

## CHALLENGES OF CLIMATE CHANGE

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This is a great panel because you have heard perspectives from all different sectors and what seemed to me to be one of the most salient messages to stand out was the fact that ethics is something for all of us to be concerned about. As a parent, ethics is one of my primary concerns when I teach my child. As a faculty member and a teacher, ethics is something I strive to instill into my students. But at the same time, as an apolitical observer of American politics I have to say that we live in a remarkable time when ethics, lack of ethics are being exhibited by people at the highest levels in society. So it is an enormous challenge to be talking about, to be trying to model, to be trying to instill ethics when we are not just living in a situation where there is a neutral perspective towards ethics but where there is active opposition to ethics. And again, that can happen at every level. It can happen at the level of an institution, of a corporation, of a region of a state, even of a country.

I am a climate scientist and I study, essentially, the physics of the planet. Now you may say, "The physics of the planet is the physics no matter what you think of it, no matter what your perspective, no matter what your ethics." And that is true. Doing science through the wrong motives or the right motives, you're going to end up with the same answer and the universe will be the same. But once in a while, a science comes along, a conclusion comes along that has stunning implications for us as a society and for the ethical and moral judgments that we have to make. Climate change is one of those.

I began my career studying astrophysics and in astrophysics there is no immediate moral decision to be made. There is, you know, the how many angels can dance on the head of a pin question of whether we should be searching for alien life or not; if it isn't going to be friendly. And that is a very interesting topic to discuss over beer at length, but there's no real moral urgency when you're studying astrophysics. I, on the other hand, after completing an undergraduate in that field, switched fields because of the urgency of a different issue that required the exact same set of skills. I still remember my shock to find out my final year of my undergraduate degree that climate modeling is all physics. And in fact the exact physics that I'd taken in astrophysics was what we used to study the planet.

It's basic chemistry that tells us that whenever we burn gas, coal or oil, it produces carbon dioxide. We've known this since the 1850s. That is not a typo. Yes, over a 170 years. We know that we've been

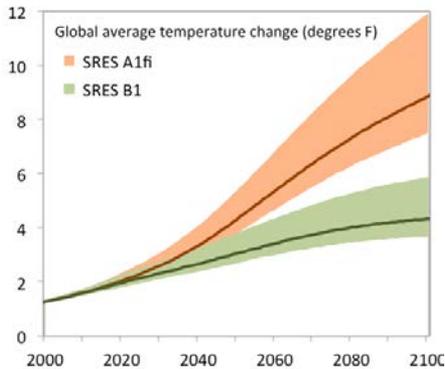
burning a lot of this stuff. And we know that fossil fuels powered the industrial revolution. We also know that, by and large, the industrial revolution was an extremely positive thing for us. We would not be here today if not for the benefits it brought us in terms of technology, lifestyle and the luxury to sit here and talk about things instead of being subjected to a grinding life where you work, you engage in manual labor from dawn to dusk and hope that you don't die at the age of 23.

This is what the science has showed us. We've been connecting the dots on this for a very long time to recognize the fact that the planet is warming. Last year was the warmest on record. Next year, this current year is going to be the warmest on record again. And when we look around the planet, it's not just a matter of thermometers and satellites, it's a matter of twenty-six and a half thousand indicators of a warming planet. Some of them in our own backyards. When is the peach tree flowering in the yard? Why do we have fire ants here when we didn't used to because our winters were too cold? We see these changes all around us. We also know, as scientists, it is our ethical duty to carefully check to see if there are any other causes for a warming planet that have nothing to do with humans. But we've been doing this type of ethical checking for a very long time.

