CLIMATE SENSE

“Introducing the climate change challenge”

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Episode Summary:

Climate change is all over the news these days. We hear about hurricanes and heatwaves, droughts and floods, and young people protesting to fix the problem now. Climate change was a centerpiece of President Biden’s campaign in 2020, but it is still a divisive issue in U.S. politics. In this episode, Samantha Gross and her guests address the science and origins of climate change and the sources of the pollutants that are warming our world.

[montage of street sounds and music]

GROSS: Climate change is all over the news these days. We hear about hurricanes and heatwaves, droughts and floods, and young people protesting to fix the problem *now*. Climate change was a centerpiece of President Biden's campaign in 2020, but it is still a divisive issue in U.S. politics.

Some on the left are pushing for declaration of a climate emergency and drastic action right now, while some on the right say that the climate has always changed and that humans aren't responsible for whatever changes we see today, or even refuse to admit that the climate is changing at all.

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I'm Samantha Gross. I'm the director of the Energy Security and Climate Change Initiative at the Brookings Institution and have spent my career focused on energy and environmental issues. I've been in Washington for 20 years now, working on energy policy in government and private industry before I came to Brookings. But I started my career as an engineer, designing technical solutions to environmental problems. My work now focuses on how to achieve an energy transition—the technical, political, and social challenges in getting from here to there.

This podcast series is intended to shed light on the essentials of climate change and how to deal with it. I'll talk to experts in various climate-related areas to help you understand the issue. How serious is climate change and what causes it? How does our energy system work and why do we use fossil fuels anyway? What are potential solutions and are they ready for prime time? Why is it taking so long for the world to act? For all the noise in the media, these answers can be hard to find. But my colleagues and I are here to help.

We'll start with Rod Schoonover. Rod and I have been on panels together over the years and I think he has a knack for putting the science in understandable terms.

SCHOONOVER: I'm Rod Schoonover. I'm the head of the Ecological Security Program at the Council on Strategic Risks. I'm a scientist. I teach climate and climate change at Georgetown University, and I have a background in national security.

GROSS: I asked Rod to explain what climate change really is, at its most basic level. Is the earth getting warmer? And if so, why and how?

SCHOONOVER: So, one of the basic principles of physics is that anything that has a temperature above absolute zero, and that's practically everything, will radiate thermal energy, radiate light in the form of infrared radiation to the surroundings. On its way out to outer space this infrared light has to pass through the atmosphere. So, the major components of the atmosphere—nitrogen, oxygen, argon—they don't interact with this outgoing radiation at all.

But there are some gases, such as carbon dioxide and methane, nitrous oxide, a bunch of industrial gases, and water vapor, that do interact with this outgoing infrared radiation.

GROSS: Yes, water vapor is a heat-trapping gas, and one that is important in regulating the earth's temperature. But the difference between water vapor and the other gases that Rod mentioned—carbon dioxide, methane, and the others—is that human activity isn't changing the level of water vapor in the atmosphere. But the other gases are a different story.

SCHOONOVER: These gases absorb that outgoing light that's coming up from the Earth and then they re-emit it in random directions. And so a large fraction of that re-emitted infrared radiation is downward. That's the heat trapping phenomenon, which is called the greenhouse effect. It's a natural process that allows the Earth to be warmer than we would expect if it didn't have an atmosphere. But this natural process is exacerbated by the industrial emission of gases like carbon dioxide.

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GROSS: An argument that I often hear is that the earth has always changed. Why do we humans think we are so powerful that we're changing the earth's whole climate and have the ability to model and understand what it is we're doing? But we see the earth's temperature and weather changing faster than anything that humans have observed before—you have to go back into geological time to see anything like it.

Climate is the average of weather over space and time, so we still have some cold spells and snowstorms, but the overall average temperature of the earth is trending upwards—1.9 degrees Fahrenheit warmer now than before the industrial revolution. Such changes have happened before in geological history, but they generally didn't turn out well for life on earth at the time.

SCHOONOVER: We have seen the Earth go through cold periods and hot periods. And in fact, this is one of the reasons why we understand the greenhouse effect so well, because we can look back at those changes. And so the fact that it has changed on geological timescales is not a counter to the argument that we are changing it rapidly at this time. In fact, humanity has never existed in a period of such rapid injection of carbon dioxide and other greenhouse gases into the atmosphere.

