Environmental Defense Fund

SPECIAL REPORT
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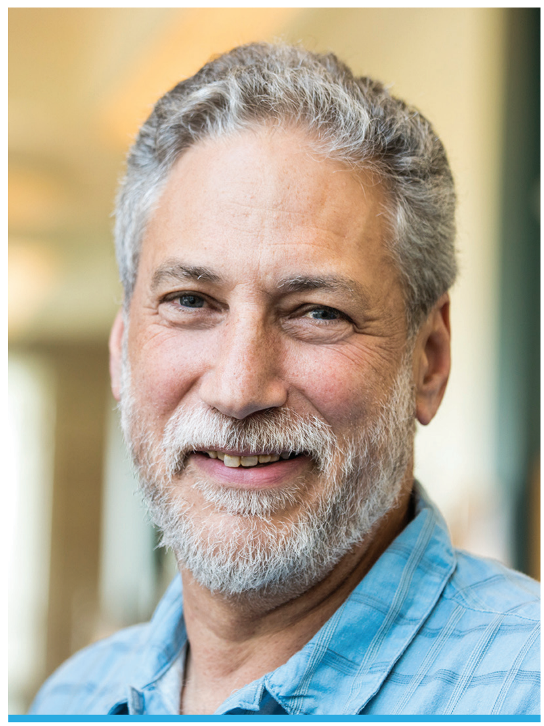
From Academia to Action

Steven Hamburg is chief architect of the "methane moment" that launched a revolution in the way we fight climate change

By Tom Clynes



EDF Chief Scientist Steven Hamburg

As EDF's chief scientist, Steven Hamburg oversees a vast range of scientific efforts. Before joining EDF in 2008, Steve directed the Environmental Studies Program at the University of Kansas. Then, as a professor at Brown University, he founded the Global Environment Program at Brown's Watson Institute. He has published more than 100 scientific papers covering biogeochemistry, forest ecology and climate change impacts. And as a lead author for the Intergovernmental Panel on Climate Change (IPCC), he was acknowledged as one of the contributing recipients of the 2007 Nobel Peace Prize.

After more than 20 years of teaching and researching, Steve left academia to lead EDF's scientific efforts — including what may be the organization's boldest endeavor yet: MethaneSAT. The result of a coordinated effort by dozens of scientists, engineers and others around the globe, the satellite will allow anyone to track methane emissions, anywhere in the world.

Steve recently took time out to describe the history-making path to MethaneSAT's launch in March of this year — and how it will drive reductions of a long-overlooked greenhouse gas that is the key to quickly slowing the rate of global warming.

Steve, how did you first start thinking about climate change?

My spiritual home is my place in northern New Hampshire, in the middle of a forest that I've studied literally for 45 years. When I started working on this forest and thinking about the impacts of climate change, I thought it was something we'd see in the future, something my daughter would see. But it didn't take long before I started personally seeing those impacts. I felt an obligation to tell the world what's happening — but even more importantly, to help address it.

What sort of changes did you notice in the forests?

The changes have been dramatic. In my classes, I used to show a slide that one of my students took, of a little red oak next to a big red spruce, which had long been the dominant tree of the forest. We see the tree of the future next to the tree of the past. Those red spruce are nearly gone now. I did my doctoral work on reforestation and carbon cycling, and established permanent research plots close to where I now own my property. We published a paper in the 1980s, showing for the first time that industrially caused climate change was already changing the composition of a forest. The rate of change I was seeing in the forest was shocking to me; it has been much greater than I had anticipated and it is accelerating.

Over more than 45 years of research, Steve Hamburg has seen dramatic changes in the forests of northern New England.

How did you come to pursue environmental work?

I struggled with school, and I had undiagnosed dyslexia. I was a very slow reader; I finished my first book in fifth grade. Almost every report card said, "if he only worked harder." I was working my tail off, but it wasn't obvious to them. My schools overlooked the Hudson River, and my favorite pastime was looking out the window and observing what was going on, on the river. On my 16th birthday, my parents allowed me to buy a kayak, which I still have. I would go out on the river as often as I could and try to understand this fascinating ecosystem. I initiated my first environmental research looking at the ecology of the river working with a local college professor a year later.

I had a series of mentors that made all the difference in my life, including George Woodwell, one of EDF's founders. I skipped the first two weeks of my last semester in college to take his course in ecosystem ecology at the Marine Biological Laboratory in Woods Hole. I don't think many people used the term "ecosystem ecology" then. I got excited by the science we covered; it set the direction of my career.