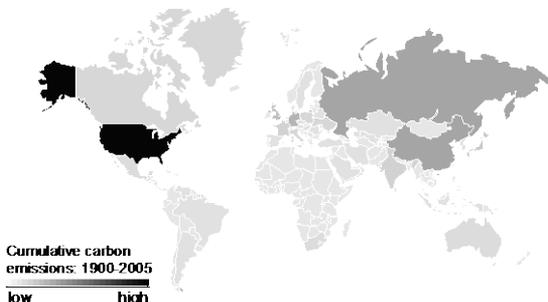
Joseph Fourier (1768-1830), John Tyndall (1820-1893), Svante Arrhenius (1859-1927), Guy Callendar (1898-1964) are the original scientists who discovered that burning coal and gas and oil produce carbon dioxide, that carbon dioxide wraps an extra blanket around the planet and traps heat, that human activities and human energy choices are increasing this extra blanket, and that the temperature of our planet is warming. These are the scientists who discovered that.

We have been carefully and ethically checking all the other natural suspects that have caused climate to change in the past. We know today that it isn't the sun causing us to warm because the sun's energy has been going down over the last 40 years, not up. We know that it can't just be natural cycles like El Niño because all they do is move heat around the planet. They don't cause the entire planet, from the bottom of the ocean to the top of the troposphere to warm. And, we know, that it can't be the earth's orbit because the next thing on our geologic agenda was another ice age. We are not still warming after the last ice age. We had peaked. We're on the long, slow slide into the next one. And that one, that long slow slide has stopped, which is a good thing for us humans but instead we're going incredibly fast in the opposite direction. And the last thing we know

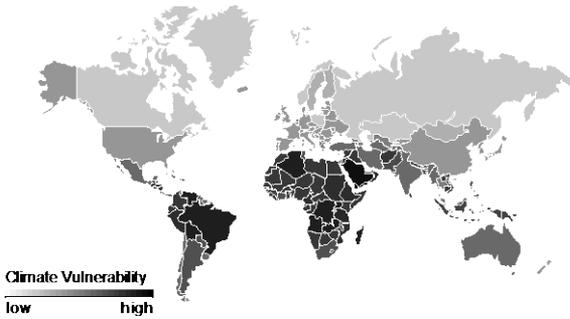
is that when we look to the future, we look to how much our planet is likely to warm in the future.



The shaded area is scientific uncertainty but the two different colored areas are not scientific uncertainty They are uncertainty regarding the choices humans will make regarding where we will get our energy from if we continue to depend on fossil fuels versus if we transition to clean sources of energy which we have so much of here in Texas. There will be a huge difference in the impact that has on our planet. And not just long-term. Did you know that burning fossil fuels, burning gas and coal and oil is already, today, responsible for over 200,000 deaths in the United States every year from air pollution? And burning fossil fuels is responsible for over 5.5 million deaths around the world. Those people are primarily the people who are disadvantaged, who cannot afford to buy a home in a nice part of town, who live in places where home prices are cheap because of the pollution. There are considerable ethics involved in how we respond to the issue of our energy choices and the issue of a changing climate. When we look for where all of these heat-trapping gasses have come from, if we add it all up over the last hundred years, there's one country that stands out.



And here is where the ethics hits the road, so to speak. Take the map above, fix this map in your head and now consider this second map that looks almost identical except it shows something different. It is not showing who's driving the problem, it is showing who is most vulnerable to its impacts.



These two figures, to me, embody the heart of the ethics of this issue. Is this fair? Is this just? Is this right? I don't think any of us who are humans sitting in this room or listening to this online, could answer yes to that question. I don't think that a kindergartener would answer yes to that question. Ethics is central, not so much to studying the science of an issue (although we want to study that science ethically and with integrity), but ethics is even more important to how we respond to what science tells us. Because this information demands a response. And we are seeing that.

We see that, for example, when we look at impacts. This is the work I do. I look at impacts. Due to sea-level rise, we stand to lose the Florida Keys and half the Everglades within this century, but Bangladesh stands to lose the area where 18 million people live and they grow half of their rice. Glacier National Park will have to be renamed within many of our lifetimes because it will have no glaciers left. But around the world, primarily in southeast Asia, and Latin America, there are a billion people who depend on glaciers for their water supply and when those glaciers are gone so too is their water.



