

Atmosphere of Hope

<https://www.climateone.org/audio/atmosphere-hope>

Recorded on November 29, 2015

Greg Dalton: I'm Greg Dalton. And today on Climate One we'll learn what's going on with the weird weather in California and around the world. This year will almost certainly be the hottest ever recorded and burning fossil fuels is largely the reason. Scientists are gaining better understanding of how humans are altering the earth's operating system every time they plug in their phone or start their car. One result is beach weather in November and fewer foggy days along the California's coast. The downside is that climate disruption is also driving more floods, droughts and fires that hit the economy and cost everyone money. Over the next hour, we will talk about the latest climate science and what corporations and individuals are doing to move to a cleaner kind of capitalism. A lot of progress is being made. Innovative technologies and smarter companies are having a real impact that sometimes gets overshadowed by gloomy headlines. Joining our live audience at the Commonwealth Club in San Francisco, we're pleased to have with us three guests. Tim Flannery is an Australian scientist and author of the new book *Atmosphere of Hope: Searching for Solutions to the Climate Crisis*. Ben Santer is a Climate Scientist at Lawrence Livermore National Laboratory. Rebecca Shaw is a Senior Lead Scientist with the Environmental Defense Fund. Please welcome them to Climate One.

[Applause]

Rebecca Shaw, you were a budding what marine scientist in the late 1980s and you were down in the Amazon and had kind of a climate epiphany. Tell us what happened.

Rebecca Shaw: Yeah, I was a research assistant on a project. It was after I finished my undergraduate degree at UC Santa Barbara and I was so excited to study the natural world. And I went down there at the time when there was a burgeoning understanding of what was going on with deforestation and its effect on climate. In fact, the Time Magazine that month that I went down, pretty sure it was that month had a picture of the Amazon on the cover said the lungs of the earth.

Really talking, really making the point that we were actually taking away our life support system. And the Brazilian government, I was just studying the natural world down there living on a floating raft out in the middle of the rainforest and the Brazilian government and the state governments down there, were feared for their sovereignty and they up the pace to settle the Amazon. And we saw the lake we were living on go from complete 100% forested to a 100% deforested in a very short amount of time. And that's when I really realized that it wasn't enough to study the natural environment but it was the, had to understand the natural environment and understand the social systems that were going to make it, sustain it both biodiversity but also the climate.

Greg Dalton: And the mayor handed out chainsaws?

Rebecca Shaw: Yeah, it was the governor of Amazonas, the state of Amazonas. But it was actually had a program where he was handing out chainsaws to the settlers so that they could go and settle the land at the time. I'm not really sure how extensive the program was but it certainly got the attention of all of us working down there. And it really was a life changing moment for me.

Greg Dalton: Ben Santer, you wrote a sentence in 1995, famous sentence in climate. Tell us about that sentence and what was the consequence of writing that sentence?

Ben Santer: Sure. In 1994, I received a phone call out of the blue and was asked to participate as a convening lead author for the climate change detection and attribution chapter of the second assessment report of the Intergovernmental Panel on Climate Change, or IPCC. And I said yes, agreed to do it. One and a half years later after evaluating the scientific evidence, hundreds of studies, our group came to the historic conclusion that “The balance of evidence suggests a discernable human influence on global climate.”

And I had no idea that that single sentence was going to change my life profoundly and really change the world. It had significant impact in politics and science, it cost me about one and a half years of grief defending that finding and the process by which it had been reached. But I learned a lot of important lessons, words matter and they can change the world. And it’s kind of sobering to think that it’s now this month 20 years since that historic balance of evidence finding.

Greg Dalton: How did it change your life? You were attacked by the global climate coalition which we’ve read about in the newspapers recently has come to light through some Los Angeles Times reports and others. How did that change your life?

Ben Santer: Well, the global climate coalition, this consortium of energy interest didn’t like that balance of evidence finding. And --

Greg Dalton: Because it said humans are causing it. We’re the problems, not some, you know, funny things in outer space, no Martians or whatever; it’s humans are causing this disruption.

Ben Santer: It said we’ve evaluated the evidence and for the first time, the national and international scientific community spoke with one voice and said “We’ve seen enough.” And the evidence is pointing in one direction. Now, that cautious balance of evidence suggests statement was not eureka, there’s water in the bathtub, we understand everything. But even that cautious sentence was too much for the global climate coalition. It was sort of the end of the line, real recognition that humans were no longer simply innocent bystanders in the climate system, we were actually active participants. And unfortunately for me, I was the messenger and a lot of powerful people didn’t like that message.

Greg Dalton: And they personally attacked you.

Ben Santer: The global climate coalition shortly after this report was published in early 1996, produced a report entitled IPCC, Intergovernmental Panel on Climate Change Institutionalized Scientific Cleansing.

And this was at the time that ethnic cleansing was going on in Bosnia. So, the accusation was that I, specifically was responsible for purging all scientific uncertainty from this chapter of the IPCC report. So, it was a pretty serious allegation. And one gentleman circulated an email stating that I had been indicted or was about to be indicted by the Hague International Court of Justice for “falsification of international scientific documents” So nothing in my scientific career had prepared me for that kind of reaction. I thought, the report’s published, I can go back to being a dad, to being a husband, to doing my job; but I was wrong.

Greg Dalton: Real hardball. Tim Flannery, you were in Japan with the late climate scientist Steve Schneider and you had something of a climate epiphany, tell us about that.