The Earth has gone through at least five mass extinctions. People are pretty familiar, I think, with the asteroid, or meteoroid, that took out the dinosaurs and allowed mammals such as us to thrive. But there were four more before that. And some of them were associated with either rapid changes in ocean acidification or rapid changes in the temperature of the Earth.

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We don't have a time machine, so we don't have direct observation of these phenomena. But the rapid change that led to turmoil and misery for many organisms on the planet—we're seeing the same rapid increase in both carbon dioxide and possibly temperature that produced or at least contributed to some of the mass extinctions of the past.

Humans are so teensy on this vast rocky planet, how could we be changing the climate? But science doesn't work on opinion. It operates by testing hypotheses and making observations, generating data, creating models, that sort of stuff. And we invented science to make sense of the world because humans themselves are quite bad at being objective and avoiding bias.

We know that humans are affecting the climate because we've tested this hypothesis. The basic physics and chemistry behind the warming of the planet have been known for well over a hundred years. This is basic science. Importantly, there's a consensus in the scientific community that humans have been the major contributor to this warming for quite some time. After all, we have been pumping a lot of greenhouse gases into the atmosphere since the Industrial Revolution. And so, we are seeing the human fingerprint on the climate in many through many lines of evidence.

GROSS: These days, news of natural disasters like floods, hurricanes, and wildfires comes with discussions of how climate change is contributing to these events. But how do we know? Does climate really *cause* a particular hurricane or flood?

The answer is that climate change makes all of these events more likely. You can look at the historical record and see how likely a certain kind of event was over a long period of time, then compare to the frequency of such an event today. For example, does a hundred-year flood happen more often than every hundred years today? This science of climate attribution is becoming better all the time and we're understanding more and more how climate contributes to particular weather events. Rod explains this with a great metaphor.

SCHOONOVER: There's a really good analogy that comes out of the sports world. When an athlete takes performance enhancing drugs, do we talk about whether this home run was attributable to the doping or this home run or whatever? And, of course, that's a crazy way to look at it, because on average, the number of home runs goes up. And so, it's really the degree to which performance is enhanced by performance enhancing drugs, is the question.

GROSS: I think we can agree that climate change isn't exactly enhancing our weather, in general. But this idea of a juiced-up system producing more severe weather events, like droughts, floods, and storms, really makes sense.

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So, we've established that climate change is real and that human emissions of greenhouse gases that trap heat in the atmosphere, especially carbon dioxide, are the cause.

But where do greenhouse gases come from? The most important greenhouse gas is carbon dioxide, which has been present in our atmosphere forever. Humans exhale carbon dioxide with every breath and plants take it in to grow. But the level of carbon dioxide in the atmosphere today is more than one and a half times what it was in the pre-industrial era, before we humans started burning fossil fuels for energy. The concentration now is 415 parts per million compared to 280 parts per million before the industrial revolution. This doesn't sound like much, but it has already brought us nearly 2 degrees Fahrenheit of warming. And we're still going.

SCHOONOVER: For carbon dioxide, the main activity is the combustion of fossil fuels, such as coal, oil, and gas for electricity and for transportation. Many industrial processes also emit carbon dioxide, such as the production of cement or processing of metals. And for many countries, deforestation and forest clearing and soil degradation are important contributors of carbon dioxide.

GROSS: We started burning fossil fuels for energy in the mid-1800s because they are incredibly useful and allowed many of the developments in the modern world. We'll talk about the evolution of our energy system in the next episode. But for now, let's acknowledge that burning fossil fuels—oil, coal, and natural gas—is a key part of the climate change that we are now experiencing.

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But as Rod said at the beginning, carbon dioxide isn't the only greenhouse gas. And some of these other gases are very potent and significant contributors to our changing climate, even though they are emitted in much smaller quantities than carbon dioxide.

GROSS: Barry Rabe is a colleague of mine, a professor of public policy at the Gerald Ford School of Public Policy at the University of Michigan and a nonresident senior fellow at Brookings. He studies energy and climate policy and the interaction between state and federal governments.

RABE: An emerging area of interest for me is looking at short-lived climate pollutants like methane, black carbon, and the like. What unites them is that they don't last as long in the atmosphere as carbon dioxide, but their climate impacts are very, very intensive in those first years or decades of release into the atmosphere.

GROSS: Barry is working on such an important topic. We hear mostly about carbon dioxide, which is the most important greenhouse gas. But the others are also significant and so is dealing with their emissions.