In 2008, you stepped away from a very distinguished academic career and came to EDF to take on the role of chief scientist. What prompted you to make such a radical career change?

As a professor, I taught my students about environmental issues, and climate change in particular. Many of them have gone on to do tremendous work in the field. But considering what I was seeing with the climate, I wanted to catalyze change — and I wanted to do it as quickly as possible. I realized that I could have a bigger role outside academia. That decision has been validated by the evolution of the work that we are doing on methane. There was no way that I would have been in a position as a professor to mobilize such a big effort with so many collaborators in such a short period of time. And with the climate, time really matters.

You could have gone to a lot of different environmental NGOs. Why EDF?

EDF was founded by scientists who studied an issue — the impacts of DDT on birds of prey — then, with a strong foundation of knowledge about the problem, they catalyzed action that led to policy changes and behavioral changes that eventually saved these birds.

We are rare in terms of the role that science plays in our work, and the respect that the organization has for science. Our methane work is a poster child for that. There wasn't a body of science on how much methane was being emitted from human activities, so we developed it. Also, the leverage that EDF brings in collaborating with companies and working with the philanthropic community to take on these major challenges is extraordinary. I have the privilege of working with an organization that is willing to lean in and make big commitments. I couldn't ask for a better legacy than working with people who are capable and committed to making radical change. That's going to have a very positive impact on the world around us. That's what gets me up every morning.

You had occasion to meet Lee Scott, then CEO of Walmart, on the summit of Mount Washington. How did that come about?

It was 2005. Fred [Krupp] at first didn't tell me who he was, just a major CEO. I was there to talk about the impacts of climate change on the forests of New England. The bunk room in the observatory and research station up there is tiny — it's like being in a submarine. I don't think I made a good bunk mate, because I snore. But Lee and I talked about climate, and we got along really well.

At one point he said, "Look, I want to know how this relates to my company and my customers." So we were off to the races. I had visited Walmart's first environmental store in Lawrence, Kansas, and Lee challenged me to tell him whether they were doing a good job. I told him that I thought it was a lot of greenwashing. And I challenged him to sell efficient lighting if they wanted to make a meaningful effort to be sustainable. I got a couple of my Brown students to model the impacts of moving away from incandescent bulbs and develop sales targets that would make a difference. Walmart hesitated at first, but they agreed to make a public commitment to the goal of sustainably saturating the sale of high-efficiency light bulbs that met that goal. It was a tremendous success that made the front page of the New York Times. And a year later we got national legislation phasing out incandescent light bulbs.

Let's talk about methane. What is it, and why is it so important?

Methane, also known as natural gas, is a small molecule of carbon and hydrogen. It's formed from anaerobic decomposition in wetlands or deep underground. It's a very compact energy carrier, and very useful for society. Beginning late in the 20th century, we knew we needed to get away from coal, because it's so carbon intensive and puts a lot of unhealthy particulates into the air when it burns. Burning natural gas emits roughly half the carbon of coal while delivering the same amount of energy, and it burns cleaner. It seemed like a reasonable temporary solution, at a time when we didn't yet realize how quickly we could ramp up renewables.

In the early 2000s, fracking was making natural gas much more plentiful, but it wasn't clear how much of the natural gas that was being drilled and delivered

Gas and oil production is the biggest source of methane.

was escaping and being lost to the atmosphere. Without knowing that, there was no way we could understand the environmental and climate implications of the fracking revolution that was taking place in the United States.

When you taught at Brown University, you actually drove a van that was powered by methane (compressed natural gas), right?

Yes. And when I first raised the methane issue with Fred Krupp, EDF's president, I told him about that van, which I used to take my students out to the field to study forest ecology. We purchased a natural gas van because we believed it was the climate-friendliest solution to transportation. But when we dug deeper into the numbers, it was more complicated. Different greenhouse gasses have different potencies and different residence times in the atmosphere. Carbon dioxide lasts for hundreds of years. Methane is 28 times more potent as a heat-trapping gas over 100 years, but it only lasts a little more than a decade.

Plus, a lot of methane seemed to be lost to the atmosphere during the production and transport of that gas before it could be burned in Brown's van. We calculated that over 100 years, the climate would be better off for my having driven that natural gas van than if I had used a gasoline van. But for the first 85 of those years, using natural gas was negatively impacting the climate. As I told Fred, I had not signed up for 85 years of doing damage during my lifetime, and my daughter's lifetime, before we got to the positive column. We had to do something about this.