The glacier that supplies the city of Lima, Peru with 8 million people in 1978 and again in 2004.

When we have a heatwave, our electricity bills go through the ceiling. But when we have heatwaves in other places, people die because they do not have the adaptations that we have. When we flood, it's terrible. The Baton Rouge flooding? We have friends who live there. They are still working on trying to restore their homes, trying to restore their infrastructure. We have insurance. We have the National Guard. We have people warning us and helping us to get out of the way. We have people who pitch in to help once the flood waters recede. What do they do when it floods in Pakistan and when it floods in islands in the South Pacific? The impacts are orders of magnitude more devastating. Did you know that this year, for the first time, the United States has experienced two separate sets of official climate refugees, people who have to leave their homes because of a change in climate. The first is a village called Newtok up in Alaska, where what used to be permanently frozen ground under their feet is thawing and crumbling and falling into the river and into the ocean, and they had to move. No one else really offered to help them. The second is another native American tribe, living in Louisiana, where the ground under their feet is literally sinking into

the ocean. For two reasons: number one, because sea level is rising, number two because of all the oil, gas and water that has been extracted from underground reservoirs. They also have to move. And again, no one is really helping them. The island of Tuvalu, is now almost over-topped during storms because of sea-level rise. New Zealand, last I heard, is taking about 75 people per year and that's not fast enough. When their island goes under, there will be nowhere for them to live.

You can see how ethics relate to this issue. That is why, when we hear spokespeople talking about climate change, it is no longer scientists, it is no longer the inter-governmental panel on climate change who are raising their voices, it is no longer just environmental organizations raising their voices. We are hearing the pope talking about climate change and doing so with unmistakable connections to ethics. We are hearing on the right, the National Association of Evangelicals in the United States speaking out on climate change and doing so specifically because it relates to impacts on the poor and the vulnerable. What can we do? How can we respond?

I'm going to offer three short thoughts to close with. Is it right to agree? Yes, we can agree that we're at risk whether we live in Texas or whether we live in Bangladesh. That is an ethical response to a changing climate. To, number one, acknowledge that the risk is real. To not say to our brothers and sisters who live on the other side of the world or even those who live right here in Texas who are less fortunate than us, not to say to them, "Oh you're just making it up. That can't be real." They're experiencing the personal impacts and the first thing we can do in an ethical response is agree with them. The second thing we can do is prepare for a changing future because things are changing, make no mistake. There are ways to change. And I am fortunate enough to work with Oxfam to look at ways that people living in developing countries can change to be more prepared for the future whether it is improved irrigation techniques like we developed here at Texas Tech to use less water. Whether it is floating villages they're putting in in the Netherlands so that when sea-level rises, you just put in a few more feet of anchor chain. The right thing to do is to prepare.

And then lastly, the last ethical thing I believe we need to do is to invest in the new clean energy economy. Whether it is wind turbines replacing aging oil rigs over here in West Texas. Or whether it's solar panels on thatched roof huts in Africa where they never had electricity to begin with. That is the ethical response. Because when you look at Africa and Southeast Asia and you say, but they should

be able to use all the coal and all the gas that they want to because that's the way we did it. That seemingly ethical argument completely ignores the fact that they don't have any with the exception of perhaps Nigeria and of course China itself. Africa and Southeast Asia only have six percent of the world's fossil fuels. And so is it ethical to encourage them to depend on a dirty, outdated source of energy that creates air pollution as well as climate change when there are new, clean ways to get our energy that are much more affordable and don't ever run out on us? This is how ethics relate to what I do and this is what I think about every day. I'm going to close with a quote from my favorite scientist, Jane Goodall. She said this statement only two years ago, and I thought it was remarkable because it perfectly sums up my own perspective on science: "It is only when our clever brain and our human heart work together in harmony that we can achieve our full potential."