Carbon dioxide is a very stable molecule, so when we release it into the atmosphere, it stays there for a long time, as long as three hundred to a thousand years! But other climate pollutants break down much more quickly. And that sounds great, but the problem is that many of these pollutants are *really* potent—they cause a *lot* of warming for a small amount of emissions. Two of the most important are methane, the main component of natural gas; and hydrofluorocarbons, or HFCs, refrigerants used in air conditioners and refrigerators and the like.

On average, methane stays in the atmosphere for only about 12 years. But while it is there, it is almost 100 times better at trapping heat in the atmosphere than carbon dioxide. HFCs stay in the atmosphere for an average of 15 years—but are even better than methane at trapping heat, with about 4,000 times the heat-trapping ability of carbon dioxide. Clearly, emissions of these other climate pollutants are really important.

RABE: If we're thinking about this long-term century or multi-century issue, that's a CO_2 problem and it's a huge one. But when we look at these short-lived climate pollutants, the impacts for a molecule or a ton of methane or HFCs compared to carbon dioxide is much, much greater in those first years or decades. That's why this is increasingly begun to get the attention of scientists, policymakers, and the like because we recognize that this warming process is already accelerating much more rapidly than we would all like.

I tend to say somewhere between a quarter and a third of all the global warming that's already occurred is linked to, broadly defined, short-lived climate pollutants.

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Again, with this thought that if one could really achieve substantial mitigation in those sectors, one might achieve some near-term climate benefits, slowing the rate of warming over future years and decades.

GROSS: Methane and HFCs are two important greenhouse gases. Reducing their emissions provides a lot of benefit in reducing warming right now, buying us some time as we continue to work on the energy system. The sources and ways to eliminate these two pollutants are very different. So, let's start by talking about methane.

Methane is natural gas, and the largest source of methane emissions here in the United States is our natural gas system, from production to processing all the way to our homes. Leaks can occur anywhere in the system, but a key source is at the production site.

In addition to leaks, natural gas is sometimes flared when it is produced—burned instead of sold when there isn't infrastructure, or it isn't economic to send the gas to market. The burned gas releases carbon dioxide, and since combustion isn't quite complete, some methane gets emitted too. Detecting leaks and ending flaring are two key ways to reduce methane emissions.

RABE: Methane is often referred to as the low hanging fruit of climate mitigation because there are a number of technologies in the oil and gas sector, some of which are relatively straightforward to apply.

The challenge has been how to take that technology, though, and apply it, because oil and gas producing jurisdictions have been really very, very slow to impose regulatory burdens on their on their states, on their region, or on their nation where there hasn't been a global agreement.

And so especially as oil and gas production have continued to ratchet up in many places, including the United States, methane has often been overlooked or neglected, even though the capture of it actually may be able to be done at relatively low cost. And if you capture that gas, you have a marketable commodity. You're basically, when you flare or vent methane, you're releasing a nonrenewable natural resource and permanently wasting it.

GROSS: Methane doesn't just come from fossil fuels, though. Globally, agriculture is the largest source of methane emissions. As cows and other ruminant animals like goats and sheep digest their food, they emit methane. Management of animal waste and rice cultivation are also large sources of methane.

RABE: The agricultural and livestock side are probably a little more challenging from a technological perspective. But yet there too, there are some real possibilities. The Biden administration has put a greater emphasis on methane than we've ever seen before at the federal level. The president introducing just before the Glasgow agreements the idea of a global methane challenge, a broad challenge to all the nations of the world to achieve about a 30 percent reduction in their methane emissions over roughly the next decade. More than 100 nations signing that.

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GROSS: The recently passed Inflation Reduction Act contains provisions to reduce methane emissions—an aspect that hasn't gotten enough attention. The new law establishes a charge for methane emissions from oil and natural gas operations, rising to $1,500 per ton in 2026. This will incentivize producers to reduce their emissions, a real win for the climate.

Another important short-lived climate pollutant has an interesting back story. Remember back in the 1980s, when an important environmental issue was the hole in the ozone layer over Antarctica? The Montreal Protocol was adopted in 1987 to phase out the use of the refrigerant chemicals that were damaging the ozone layer. The Montreal Protocol was a huge success, and the ozone hole has been healing for years. But the new refrigerants—HFCs—have their own problems. As I described before, they are potent greenhouse gases, and their emissions now require their own policy solutions.