You realized that methane is a big problem for the climate. But it also represents an opportunity, right?

It is in fact the best opportunity we have to address the climate change we are experiencing now. Reducing methane emissions is the most powerful tool in our toolbox for slowing the rate of warming over the next couple of decades. Unlike CO2, which stays in the atmosphere for centuries, methane will naturally be converted to carbon dioxide and water and decrease in the atmosphere within 12 years. You don't have to remove it. As we dug into it, we realized that we had been undervaluing the role that methane plays and only thinking about climate as a long-term problem.

We absolutely do need to reduce CO2 and how seriously we take that need will define the climate humanity experiences at the turn of the next century. But in the near term, there is a real opportunity to slow the impacts of our actions on the climate as well as over the long term. We need to solve near-term and long-term warming, and to do that we need to maintain our focus on reducing carbon dioxide emissions and ramp up our focus on methane emissions reductions.

What was the next step?

We needed to scale up our ability to measure methane emissions, and we needed tools we could use over large areas. So we worked with the scientific community to put methane measuring equipment on planes that could collect a large quantity of data with high resolution and high precision. We worked with more than a hundred scientists to collect data on methane emissions from oil and gas production across the US using planes, cars, drones and towers, providing the first comprehensive understanding of methane emissions across an entire sector at a continental scale.

One of the senior scientists who was heavily involved in this work told me that, despite having a very long and successful career, this work had more impact than anything he had ever done before. What we demonstrated was that a large number of scientists care deeply about our climate and want to have an impact and use their science to help meet the challenge in tangible ways.

Are there limits to the kind of measurements that aircraft- and car-based instruments can do?

Yes. methane is a global problem, and the overwhelming majority of methane emissions are outside of the United States. In the U.S., we could fly, or reach sites via public roads to monitor sites and develop and test our methods. But in most of the places we'd want to monitor methane, we cannot easily get permission to fly a plane to make those measurements. Whether that's because of conflict, the need for military approval, or concern from governments and powerful companies, you usually can't get permission. But a satellite orbiting at 590 kilometers above the Earth does not need permission to fly over any country. To get a totally clear picture of how much methane is being emitted everywhere across the globe, any time, we would need a satellite.

Aircraft- and ground-based experiments confirmed the accuracy of MethaneSAT's detection methods.

And so, the idea of MethaneSAT was born. How did the vision take shape?

We started by asking what we need, not what we could do with existing technology. We needed it to be able to answer three basic questions: How much methane is being emitted, where is it being emitted, and how are those emissions changing over time? We would need the satellite to be able to see the methane gradients well enough to recreate the data that we had collected in collaboration with a dozen science teams using all of the tools we had in 2013 to characterize the Barnett Shale region of Texas.

And so, we assembled a team to help us build the highest-precision greenhouse gas measuring satellite in the world. The idea of doing this energized and captured the imaginations of people across the scientific community — people in government, academia, and NGOs. The ability to bring all that talent together is really the magic sauce that EDF was able to provide.

Could you describe the finished product?

As modern satellites go, it's pretty big. It's not huge like the Webb telescope, but it has 60 kilograms of glass alone, for the spectrometers that measure the concentrations of methane and oxygen. We needed it to have a low detection threshold and a high degree of precision. And we needed whole-planet coverage to characterize emissions comprehensively.

Just as important as the hardware is the software that can run the models to quantify those emissions and identify where they came from. As the satellite maps methane concentrations in an area, we have to look at the variation in those concentrations and look at wind and other environmental data and sort of run the movie backward to find where the methane emissions came from. There were methods for making the required calculations, but they required a lot of labor and expert judgment to provide useful results; there were no automated systems that could do the bulk of this work. So we had to develop the algorithms and engineer the software to do this, so we could keep policy-relevant data flowing 365 days a year at a steady pace. We've had arguments about whether taking on building this data processing capacity was even bolder than building the high-precision satellite.

At COP26 in Glasgow in 2022, more than 150 nations agreed to a collective effort to reduce global methane emissions.

Meanwhile, the awareness and momentum to take on methane emissions was growing. This culminated in Glasgow, in 2022, with what you refer to as "the methane moment."

When we started this work, we knew less about methane emissions than carbon dioxide.

