertain right now, whether it's going to be solar and wind, or we're going to need nuclear, and what kinds of storage technologies, and so on. And frankly, going forward, as Jeff mentioned, you need a lot of infrastructure and capital in the low-carbon economy. And we're probably going to have to spend an awful lot of money in the long run, pulling CO2 out of the atmosphere. So we're talking about trillions of dollars per year, and it's going to be for a long, long period of time. This problem is going to be with us for decades.

Michael Kopko

Got it. Geeta, let me transition over to you. You're a shareholder in many companies across the world. What are you looking for when you invest in companies today? And what do you think makes the best eco-aware companies for the future? And maybe it's not that too much complexity. If you're talking to the board of these companies, what are you looking for in terms of the balance of profitability and climate responsibility?

Geeta Aiyer

So I have the benefit of being able to choose the stocks to invest in. I should have mentioned earlier that I, in addition to being transformed by listening to Jim Hansen, my personal hero of 20 years ago, sort of got me completely immersed in the planet issue. And the fact that I grew up in India and places in emerging markets, which actually, would play a hugely disproportionate price for this, [inaudible] is that we now live here, where in addition to having a very high per capita emissions as to the world, we also have limited policy actions. So we really are looking to companies. And I have the luxury of being a global investor. And so what we are intentionally looking for in addition to obviously good managements and financial fundamentals, ease and understanding of where the companies' businesses are aligned. And here, we are looking to the companies that will be part of these solutions. So there is risk avoidance, but there's also tremendous opportunity. And we play in both of those markets. So the investment of the portfolio is driven by the desire to have visionary managements that have risk management in place and, by their actions, are not contributing to the enhancement of the risk. So clearly, fossil fuels and so on are not in our portfolios.

Geeta Aiyer

Conversely, there are tremendous opportunities of companies which either through their own creative actions; through consumer preference; through market demand, actually, for efficiency; through the fact of potential policy action, particularly in Europe and South Korea and so on, where green recoveries are now going into the physical spending policies, even in the emergence from the pandemic and the downtrend that has resulted, we see tremendous opportunities. So examples would include, in France, we own Schneider Electric, an industrial name, that is a huge beneficiary from the demand for energy-efficient infrastructure. We own Ørsted, which is a Danish wind farm. Offshore vendors gaining traction and is at parity without subsidy; it's pretty close in most places that they operate, and including here in New England where I live. Then we own a company called Delta Electronics in Taiwan. They are companies which are in power management. A lot of what we saw even in the blackout in California is really about, "How do you manage supply and demand in the new era of removals?" You really have to have a very intentional demand management. We have long relied on the mindset of supply management, which is preparing for peak load and base loads. And clearly, software and technology would play a huge role in that.

Geeta Aiyer

And of course, even in the US, we own Home Builders. The build environment as many have spoken. There are opportunities for green homebuilders, insulation providers. We are very much investing in these. In terms of our engagement though - and this is where I believe the biggest change comes about - is that we have engaged two very broad groups of companies. We are very much into demand reduction because fossil fuels and so on exist because demand for energy has been growing. And so eco-efficiency is the way we think of it, emissions, energy, water, waste management. And by doing this, it's a win, win, win for the shareholder, for the company, for the employees, and the community at larger. And so this is an

engagement that we have undertaken for many years with industrials, with REITS, which owned buildings; you can think of any transportation companies and so on.

Geeta Aiyer

But the much more impactful and, we think, now much grown in its acceptance and ubiquity in some ways is the idea of engaging banks. We began about seven years ago in 2013, engaging the financial system about their role in both embedding risks within their loan portfolios as well as being part of that solution, the $2 trillion a year that we were talking about, needs to be financed. And therefore, we need financial institutions to be thinking, not that their loan portfolios and risk management as usual would not do. Today, of course, this has gained a lot of traction; people have talked about TCFD. I am most encouraged by the fact that there are indeed coalitions of banks. So I draw attention to the PCAF, Platform for Climate Accounting among Financials. What these are - and one of the earlier speakers alluded to this as well - they are industry groups which are ecosystems in a way, kind of challenging each other to a race to the top. And this is what we need to unleash the ambition and to unleash the creativity and to also unleash actually financial creativity, in addition to technological creativity and industrial creativity. We need instruments. We need financing mechanisms. We need kind of a competitive spirit to come to it.