Tim Flannery: Well I did. I’d been working for years before that in the high mountains of New Guinea. And I’d seen the tree line was advancing on all of those mountains. And I knew that there was some sort of climate signal there but couldn’t kind of put it together in my mind what was

happening. And I went to a biodiversity conference in Japan and Steve Schneider spoke for an hour and that totally changed my world, it put everything in context. I could see then that those alpine environments with all of the unique flora and fauna just wouldn't survive unless we did something about climate change. The mountains weren't high enough to provide a refuge for them. So that was it then for me, I just was just sort of I had to do something and I thought the best thing I can do is to write a book to inspire the people who perhaps don't understand as well as I did. I was a scientist, you know, trained scientist and I've missed the full importance of it. So I just tried to sit down, it took me about four years ago through the same literature that you would have gone through and just to put it in simple terms for people what this was all about and then, so that was the outcome.

Greg Dalton: And that book, if that was *The Weather Makers*, that book came out in 2005 or so, a lot of people have been impacted by that book including Richard Branson, including myself. I read that book when I was in the Arctic in 2007 bouncing around the Arctic Sea in a Russian icebreaker and I read that book when I was up there with scientists. So I'm one of the many people that was impacted by that book. Tim Flannery, also you write in your latest book *Climate of Hope* about the 2014 Australian Open. So tell us what important moment that was in Australia that really drove home climate reality?

Tim Flannery: Sure. Look, I live in the city of Melbourne where the Australian Open is played. And the people of Melbourne are very proud of it, it's their one moment in the global sun, you know, when everyone's looking at Melbourne and what's happening there. And in 2014, unfortunately, the open coincided with a really exceptional heat wave. We had three days in a row with temperatures above 42°C and you can help me that must be above 110 Fahrenheit and somewhere up there. And in the courts, temperatures were in the low to mid 50s and we had 1000 spectators that had to be treated by paramedics for heat stress. And the players bravely played on, but it clearly it got to the point where that just couldn't go on. So the match was stopped. I mean you can imagine the consequences, when you've got all the sponsorship deals and the broadcasting deals and everything, it's just horrendous, you know, but it did happen. And months later, scientists produced a study looking at that heat wave and just said, was it human caused or not? And what they did was a series of computer runs some of which excluded the human caused greenhouse gases and some of which included it. But in 12,000 runs where the human influence was excluded and only once out of those 12,000 runs did they get conditions anything like the reality that transpired at that time.

Once you add the human greenhouse gases into it, it becomes much, much more common that you get those extreme events. So for the first time, at least in Australia, we are able to say this wouldn't have happened without the human influence. This was caused by humans, this disruption. So that was a big moment for us.

Greg Dalton: And Rebecca Shaw, climate is abstract even for people who are tennis fans and see, you know, melting tennis balls; climate is still pretty abstract. But food is one area where it's real for people with some interesting shifts happening in food, in food companies that are really trying to address climate solutions. Not so much talking about climate but talking about good healthy food.

Rebecca Shaw: Yeah, I think one of the things that -- so I really appreciate the book and the word hope in the title. Ten years ago I was not so hopeful because and I think part of the reason was there weren't enough people who understood the specifics of the consequences of climate change, the way that scientists were understanding them. But what's happening now as you begin to see the impacts actually becoming very real and when the impacts are actually affecting the things we care about our health, our safety, our food supply, or our ability to grow certain kinds of food, or even our pocketbooks. We begin to pay attention and it's really happening in very different kinds of way across the planet but people are experiencing the impacts of climate change in the ways that they

really, really care about. And one of those areas is food. And food companies are paying attention. Food companies are paying attention to the shifts in market for healthy and local food, but they're also really, really paying attention to trying to match that healthy food production, and getting it to their market with the risks that are associated. The climbing risks that are associated with increasing temperatures and more variable precipitation in the future.

And so they are really paying attention, and they're making some really significant commitments to decrease greenhouse gas emissions from their entire corporation, to make sure that when they are sourcing food, they're doing so in a way that is healthy for the environment and that builds resilience and farming systems. And they're also making sure that they're looking at their supply chains trying to limit the transport routes. And so as you begin to see companies or institutions or individuals or municipalities feeling the pain around safety around food, around health or around the pocketbook, changes are being made. And those changes, whether they call climate change responses are not, they're very, very important for our ability to adapt to climate change. And we're seeing it in food companies in a big way.

Greg Dalton: So tell us about Cheerios and Campbell Soup, two icons in the American supermarket, in the kitchen.

Rebecca Shaw: Yeah, so we work with large corporations to help them make sustainability commitments and follow those sustainability commitments all the way down to the ground. And some of those, a few of those companies that we're working with include Walmart, Kellogg's, General Mills. They are really making amazing commitments, because one of those places we're seeing again climate impacts that are most severe most quickly are in the farming community, in our ability to produce food. They are making real investments into their companies and outside their company. So supply chains are the link between the, say General Mills and its Cheerios to the oat miller, to the oat grower all the way down to the farm. And they're making very real commitments in the farm, in the farm, so they're skipping all the way down to where the food is being produced to make investments and commitments to soil health that will increase resilience for food production over time. To decrease fertilizer use, which actually emits a very powerful greenhouse gas, nitrous oxide, 300 times more powerful than CO₂ and it's if it's overused in farming systems, it sits on the farm and then gets admitted as a greenhouse gas.

And they're also making really significant commitments to water use efficiency. So as precipitation becomes more variable, we can make sure that we have sustainable water supplies and healthy food being grown for all of our needs. It's a real challenge, food companies can't do it alone but I see them certainly in the work that we do as some of the leaders because this is where the pinch point is right now.