By 2022, our understanding of methane emissions was pulling ahead of our understanding of carbon dioxide. A global community of scientists leaned in and brought their expertise to solving this problem. And the key was that we could create much greater clarity about the nature of the problem, the size of the problem, the location of the problems.

The challenge now was to catalyze action. It was apparent that we had a rapidly evolving ability to measure these emissions, as well as a substantive opportunity to cost-effectively reduce them. At the Glasgow Conference of the Parties (COP26), we had what we refer to as the methane moment. The global community came together to sign the Global Methane Pledge, acknowledging that reducing methane emissions from energy, agriculture and waste is regarded as the single most effective strategy to limit warming in the near term. More than 150 nations agreed to a collective effort to reduce global methane emissions at least 30 percent from 2020 levels by 2030.

In Glasgow, someone came up to me and said, "It's amazing — methane came out of nowhere and all of a sudden it's a big deal." Methane was making it to the main stage of the climate arena.

And then, on March 4, 2024, we had another major moment, at Vandenberg Space Force Base in California. You were there at the launch.

I was at the launch viewing with Steve Wofsy, the Harvard atmospheric scientist

A climate revolution: EDF staff, supporters and partners celebrate the launch of MethaneSAT at Vandenberg Space Force Base in California.

with whom I developed the idea of MethaneSAT, and who delayed his retirement for several years to see this project through. We watched the rocket go up with our satellite on it, and roar into the sky. Both of us turned to each other and said, “Who the hell thought we’d ever pull this off?” It was a triumphant moment, the result of an audacious, collective effort. But already I was thinking about how much work we had left ahead of us. I told Steve and everyone else on the team that our only measure of success is whether methane emissions go down.

Prior to launch, engineers carried out a series of tests on MethaneSAT’s systems.

How will we accomplish that?

If we have great data without action, nothing changes. And so, we can think about MethaneSAT as really two big systems: the data collection system and the advocacy system that goes along with it. We’ve been coordinating with our advocacy team from day one, building the pipeline and the systems to allow us to catalyze action once we have enough high-quality data to act. That team is just as skilled as the engineers building the satellite. Our in-house team is coordinating the complementary skills, including collaborators outside EDF, to create momentum and ensure that we will be effective in driving the emissions reductions we need.

Everyone involved understands that even if the satellite works perfectly, we fail if emissions don’t decline. Having that one ultimate metric of success is incredibly motivating. Whether you’re trying to solve a technical problem on the satellite, or you’re working with a company to convince to it take action, you know that you’re doing something for future generations, for the environment, for humanity.

Now that the satellite is launched, how long will it take for the data to start flowing?

There will be a very deliberate commissioning phase. The operations center will be making sure it's healthy and working effectively. And there's a whole program to monitor debris in space and make sure we don't get hit. We had to turn it on carefully, testing all the systems, making sure that everything's working well and communicating. Then, after a few months, we started collecting data, starting with places where the environmental conditions make it easier to understand, or where we have ground-based instruments that can concurrently measure methane concentrations.

Then we'll incorporate our data platform, which we've been testing and fine-tuning for several years. We'll combine the methane concentrations with wind and environmental data, and make sure it is accurately measuring methane concentrations. After a few months of what I call "opening the valve," we'll be in full operation.

Will the satellite be able to get a picture of any part of the world we want?