Here's Barry Rabe again:

RABE: HFCs is an area where globally we've made quite a bit of policy progress. Through the Montreal Protocol, more than five years ago, there was an international agreement in Kigali, known as the Kigali Amendments, to achieve a fairly rapid and substantial transition away from those HFC chemical sources for refrigerants, for cooling systems through the end of this decade and into the next one.

In many countries, including Canada and Mexico, there was initial ratification and engagement.

GROSS: The U.S. lagged a bit, but in September of 2022, the United States Senate ratified the Kigali Amendments. Since this is a binding treaty, it required a two-thirds majority—an astonishing feat for a piece of climate legislation.

RABE: The recent step by the United States Senate to approve ratification of the Kigali Treaty is really an extraordinary capstone on a process that illustrates that our nation and the nations of the world can work together constructively to develop a serious plan in the climate arena. It gets relatively little attention by scholars and the media, but I think this is a hugely important step to take on one sector that involves the chemicals that we use for air conditioning systems, or for refrigeration, but also other areas.

Of course, it wasn't just invented a few years ago. It builds on decades of progress, perhaps our greatest international environmental success story of the last century: The Montreal Protocol initially created in the late 1980s with American, but also international and corporate support to address the huge challenge of ozone layer depletion

After the Obama administration negotiated the basic terms of Kigali toward the very end of the second term of the Obama presidency, the Trump administration moved in a different direction. And yet, even in those latter stages of the Trump presidency, in December of 2020, a remarkable agreement and legislation was adopted with big bipartisan support in the House and Senate called the AIM Act, American Innovation and Manufacturing Act that laid out a path for the U.S. to achieve an 85% reduction in the production and use of hydrofluorocarbons—HFCs.

Almost all the other nations of the world have agreed to this. China and India have ratified this treaty on somewhat different terms because they're somewhat less advanced economies than the U.S. But lo and behold, using Senate treaty approval powers, which we haven't seen used much in the environmental realm in the last 30 or so years, by a vote of 69 to 27, the Senate agreed to formally ratify Kigali, basically creating a global infrastructure now to implement these policies.

GROSS: A 69-to-27 vote in the Senate is unheard of these days, for anything, let alone something climate related. But what happened is that lawmakers listened to U.S. industry, which stressed that they wanted the Kigali Amendments and needed the U.S. to join. Without U.S. ratification, they could lose access to global markets.

RABE: And so you had a number of large industries, manufacturing consortiums, and the like, that use these chemicals, putting pressure on Republicans and Democrats to come together and adopt this resolution.

An interesting thread that runs through the entire AIM Act in 2020, and the more recent Kigali vote in the Senate is this, not unanimous, but substantial support from Democrats, but significant number of Republicans as well. The public deliberations legislatively have been civil and thoughtful. Those are not always words that I would use to discuss engagement in the Congress of the United States in the last several years.

And I also think what made this one so interesting is that you had many members of Congress who could directly relate this policy to a benefit that would be seen in their state or in their district.

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Just look at all the places in the U.S. where cooling chemicals are produced and used and you get an interesting kind of patchwork quilt. And you saw very strong correlations between concentrations of industry, especially ones that thought they had a future advantage to beat the science and move forward and how their members voted, in some cases even more consequential than what their party affiliation was.

GROSS: Aha! Even in our politically polarized environment, we saw senators voting for the interests of their constituents. Maybe this is the way forward for climate policy in the United States, making it clear that preventing the worst of climate change provides a better life for everyone, and that climate action provides economic opportunities, not just lost jobs or dislocation.

We know that climate policy has been challenging in the United States, so it's great to wrap this first episode on a positive note. Dealing with climate change is not all about sacrifice and costs. There are many areas where dealing with climate can create thriving businesses and communities, and we'll focus on those positives throughout this series.

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GROSS: Many thanks to the experts I talked to in this episode. Fred Dews is the producer; Gastón Reboredo the audio engineer; and Matt Murphy the audio intern. My thanks also to Louison Sall and the communications teams in Brookings Foreign Policy and the Office of Communications. Show art was designed by Shavanthi Mendis.

You can find episodes of "Climate Sense" wherever you get your podcasts, and learn more about this show on our website at Brookings dot edu slash Climate Sense Podcast. You'll also find my work on climate change and research from the Brookings Initiative on Climate Research and Action on the Brookings website.

I'm Samantha Gross, and this is "Climate Sense."