Greg Dalton: Tim Flannery, I vividly remember I think it was 2008 when rice was rationed at Costco in California because there was an Australian drought and rice out of Australia. So what's been the impact, are you seeing similar signs of optimism and change in the agricultural area in Australia?

Tim Flannery: We certainly are. I think you're quite right that farmers are at the cutting edge of this. They watch the seasons carefully. They know things are changing. I was just speaking to Australian grape growers recently and they told me that they had seen that the season for harvest had advanced by a month over a couple of decades. It's very significant for them and many of them are buying land in Tasmania which is the southernmost part of Australia. Because where they grow now, it's just getting too hot, the grapes are getting sunburned they don't have the water reliability and bushfires are tainting the grapes with the smoke because we're getting really mega fires in Australia now as well. So conditions are changing and we are seeing farmers now become much

more proactive about reducing emissions. We've got a fantastic institution in Australia called the Clean Energy Finance Corporation and it's helping farmers to reduce emissions wherever it can. So if you own a piggery, you can go to the CEFC for some funding and unlock some more bank funding, to put a biodigester in so that you deal with that waste rather than just let the methane which is, you know, 20 times more potent than CO₂ as a greenhouse gas.

Likewise, if you have the feedlot, they're helping do the same sort of thing. So there's a lot of investment going into the regional rural sector now. We've also got a policy called the carbon farming initiative which helps farmers at a much more hands-on level. So if farmers want to change their practice of the way they graze their animals. So that you go into rotational grazing that means you move the animals around the pasture rather than just let them to roam free. That helps perennial grasses grow and you get a deeper root mass and more carbon in the soils. So that can be funded as well. So I think there's, I'm quite optimistic about the farm sector in Australia. I think they have the capacity to change and with a little bit of assistance we should see some big reductions in emissions.

Greg Dalton: Is it going to affect Australian beer?

Tim Flannery: Well, that's a great question. That's one I haven't look into but it certainly affect the Australian wine --

Rebecca Shaw: As soon as it does, the whole system is going to change.

Tim Flannery: That's true.

Greg Dalton: Sunburned grapes, I like that one. Ben Santer, is there sometimes a research bias in science to come up with big headline grabbing studies that affect the whole world. Do you think there's a bias toward doom and gloom in science?

Ben Santer: No, I don't. I think that our currency is getting the science right. In the end that's what scientists are judged on. Did you get the science right? So the greatest good is knowing that your results are appropriate, that you are -- were obtained with appropriate methods. Your inferences are appropriate that you drew from those research procedures, and that your findings are going to stand the test of time. In the end, I think that's what most of us really care about. Did you get the science right? Not did you get the big headline.

Greg Dalton: Rebecca Shaw, a lot of the changes that are happening are social and cultural and perhaps not so measurable. And some people in climate conversations focus on, you know, how much carbon did you reduce and how much energy displaced, that sort of thing. So do you think that sometimes measurement is sort of overemphasized in the social, we're talking about a social change here?

Rebecca Shaw: Yeah, I mean we are talking about social change now, but if you think about how climate science came up through, came to prominence they really came through the physical and natural science, where we are looking at if you do this, if you add this amount of greenhouse gases, what does it going to do to the atmosphere and what will that -- how would that change weather patterns and how would that affect the things we care about. Whether it be the plants or the animals or sea level rise or so on. And so it turns out it has a big, a really big effect. And so it became more doom and gloom as we went on. But one of the things that I think that really began to show up later on was how we all interact with that kind of information and what we do with that information and how we make sense of it. And sometimes the kind of information that comes out just about the physical or natural science, and the impacts isn't the kind of information that you and I can use actually, to actually create change. And so what I've seen a whole a lot more in the last

five years in particular is a lot more attention on how all of us interpret that kind of information.

And what kind of information we need in order to create the kind of change that's going to matter at the collective level not on an individual level. And so you see a whole lot more focused on that. And we certainly use a lot of that, a lot of that new science that's coming out of the social science literature in the psychology literature to really think about how we deliver our message in a much more effective way to help people who need to know, understand what the natural scientists and the physical scientists are talking about.

Because it's really severe. And I just think 10 years ago I used to talk about don't you all understand, it's so bad. And now, I understand that lots of people don't think like I do. And so it's really more important for me to be thinking about how is the audience going to hear what I say. And I'm using the latest research coming out of the academia to really do that very well. And it's not like it's new science, it's new to this particular application of science. So it's a really incredibly exciting time to be working on this issue because you really see a lot of social change. You see people dealing with this information. There's a lot of positive reaction out there on the planet to help us adapt to create more resilient society, more resilient food systems. And to really take a leadership role and really studying what's going on in those places and why those people are able to take a leadership role and really move the ball forward in terms of creating positive change so we avert disaster I think is really worth our attention.

Greg Dalton: Getting off fossil fuels could result in a healthier people, cleaner communities, cleaner economy. Tim Flannery, if someone is listening to this, what are some top three things that you suggest someone can do. Okay, alright what do I do in my life? What do I change tomorrow?

Tim Flannery: Well, you know, when I wrote *The Weather Makers* ten years ago I had a list in the back of the book about things people could do, you know, put solar panels on their roof, change their light bulbs and whatever. But the one thing that the new thing that's happened since then that I think is just infinitely powerful is the emergence of these groups of concerned citizens who are working together to do something. You know, we got a little group in Australia called Solar Citizens who own PV panels on rooftops, you know, solar panels on roofs. They're hardly radicals, most of them are pensioners or people with a heavy mortgage, you know, they're watching their budget. So they want to make sure they control their energy costs. But they form this group and they now lobby in marginal electorates to say to government, you know, we like this stuff we want more clean energy. And, you know, Australia is leading the world with solar rooftop installations.