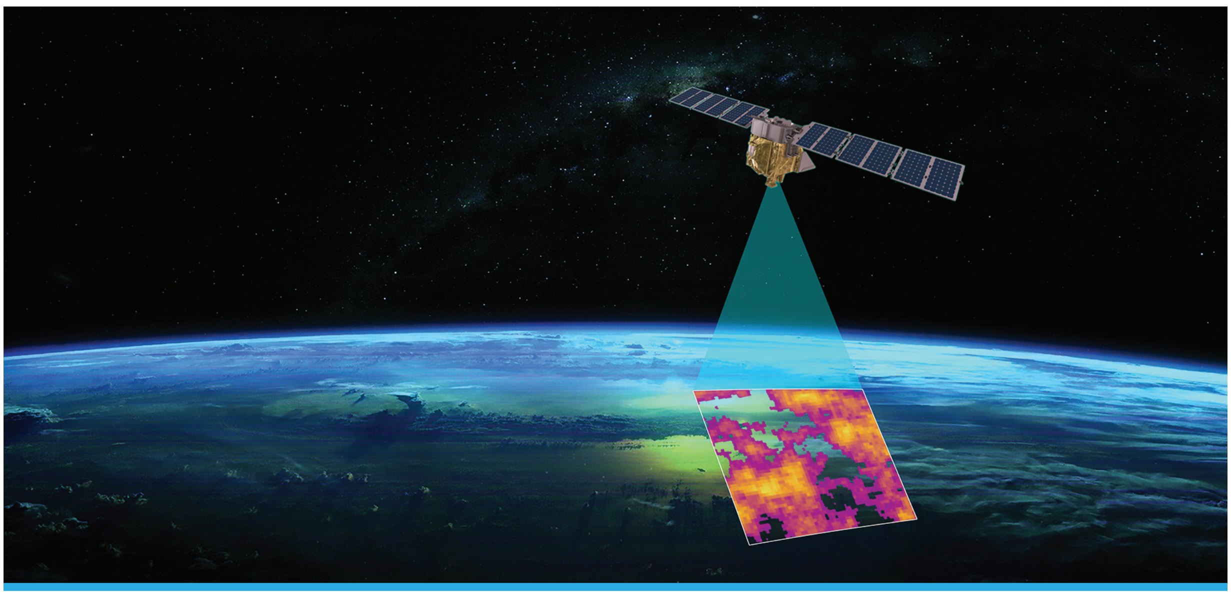
Yes. It's in a pole-to-pole, low-earth orbit, circling as the Earth spins. So each time it circles, every 95 minutes or so, it's seeing a different piece of the Earth. Depending on cloud cover, we can see any place on Earth roughly twice a week if we are in northern latitudes. Within a few months, we'll be able to get a detailed picture of most of the world, with the exception of places that have lots of clouds. We can't look through clouds, so that'll take a little longer. We want to build the full global picture, with a very high degree of confidence.

Do we anticipate any quick wins once it's all up and running?

I think the key is to not think about it as quick wins, but as building a puzzle. Over the course of 2025, we'll get an understanding of what's happening across the oil and gas production industry, and a clear and crisp understanding of where the problems are on a global scale. By the end of the year, the puzzle will have the overwhelming majority of the pieces in place. We'll be able to show who's performing well and who's not. That data will allow people to act, whether it's through corporate action, the marketplace, through regulatory frameworks or in financial environments.

How accessible is this data going to be? And what will it cost to access it?

This is information that very much needs to be shared and used. And so, we are making it available free of charge to everyone who's using it for noncommercial purposes. If someone wants to sell it to somebody else, we will offer a fee-based commercial license, to allow us to cover some of the operating costs. But everyone else can go to our portal and look at the data and download the data on Google Earth Engine. It's important that we have complete transparency, and an open environment that allows everybody to participate.



MethaneSAT orbits the Earth 15 times a day, scanning for methane pollution.

Have some people been surprised that we're not charging for access to this data?

Yes. We went into NOAA — the National Oceanic and Atmospheric Administration — to talk about getting the license to launch the satellite early in the project. Toward the end of the meeting, they asked, "So, who's your customer?" And we told them that our "customer" is civil society, the world. "But who's going to pay you for the data?" they asked. And we told them we're not going to sell it. We're going to give it away. It was mind-bending for them, the notion that we're not a government and we're going to put up a satellite and give all the data away. It took them a while to get their heads wrapped around that idea.

Are we expecting attacks from the industry? Will they try to devalue this?

I'm sure there will be pushback. There will be efforts to say that it isn't sufficiently well developed, or it isn't sufficiently precise, that the uncertainties are too great. But that's why we have participated in controlled release experiments with our aircraft version of MethaneSAT, MethaneAIR, to show that in fact we can accurately characterize how much is being emitted; the results were very strong. And we're not looking at a single scene; we can collect a lot of data in a relatively short period of time and we can stack it and see what the average is and see how it varies. That will greatly reduce the uncertainty in our measurements and allow us to say with a great deal of certainty which places are higher or lower than others and which areas are significantly different both within a region and across regions.

Our Vision 2030 strategic plan includes methane-relevant deadlines starting in 2025. Can we still achieve these goals?

Absolutely. There's every bit of evidence to suggest that the industry is perfectly capable with existing technology and capacity to significantly reduce methane emissions very quickly. Some companies have already done this. The industry historically did not collect enough data and analyze it to understand why some facilities weren't performing well. And when they do have the data and act on it, past experience gives us every reason to believe that emissions should drop significantly. One thing in our favor is that most companies are motivated to stop wasting their own product.