Geeta Aiyer

So as important as our work in telling banks to cut back, and it's sad that there are $2 trillion dollars of fossil fuel investments financed even since COP 21. So in the five years since Paris, we have financed even more fossil fuels. We will, obviously, need to stop doing some of those, as well as urge the financing of new technologies and new investments. I'm going to stop there and see if you have other questions. To me, we really stand at the cusp of risk and opportunity, and depending on the day you ask me I'm optimistic or not. We are racing against time.

Michael Kopko

Yeah. A question from an earlier panel from one of our attendees around private equity firms starting to integrate and other institutions, ESG and SRI data, and whether it's a version of cheating to the test or they're making real changes. And I want to blend it to a question around all these pledges that Tony mentioned in the previous panel. Now when you see Apple, Microsoft, Amazon, smaller companies making these carbon-neutral corporate pledges, is that marketing, or does that have real meaning and real impact? And to the extent it has real impact, what are we talking? Is it a drop in the bucket, or is this the movement we've been waiting for?

Geeta Aiyer

We welcome all such ambition. And it's up to us to both hold them to the pledges and to raise the bar from time to time. So I think the first important contribution there includes actually creating real metrics that matter. So not only reporting on scope one and scope two but also scope three emissions, which is to say, in your supply channel and in your value chain. So into the company and out of the company forward, these metrics will be created. There will be some transparency and accountability. Companies have raised the bar. Apple has included scope three emissions as something to offset Microsoft that said, "We go negative." So I'd like to see this happen, where they promised to offset their carbon emissions from the day they started, which is 1975. So quite a large and lofty pledge. What we need to see is to applaud the technology that emerges. They have pledged billions of dollars to creative venture capital to their own teams. They have galvanized their employees. Everyone is now able to include, and in very small mundane ways, if we bring carbon pricing into corporate decision-making into allocations of capital. And these pledges served the role of bringing those into accounting.

Geeta Aiyer

So fields such as financial education, accounting education, the CFA programs, the business school programs, have all to adapt, adjust, and start incorporating these externalities that will ultimately be included. And this is one way that these externalities get included, which is that the company makes a pledge. So now you have an earnings target in your allocation of capital, but you also have another criterion, which is, will this investment move us forward towards the accomplishment of this? And so we applaud many of those. I would love to see much, much greater acceptance, much greater ambition. I would love to see more monitoring. I think that relentless pressure of engaged investors is very important. So is the activist community and the customer community. Every company understands business, the topline. And frankly, our young people have done us a huge service by seeing very clearly and connecting the dots into their purchasing decisions, the impact on planet, the impact on climate and water, and environmental justice and climate justice issues into their purchasing decisions. So I think we have a lot of actions going on. And the earnest, idealistic employees that work in the technology industry will definitely play a part in this.

Michael Kopko

Great. Thank you. I think one question to go to, Bob, for a second, as we kind of then shift to the hope for the future and some impacts for portfolios and portfolio managers, it seems like Tom Broadbent, Bob, wants to know, you kind invented this Black-Litterman model, coming off of Black-Scholes; you're becoming a part of financial history in America and the world. How does that model of people understand portfolios better? And how should they best apply it to a diversified portfolio for themselves?

Bob Litterman

Okay. Well, let me try and answer that in about 30 seconds. Black-Litterman, as many in your audience, I'm sure, know is a way of trying to optimize portfolios with respect to risk and return. And the critical inputs are the risk and the expected return assumptions. Now, when we put assumptions about both risk and return that incorporate climate-related factors, that's going to impact your allocation at the end of the day. And so you could think about their number of sources of expected returns on assets. In genera,l climate change is going to impact valuations of all assets. And obviously, some are going to be more sensitive than others. And so you've got the physical risks that are going to impact the valuations of assets of companies. You've also got the transition risks that are going to impact sectors and countries as well. So there's kind of a top-down: are you in this sector? Are you in a country that's going to be disadvantaged?