About one in five Australians now benefits from solar electricity on their rooftop. So joining groups like that is really, really important. Australian Youth Climate Coalition, I think there's an American Youth Climate Coalition. It's another great outlet for younger people, they use social media in ways that astonish me when I see that. So no matter what your age, what your interest, I think joining those groups online is just really, really a powerful thing to do.

Greg Dalton: Talking about -- and Rebecca Shaw, other things that an individual could do, you know, any tips for people listening to this. If you already got solar panels, maybe electric car, what can people do?

Rebecca Shaw: Well, I'm going to stick with the food theme because it depends on how, you know, if you think about the world from a physical scientist or natural scientist point of view and you look at the role of agriculture in creating climate change, you come up with a certain set of numbers.

And if you include deforestation you'll be right around the third of the problem. If you don't include deforestation and most land clearing for deforestation is because of agriculture. And if you don't include that, you're about 17 globally, about 15% or 17% of all the greenhouse gas emissions come from agriculture. So, you know, what are you going to do with that? Well, can we talk about the

food system. So the Food and Agriculture Organization did a study in, so this is a UN scientific body based out of Rome. Did a study in 2012, they said if we look at the food sector, what are the greenhouse gas emissions from the food sector and it's 30% without deforestation, so 50% with deforestation. So I have to apologize, there's lots of ways you can count these numbers up but the point is what we eat and how we eat it and when we eat it is a really important driver of greenhouse gas emissions. And so if you're eating things that come from far away, they have a high carbon footprint because they had to be transported there. If it's a water intensive crop in a drought-ridden region, it's a greenhouse gas intensive food.

And I think the biggest piece of it and the thing that we can all do is that 40% of all the food that's produced is wasted. And so just by watching that we don't waste food at restaurants, in our homes, that we're careful that what we buy we're going to consume, is a really important step forward that within in protecting and reducing greenhouse gas emissions but also saving water that's a scarce resource, and also in maintaining biodiversity on the planet. So I think paying close attention to the food and not wasting food is a really critical piece of it.

Greg Dalton: I recently talked with the CEO of a company called Impossible Foods. They've raised \$180 million of venture funding, former Stanford medical professor and they're creating what they say will be a fantastic burger made from plants that people will, meat lovers will love. They're not after the people who are members of EDF and vegans and environmentalists on the coast. They're after sort of the heartland meat lovers and they want to displace the cow because they think that animal protein production is the most harmful industry on the planet worse than big oil. Something really interesting to watch I hope to have a taste of one of those soon. Ben Santer, what can a person do to have an impact, individual?

Ben Santer: Educate yourself. To me, it's that understanding of the basics of the science the understanding of the nature and causes of climate change, and likely outcomes. If we had an informed, scientifically savvy electorate, we'll be in a much better position to make wise choices on what to do about all of this. So to me that's the best thing you can do. Listen to programs like Climate One, understand the basic science, get involved, get engaged don't sit on the sidelines.

Greg Dalton: What do you say to a person who says to you, I heard it stopped. There's a pause and there's been no warming for the last 15 years. Ben Santer, what do you say?

Ben Santer: Sure. I first encountered that narrative in congressional testimony in 2011 where one of the witnesses made that very sentence, made that very statement: global warming stopped in 1998. And he argued that computer models of the climate system the very models that Tim talked about were incapable of producing pause periods with little or no warming of your surface when those computer models were run with human caused changes in greenhouse gases. So this is what I like to call science by assertion, and by eminence of position. He produced no evidence to support those claims that global warming stopped and that computer models couldn't produce these kinds of pauses and he was wrong on both counts. We know that climate change is not an either/or proposition. All human, all-natural -- it's both. By burning fossil fuels we've increased the levels of heat trapping greenhouse gases like carbon dioxide from roughly 260 parts per million at the time of the industrial revolution to the historic threshold of 400 parts per million now, an increase of about 43%. And what we know is that given the physics of carbon dioxide and other greenhouse gases, you increase the concentrations of those heat trapping greenhouse gases; the planet is going to warm. But that warming is going to take place against the backdrop of this rich year to year and decade to decade natural climate variability. So things we know and love here in California like El Niño's, La Niña's and other modes of natural climate variability.

So the expectation always was scientifically that you wouldn't see some linear increase in

temperature, some straight line with each year inexorably warmer than the previous year at every point on your surface. You would see periods where warming accelerated and you would see short periods where warming showed little or no increase, where there was a slowdown. That's the way the climate system behaves and indeed that's what we saw for much of the last 15 years. But as Rebecca pointed out 2014 was the warmest year on record. 2015 is going to be warmer still; likely 1°C, so nearly 1.8°F warmer than it was at the time of the Industrial Revolution and the pause is over. Now scientists have spent a lot of time our group included trying to understand the combination of natural and human factors that have operated over the last 15 years. But the bottom line is you don't look at one short 10 or 15 year noisy period of record to make inferences about whether there is or is not a human effect on climate. That's silly.

Greg Dalton: It's kind of like looking at the one day of the New York Stock Exchange to understand that the long-term trend that it goes up and it goes down but the long term trend is upward. If you're just joining us, Ben Santer is a climate scientist at Lawrence Livermore National Laboratory. Other guests today at Climate One are Tim Flannery, author of the new book *Atmosphere of Hope* and Rebecca Shaw, a scientist with the Environmental Defense Fund. I'm Greg Dalton. I'm Greg Dalton, I can't say my own name.

We're going to go to our lightning rounds with a brief, brisk, agree or disagree questions starting with Tim Flannery. It's a bit of, it's an American referenced question, you put hope in the title of your book because you bought Barack Obama's hopey changey thing?

[Laughs]

Tim Flannery: I put hope in the title of the book but I disagree - if I've got to agree or disagree - disagree.

Greg Dalton: You put it in because --

Tim Flannery: I put it in because I finally after a decade of misery, felt hopeful. A few things had started to change, I could just see the light, you know. And that was really important for me. I thought other people should see it too.

Greg Dalton: And that was natural, no medication involved?

Tim Flannery: No medication involved.

Greg Dalton: Good, we like it the healthy way organic here. Ben Santer, in the battle for American hearts and minds, the princes of darkness are more effective than the princes of truth and light?

Ben Santer: Disagree. I think as we see now with Exxon and the story that's unfolded in the last couple of weeks about what Exxon scientists knew --

Greg Dalton: But they won for a couple of years, they won for quite a while.

Ben Santer: They won for quite a while, you know, but the truth will out, the physics of the climate system will always trump ideology and will always trump disinformation. And that's what's happening here. As Tim mentioned, the story in the physical climate system is emerging that gradual warming signal with gradual increases in greenhouse gases. But there's also in parallel a story emerging in public understanding of this issue. So I don't think that the princes of darkness or the forces of unreason as I like to call them, I don't think they'll win. You know, they've fought a rear guard action now for two to three decades but in the end, if the science is credible, that message is going to come out and people are going to do the right thing.

Greg Dalton: Let's hope for a Disney ending, okay. Yeah.

Tim Flannery: Can I just say Ben that they might not win but they have cost us dearly. That decade of lost opportunity that they've cost us now has been the darkest I think we've been through.

Ben Santer: I agree with that completely but I do think that in the end they will be held accountable as we see now with Exxon and with the global climate coalition. Those questions are being asked. What did you know, when did you know it and why you didn't tell the truth about the science?

Greg Dalton: Very interesting. Rebecca Shaw, yes or no, some corporations try to use environmental groups to greenwash?

Rebecca Shaw: Oh I think that's absolutely true. And I think that this is one of the reasons why I see so much hope because it's happening less and less. There are real risks in current business models in corporations if they don't take into account a changing climate, particularly as it relates to their raw materials. And so, there's a real -- one of the things that's really important to understand is we need to go through on a very big transition to get to a new model way of doing business that doesn't continue to emit greenhouse gases. That takes care of the earth, make sure that we're using water resources wisely, making sure that we're not creating air pollution and water pollution to the extent that we are. And it means a different way of doing business and that's a really hard transition, as hard as the transition we just went through in the industrialized, where we industrialized. And that took a 150, 170 years. And so if we know we need to do business differently moving forward, we need a transition. And there are lots of institutions, lots of people that don't know how to do that. What I see is amazing effort at cooperation and collaboration that we've never seen before amongst unlikely allies, environmentalists and big corporations working together to figure out how you create that transition to that new state that we actually need.

We need new business models. And I think the other really positive and really wonderful thing here is that there's so much energy coming up in the millennial generation to really take on these big challenges of this transition. And you can see it in the hi tech community where solutions, where lots of kids coming out of college today and coming out of graduate school are going directly into the social change in this transition. They're really looking to create change. So has there been greenwashing, absolutely. Is the time of greenwashing over? Absolutely, because the time for real change is now and there's a deeper recognition that it's imperative for all of us.

Greg Dalton: Alright, let's get back to our lightning round with yes or no answers.

Rebecca Shaw: Oh sorry.

Greg Dalton: I let the cat out of the barn on that one.

[Laughter]

Ben Santer, personal attacks on climate sciences have had a chilling effect on scientific inquiry, yes or no?

Ben Santer: Yes. But I don't think it stopped the scientists from their job.

Greg Dalton: Rebecca Shaw, we would not be in such a mess if more women were in positions of corporate and political power?

Rebecca Shaw: Oh of course.

[Laughter]

Greg Dalton: Tim Flannery, people concerned about civil disorder and food shortages driven by climate disruption should move to New Zealand because they have lots of water and sheep to eat?

Tim Flannery: No.

[Laughter]

Greg Dalton: Move to Australia?

Tim Flannery: I don't believe in the refuge theory. We're a global community now and we're going to face this together or we'll fall divided.

Greg Dalton: Nowhere to run or hide. How they do on the lighting round, I think they did pretty well.

[Applause]

[CLIMATE ONE MINUTE]

Announcer: *To many people, the facts surrounding global warming seem so obvious that it's hard to understand why others don't share their concern. When he came to Climate One last May, UC Berkeley Linguistics professor George Lakoff explained it this way:*

George Lakoff: *If you have a certain world view that doesn't allow you to see the facts, you won't see them. And the reason is very simple: in general when you perceive something, something comes into your eyes. You have about a tenth of a second before it becomes conscious and it will change in that tenth of a second to fit to what you already know or believe. It will change fast. So when you have facts that come in that won't fit the way that you understand the world, then the facts will either be ignored, ridiculed or attacked because they will threaten the way you understand the world, or not threaten them; you will be happy with the way you understand the world and ignore the facts.*

But the frames that frame the facts are part of your brain. That part of your brain is not gonna change. And so you have lots of people in this country who have conservative world views and, you know, they just don't see it. It's not like they're denying it, it's not like they, oh I know that fact and I'm gonna deny it. It's like, it's not even a fact.