Bob Litterman

Russia has a lot of expensive sources of fossil fuels. They're going to be disadvantaged when the world moves quickly towards renewable energy. Countries that are importing fossil fuels, on the other hand, are going to be positively impacted within a given sector, let's say oil and gas. Some companies are much better prepared for the lower prices on oil that will come from lower demand, that will come from creating those incentives to reduce emissions. So I think every sector's going to be impacted, but some much more than others. And you have to incorporate into your portfolio design those impacts, both on the expected return side and the risk side. And that's how you, just like you do with any other risk factor, incorporate into your portfolio. And I might add that this is true of climate, but it's also true of social and governance factors as well. When you incorporate them into your portfolio construction, they're going to have impacts on expected returns and risks, in other words on the distribution of outcomes. And it would be investment malpractice not to take those

factors into account. Absolutely, they should be taken into account, just like all other investment factors.

Michael Kopko

And let me just-- Jeff, you're kind of responsible for advising and managing a lot of money. And when you're with your clients, how are you thinking about the transition of capital going forward, accounting for some of these changes that Geeta and Bob are suggesting? And what is a prudent strategy and maybe, for your more aggressive clients, what do you think's on the futuristic or avant-gard side?

Jeff Gitterman

Yeah. I mean, we've partnered recently with Texas and built out the first UMA platform that addresses physical climate risk in the portfolio modeling. So basically, when we're creating models, we're diligencing our managers to make sure that they have some adherence to the companies that they're investing in and TCFD or a 2-degree warming scenario. We partnered with Wellington Woods Hole; we're the first retail distribution of their climate-focused portfolio. We created a climate bond fund with TWS. I mean, it's our opinion that physical climate risk will be the defining factor of the kind of wealth crisis over the next few decades, unfortunately. I think what people fail to grasp right now-- not people like Bob and Geeta, certainly, which is why I love listening to them, but-- what investors, wealth managers, and even a lot of asset management firms that we speak to today, fail to grasp is how quickly something can get priced into a market. I think people always think they have time. And my good friend Spencer Glendon was asked, "When is it time to start selling your real estate on the coast in Florida?" And he said, "Well, when everyone's asking me when, when it's going to be too late." And I think that's a brilliant statement because everyone's starting to ask when right now. So that means, there's going to be a rush at some point that you're just not going to be able to get ahead of.

Jeff Gitterman

So you either have to be bold and make some commitments now, that there's at-risk assets that you can pull out of your portfolio, for no pricing. I think that's what other people don't get. Well, it makes some miss it, certainly, and they'll be flooding in the areas that you didn't expect. But you have to kind of be an idiot, at this point, not to know that Houston is prone to flooding, or that the gulf is prone to more storms, or that Miami is getting sunny day flooding on a regular basis at this point. So we can build models, and we can keep getting smarter, and we can look at risks and opportunities. I mean, heating and air conditioning companies-- Europe has 2% air conditioning in some of their countries, and you're talking about COVID, so they can't have cooling centers. And heat waves that are killing certainly more people than any storms. I think that's the other thing people miss, that extreme heat kills more people than any hurricanes, tornadoes, or flooding combined. That's one of the biggest risks, and it's one of the biggest factors in looking at migration patterns certainly.

Jeff Gitterman

So we started to build it. We worked with great managers. Geeta was in our portfolios, and we're just trying to stay a little bit ahead of the curve and listen to smart people like Bob. And that report - if you guys haven't read it, I don't know if someone can attach it, but - it's dense but definitely worth reading. It's an eye-opener. And then even today, there was an announcement by the Climate Service out of Brooklyn that I think Swiss Re and Aon and a few others now partnered with them to get physical risk data. So that's the other thing, that the insurance companies are kind of the canary in the coal mine, and when they act, the capital markets have to follow. I think people forget we used to build cities and they would burn down every couple of years. Chicago, San Francisco. And then all of a sudden, the insurance companies came along and said, "We're not issuing insurance anymore unless you build to these fire codes." And they changed the whole industry overnight. They're

going to do the same thing with climate risk because they're just not going to be willing to keep writing checks for risk that is foreseeable, that the science is pretty hard on at this point. Climate models are converging on all of their data over the last 30, 40 years, have been extremely accurate. So the writing's on the wall and, as an investor, it's time to act.