Announcer: *George Lakoff, author of Don't Think of an Elephant! Know Your Values and Frame the Debate. He spoke with us in May of 2015. Now, back to Greg Dalton and our live audience at The Commonwealth Club.*

[END CLIMATE ONE MINUTE]

Greg Dalton: Tim Flannery, you write about a number of third way solutions, exciting technologies from planting trees to possibly storing carbon dioxide in the Antarctic. So tell us what's really exciting that you see that could really help on the solutions side?

Tim Flannery: Look, I see those technologies as being inevitable because we've already committed just with the greenhouse gas in the air to one and a half degrees of warming. My scientific colleagues tell me that the Great Barrier Reef will be dead, Australia's Great Barrier Reef just can't survive that amount of warming. Moreover, it looks like we're not going to be able to change our

energy systems fast enough to avoid two degrees, you know, we've at this decade of lost opportunity, it's been horrific. But the hope is that we can draw CO2 out of the air at scale..

And can I just tell you how this came about. In 2006, I met with Sir Richard Branson. He wanted to discuss my book. And he expressed pessimism about humanity acting fast enough to avoid disaster.

In hindsight, he was absolutely right. But what he did was set up something called the Virgin Earth Challenge. It's a 25 million pound price awarded to technologies with the potential to pull a gigaton of carbon out of the air. That's about 3.7 gigatons of CO2. We've had 11,000 entries. Now for years I was not certain that we could do that. But just in the last 18 months, I've seen enough new developments that I think we will see that happen. Carbon negative concretes, carbon nanofibers directly from CO2. The possibility of putting big chiller boxes in the Antarctic and cooling the air enough that the CO2 falls out as snow. I mean -- some of these things sound like science fiction now but, you know, we're talking about 2050, that's like 20 or 30 years for these technologies to develop and just think about the transition of last century from 1915 to 1950. So the horse-drawn era, you know, just a decent age, an age of empires that hadn't changed for centuries. And then 35 years later, 1950 nuclear power, jet aircraft half the world around about living under communism. It sounds like science fiction and I think that 2050 is going to sound even more like science fiction than it does today, you know, in terms of those figures.

So, but the thing we know is the gas isn't going to come out of the air by itself. It will be there driving more and more adverse climate change as the decades go by. We need to get that gas out of the air, it is entirely possible to get it out at the gigaton scale. We can see the technologies that can do that. One I didn't mention is seaweed farming, you know. A desktop study suggested if we planted 9% of the world's oceans with seaweed, we could draw down all of current emissions because seaweed just grows so fast, you know. Now, I thought that was fantastic when I first heard it but then I did the calculation. 9% of the world's ocean is an area of about four and a half times the size of Australia. It's a really, really big area and then you got the problem what you do with all that seaweed --

Greg Dalton: Make sushi.

Tim Flannery: -- it's a challenge, right? And how you get the CO2 out of it. So there are challenges there. And when I wrote the Atmosphere of Hope, I did the best conservative calculation I could of what these technologies might be achieving by 2050. I think that conservatively and that's, not thinking about seaweed or any of those things, that are just at the very early stage now, we could be drawing about 40% of current global emission side of the atmosphere by 2050. And that might really buy us some time in order to both adapt and to reduce air emissions so we can avoid or just skim below that two degree guard rail.

Greg Dalton: If you're just joining us Tim Flannery is author of the new book Atmosphere of Hope. Other guests today at Climate One are Ben Santer from Lawrence Livermore National Laboratory and Rebecca Shaw, is a scientist with the Environmental Defense Fund. I'm Greg Dalton. Let's also talk about solar which is a very real, very positive story. I think one of the most positive stories. Tim Flannery, you mentioned earlier you write in your book that solar cost have come down a hundred times in ten years, that's phenomenal.

Tim Flannery: Yeah, it's incredible.

Greg Dalton: And is there more left to go? Solar still only 1% of power in the United States so how revolutionary could this be?

Tim Flannery: Look, it is coming down at 10% per annum, it has been doing for the last 30 years.

Costs are just, they're very competitive now that, you know, solar has made it to the market. Wind is a similar story, I've got a friend who invests in wind farms and his company just signed a power purchase agreement in Texas to deliver electricity at about 4.1 cents a kilowatt hour, I mean that was fantasy a year ago. The cost have come down so much. And I've worked with various large wind companies and they see a total revolution happening in the next five years. They see containerized wind turbines, so everything comes in a shipping container built on site. 3-D printers on the blade to keep them up to scratch so you don't need to replace the blades, you know. Gearless wind turbines with the heads, with so few moving parts that the maintenance is cut down. In the next five years, the cost of electricity from wind turbines is projected by these companies to be half what it is today the cost of electricity from wind. So we are seeing a huge change in technology in these areas. And I'm absolutely confident that they are going to push fossil fuels out of the market, especially once we get battery technology down to cost as well. The trouble is the time, the transition can't happen overnight globally. So we're committed to quite a lot, omitting quite a lot of CO2 in the next 20, 30 maybe even 40 years.

Greg Dalton: Let's talk a little bit more about Australia. Tim Flannery, you were a climate commissioner there. There's been some politics, climate has been a national political story in Australia the way it hasn't been in the United States. Some elections turned, prime ministers coming in and out of power partly based on climate. You had to have some armed guard protection because of your role, tell us about that.

Tim Flannery: Well, it's not just partly because of climate change we've lost about four prime ministers at last count over the climate issue. It's a big issue for us, it divides us down the middle as a country. You know, we used to just a few years back export or control more of the seaborne coal trade than Saudi Arabia controlled of the seaborne oil trade. We were the coal tsars, you know, and so it's a big lobby, a big industry in Australia. But we're also at the forefront of the impacts of climate change, so everyone knows it is a lived experience in Australia. So we're really divided. So you know, what Prime Ministers say about climate change, determines their fate.

We had a government that was very proactive trying to do something about climate change. They asked me to be the climate commissioner for the country, which I accepted. So I did that job for three years under incredibly difficult circumstances I can tell you. We were out there every fortnight talking to the Australian public and as you said we had to have guards at various times. Photographs of my house were published online with incitements from our own indigenous Rush Limbaugh types to, you know, do something about this problem. So it was really tough. And the government changed. A very anti-climate change, climate change denier came to power. Their very first act was to sack the climate commission. We decided that wasn't good enough and some of our commissioners were pretty conservative -

Greg Dalton: Sack, so that means to do away with it, right?

Tim Flannery: Yeah, sorry about the colloquialism, yes to get rid of us. That was their very first act as soon as they came to power. And we just said, you know we're not going to go. We're going to appeal to the public for some funding to keep us going just with the same group of people trying to do an educational role. And within five days, we had a million dollars. The Australian public really cared. We now run an organization that's three times the size of the organization we run in government. And because it's not as bureaucratic as the government organization was we're a lot more effective. So we just decided to bounce back and we're hardly a group of radicals could I say, you know, one of our climate commissioners who is now a chairman of the climate council is the ex-CEO of BP Australasia, a fossil fuel company. So there is hope in Australia. I think we'll keep pushing forward no matter what happens.

Greg Dalton: And there's also been a carbon tax, Australia was one of the first places to put a price on carbon, but there was some people said it was a little bit of Swiss cheese, that it wasn't really effective carbon tax but it's, tell us, is that still in place?

Tim Flannery: It was a very effective carbon tax. It reduced the amount of coal in our electricity mix by about 77% down to 72% over the two years that run. But it was abolished with the skeptical government that came to power. And now we've lost all of those gains. Look, I think we could've solved the carbon tax better, I wish that the government had just cut a check for everyone as a sort of rebate for any additional costs they would have faced in their electricity bills and so forth. That wasn't the way we ended up doing it and we have the distinction now of being the only country on the planet that's gone backwards in terms of implementing a carbon price and that needs to be addressed in our future.

Greg Dalton: And lastly, before we go to audience questions, you just spent a couple weeks in Canada, the government just changed their - Canada left the Kyoto protocol. It's been becoming kind of a petrostate recently with the oil sands. New prime minister in Canada, younger generational change; what's happening up there?

Tim Flannery: Look, enormous hope. Canada, they are seeing the climate impacts very clearly just like Australia. In fact, Canada is kind of like a colder version of Australia really. We're really, really similar. Queen's heads on the money, it's all kind of, you know, we all like beer and whatever. But I think that they're going to do some great things. And in fact there's a heads of Commonwealth governments meeting in Malta just before the big climate meeting. So our new prime minister Malcolm Turnbull who wants to do something about climate change will meet Mr. Trudeau, who's the new Prime Minister of Canada for the first time and I think we'll see some really good action. But the ground work's already been laid. The liberal, the Canadian liberals have done a very good job in terms of trying to be very inclusive and get everyone on board for some really deep and meaningful action.

Greg Dalton: Let's go to our audience questions.

Male Participant: Richard Bailey, The Climate Museum Institute. Question for Ben Santer, given that museums are not beholden to corporate bottom lines or government politics or things like that and they're independent. Do you think a Climate Museum Education Center can have a significant change in educating the general public?

Ben Santer: Yes I do, and truth in advertising my sister is vice president for science content at the Miami Museum of science. So I've interacted with her and her colleagues for many years now in terms of how one might do a better job making museums venues for allowing the public to interact and intersect with climate science. The Science Museum of Minnesota is another entity that I've been involved with on a couple of occasions and they do a terrific job explaining what we do as scientists, why people should care about it, what likely outcomes are. I think there's a big role for museums in terms of interfacing with the public on the science.

Greg Dalton: Make it more real. Let's hope that that one in Miami is not underwater before too long.

Let's have our next question at Climate One, welcome.

Male Participant: Thank you. I was wondering how the panel would look at how the governments of the world are all seem to be interested in growth, economic growth. How can we have deal with climate change, and still deal with economic growth?

Greg Dalton: Tim Flannery, that's a tough one. The whole system is built, everyone's retirement plan who's listening to this is built on compounded quarterly growth.

Tim Flannery: That's right, but there was a very interesting study produced by the International Energy Agency earlier this year that said for the first time since they've been keeping records which is the last 40 years, they'd seen in 2014, a year in which global economic growth continued, but the emissions growth stalled. So it looks like we might just be entering this phase where we're decoupling the global economic system from the dependency on fossil fuels, and the emissions that come with that. And solar and wind are obviously a part of that but billions and billions of actions of the people have done around the world were also a big part of it to be more efficient in their use. So I'm so hopeful that we might just be at the beginning of this new era so we can continue growing our economies in very productive ways that aren't so carbon intensive and not so resource intensive. And continue to have that but reduce the emissions. We say we want now for a couple of years, you know, we have reached that point but initial data is pretty interesting.

Greg Dalton: And California has successfully done that for a couple of decades. California has grown its economy, grown its population and energy and greenhouse gas output has stalled or declined. Let's go to our next audience question. Welcome to Climate One.

Male Participant: I think the question is for you Ms. Shaw. Do you see any evidence that the corporations, companies, businesses that recognize that climate change is a threat to their business are willing to speak in an organized public and political way to counter the rhetoric of those other companies that refuse to recognize the validity of climate change?