Michael Kopko — Thanks, Jeff. Before we take kind of final questions from the audience and wrap up, I want to just open it up to the panel. What are we not talking about-- through today's discussion, what hasn't come up that needs to be addressed, or what are you kind of most hopeful for? What's kind of the signs of light coming through on this solution?

Bob Litterman — Well, let me jump in here, Mike. I think we've learned a lot from the COVID pandemic. And I know, in some ways, it's very sad and depressing to see what has happened. But some of these lessons, I'm very hopeful, will be taken to heart and applied to climate. And the lessons are, first of all, how interdependent the world is. We can't isolate ourselves from the rest of the world. We all live in a country that is impacted by the actions of others in other countries and also our own fellow citizens. We need more of a social compact in this country. You can see how this country, the US, has responded to COVID, relative to other countries around the world, particularly in Asia and Europe. And the social compact there is much stronger. We need that. And then the final thing I would point to is the urgency of addressing this risk management crisis. There was an amazing study out of Columbia University that suggested that back in March if we had responded one week earlier, we would have cut the number of deaths in half. And similarly, with respect to climate. When you've got a risk management crisis, you have to address it with urgency. You don't know how much time you have. If we have enough time, sure, we can solve this problem. The problem is we don't know how much time we have. And this problem is going to take decades to address. And so, anyway, what makes me optimistic is the idea that the pendulum which swing way too far in the wrong direction may come swinging back very sharply after this election.

Michael Kopko — Thanks, Bob. Any other thoughts from Jeff or you, Geeta?

Geeta Aiyer — I agree with everything Bob said and just want to add that we should never underestimate the opportunities to redesign what we already know how to do. And this, to me, is the most-- creativity is the biggest asset we have at this point. And the reason I say that is that it is impossible for even renewables to replace energy that we consume in any reasonable timeframe at any reasonable cost unless we cut demand by a lot. And so we generate about 100 quadrillion BTUs of energy. We waste about 60 of those, and 40 of those do the job that they were intended to do. So Moira Prentice was a professor at Harvard and has done a lot of work on this. And part of what drives me is the hope that we can-- just as we are creatively adding new sources of supply, as a culture we've always worked by pushing the supply curve, by expanding supplies instead of ever curtailing demand. And I believe that the COVID crisis has put us in touch with how we can curtail demand and we can change what we do and how we do it. And if we limit a scarce resource, which is carbon in the carbon budget of this planet, to the highest, best use, we will be well served, whether with price or without. The call is to limit it to its highest, best use. One flight round-trip to London and back, to the United States, is equal to a year's worth of carbon per capita consumption in Sub-Saharan Africa. So honestly, we have to take stock and see how we really use it, putting it to its highest, best use given the crisis we face.

Michael Kopko — Thanks, Geeta. Jeff, any final thoughts?

Jeff Gitterman: No. They're both way smarter than me, so I'll let them talk.

Michael Kopko: Okay. Well, I think we're going to end on that. I really want to thank all of our experts for a really wonderful evening and a discussion about this topic. And especially also our audience for kind of coming in and putting in extra hours. I know you're all actively engaged in for-profit and non-profit activities to putting your time in this evening to kind of push this conversation and submitting great questions. Unfortunately, we couldn't get to all of them, but please let us know and we'll ask additional questions of our experts or check out our website. I want to thank you all again for having this discussion. We'll have a recording of this all available to you, and we'll send it out to everyone who has RSVPed. And thank you for pushing this incredibly important topic forward today. And on behalf of all of us at Impact, thank you so much for making the investment in us as well this evening.

Bob Litterman: Thank you.

Geeta Aiyer: Thank you.

Jeff Gitterman: Cheers [crosstalk].

Michael Kopko: Thank you.