So are they willing to do that so that the conversation is business-to-business, business to government as opposed to environmentalists to business?

Rebecca Shaw: Yeah, I do think there's a lot of that happening. There are, you know, just as I -- different, we're all experiencing climate change and the impacts of climate change in different ways given how we interact with what our business is and where we live, and so on. I think that that different private businesses are feeling the pinch in different ways and you can see the food companies are concerned because of the agricultural output and its impact on that. Really, really it hits their bottom line and so they are some of the first actors and so they stood, they were at the UN climate summit in 2014 to launch an initiative called climate smart agriculture with -- so farmers standing next to NGOs, standing next to government, standing next to corporations. Saying we're going to commit to decreasing greenhouse gas emissions from agriculture production increasing farmer incomes and livelihood and increasing resilience and environmental outputs from agriculture. And those three things, companies -- everybody came to that stage and were committing to those range of outputs.

So they are taking stands, they are taking stands with one another. There are -- it's really hard in a lot of some industries to be the first mover. And so the easier thing to do is to line up a whole bunch of actors with you in your same sector and move together, and we're seeing that happen. Because nobody -- because you don't want to stick your neck out there and have it lopped off because there are consequences to taking bold stands. But we are seeing those who are feeling the impacts, the greatest and seeing threats their bottom line in the near-term are moving more boldly and they're moving boldly together.

And whether they can impact other sectors, it's a question. But I think that you're always going to have sectors that are going to lead first because, for obvious reasons there are sectors that will drag their heels but eventually they are moving and they are taking bold stands.

Greg Dalton: Let's go to our next question. Welcome.

Male Participant: Thank you. Peter Joseph with Citizens Climate Lobby. My question to each of you is it really does seem like things are different now than they were a year ago. It just feels different publicly with the Keystone decision, the Exxon revelations, Paris coming up and this groundswell from corporate world and people's movements all over the world. My question to each of you is your hope meter; I want to know what will influence your hope-ometer going forward in terms of what comes out of Paris. What are your milestones that you're looking at to gauge your own personal sense of dread versus hope versus how the climate system is going off as it will?

Greg Dalton: Thank you. Tim Flannery.

Tim Flannery: Well, that's a great question. Look, I think the Paris meeting we can already call it a success. You know, we are going to get off that worst-case scenario trajectory which is important. We still might be heading into 2.7 degrees by the end of the century, but that's a start. I think if we have a really short review period impact for future meetings after Paris that will help a lot as well because technology is changing fast.

But there's a couple of big issues that still dodge us; the gas issue the fracking issue, you know.

How much more money we're going to invest in that and lock ourselves into a fossil fuel future. The sooner we stop making out of that the better because we won't be seeking capital into that and hopefully we can go to the renewables. And what's going to happen with battery technology. You know, I've got a huge great hope for electric vehicles but, you know, Tesla already made 36,000 units last year, it was the number of cars they made; and you know, China's putting 15 million cars a year on the road. How quickly can we scale that up, you know, that sort of stuff is hugely important. And of course you know, just how quickly we can institute some sort of carbon price, some sort of carbon tax with dividend or whatever, you know. The sooner we do that, the quicker we can slam down on the mission. So there's some of the key things I'm looking at.

Greg Dalton: Let's have our next question. Welcome to Climate One.

Female Participant: I know everybody feels badly that we're missing that important political program this evening. But I'm wondering if any of you know of the Congressman or Senators we ought to be supporting who are carrying the water for climate change in our Congress?

Greg Dalton: Who'd like to tackle, that's not for Tim, American politics. Chris Gibson's a Republican member of congress from New York who's got some Republicans together to come out of the closet on climate and said he need some action. Anyone else want to tackle that?

Ben Santer: Kelly Ayotte, Lindsey Graham, Pataki --

Greg Dalton: George Pataki.

Ben Santer: George Pataki. a number of voices on the Republican side have recognize the reality of human caused climate change, and recognize that this is an issue for American jobs, national security. So I think some of the ideology is going out of it. That's one of the reasons for my own personal atmosphere of hope there; that these ideological divides are crumbling.

Greg Dalton: Let's end briefly by telling what you each do to minimize your personal carbon footprint. Starting with Tim Flannery, what do you do to --

Tim Flannery: Well I've got solar panels on the roof. I drive a hybrid car. I'd love to be able to fly an aircraft that were fueled with biofuels but I can't do that yet. So I fly a lot and that's probably my

biggest carbon sin.

Greg Dalton: Rebecca Shaw, your carbon sin as well as your carbon --

Rebecca Shaw: My carbon sin is definitely flying and I eat very little on the food chain to try and avoid carbon emissions from food and I drive a hybrid electric car.

Greg Dalton: Ben Santer, carbon sin and carbon --

Ben Santer: My sin is that my wife lives in Minneapolis so I spend a lot of time flying between California and Minnesota. On the plus side, I would say I bring the science to the people. I try and explain to people in plain English what we know with confidence, what likely outcomes are and will continue to do that to the best of my ability.

Greg Dalton: We have to end it there. We've been listening today at Climate One with Ben Santer, climate scientist at Lawrence Livermore National Laboratory. Rebecca Shaw, senior lead scientist at the Environmental Defense Fund and Tim Flannery, author of the new book Atmosphere of Hope. I'm Greg Dalton, you can listen to podcasts of this and other Climate One programs on our website climateone.org. I'd like to thank our audience here at the Commonwealth Club in San Francisco and listening online and on air. Thank you all for coming and joining us.

[Applause]

[END]