As an environmental NGO, we are sometimes criticized for favoring the carrot over the stick when it comes to pressuring companies. What's our approach here, when we get this data?

We'll want to use both carrots and sticks. The sticks are generally the market, or regulators or financial institutions. EDF doesn't have regulatory authority and we're not buying LNG, but by opening the data to regulators and market actors, we can expect people to use it both to reward those who are doing well in terms of producing clean natural gas, and pressure those who are not doing well. Governments will be able to use it to guide enforcement of regulations and determine whether or not they're meeting their overall goals. Buyers will be able to see if the product they're buying has excessive air pollution associated with it in the form of methane escaping into the atmosphere.

Rocket launches release a lot of greenhouse gasses into the atmosphere, and some satellites become space junk. How green is this satellite and its launch program?

As an environmental organization, we were of course concerned about that. We purchased offsets to compensate for the emissions at launch. The booster landed at the launch pad to be reused. And our license requires us to have the capacity to bring the satellite back into the atmosphere, where it will burn up. There will be nothing hitting the earth and no debris left in space.

Will MethaneSAT show us agricultural admissions, too? Will it pick up on things like big livestock feedlots?

Yes, we will be targeting agricultural emissions as part of our partnership with the New Zealand Space Agency. For the very first time, MethaneSAT will provide satellite-derived data on agricultural methane emissions around the globe — things like feed lots and manure lagoons, and rice production. These data will be made public more slowly because there's more development to be done on the science. We need to validate the data from different sources, which will require working with a diversity of science teams.

With environmental issues, there are often challenges, and you certainly experienced a lot of them with this project. What do you do to keep yourself optimistic when things aren't going your way?

I remember being in Southeast Alaska and bushwhacking through alder patches in the snow slide areas high on the mountain. These thickets are incredibly dense. Sometimes you are barely moving and you're just thinking, this is impossible. You don't even notice the progress you're making because you're just focused on bashing through and putting one foot in front of the other. But then after a while you look back and you see how far you've come, the progress you've made; you get above the tree line and the going gets a lot easier.

When it comes to my environmental work, I stay optimistic because I am able to look back at how far we have come. I started thinking about methane in 2009, and at this point I can't help but think that we haven't achieved enough reductions. We are in the alder patch. But if I look at how many more people in the world now know about methane, how many people have leaned in to do this work and how many governments and companies have signed up to take action, we've come a long way. We've recognized a huge problem and we are making strides in addressing it, step-by-step. I'm proud of how far we were able to climb, and that keeps me focused and optimistic.

You've referred to the focus on methane as a "revolution." Can you explain?

I am confident that the clarity we'll be getting on methane sources will have a dramatic impact on emissions across the globe — and in particular methane from oil and gas production. We see this as an enormous leap forward. Everybody who's been involved — the people who came out of retirement, the people who didn't retire, the people who did this instead of earning more money in industry, the members and donors who made it all possible — we're all playing a part in catalyzing this revolution. It's going to make a tremendous positive impact for the future of the planet.

The rocket carrying MethaneSAT lifts off from Vandenberg Space Force Base on March 4, 2024.

MethaneSAT cost $88 million to build and launch, not including the software and the associated advocacy. Much of that was funded by large grants and donations. In that context, if I'm a donor who can only afford to give $100 or $200 at a time, does my more modest gift really help?

We would never be able to do MethaneSAT without the base of giving from our members and donors who make smaller donations. This funding provides the flexibility to invest in endeavors that are not necessarily mature yet — like

MethaneSAT in its early phases before we were able to raise large sums to actually build it. Our members give us the flexibility to ensure that we can take risks and make important investments in these kinds of big ideas.

What accomplishments give you the most hope that we stand a chance in the fight to turn around the climate crisis?

What gives me the most hope are the many new tools and insights we've been able to generate, whether it's addressing methane or what's happened with efficient lighting and renewable power. I certainly didn't expect the kind of cost curves that we've seen. Fifteen years ago I would have said there's no way new renewables would soon be cheaper than fossil-fuel energy, but that's exactly what's happened. But this innovation is about more than technology. It's about insight, the insights we've gained through learning to do things differently, in ways that allow us to make much more rapid progress. That insight, combined with new technology, is innovation writ large.

Every day we find even more opportunities to innovate. I feel a real privilege to be at EDF, embracing that innovation and knowing that our donors are looking to us to find those unseen opportunities — and helping us to exploit those opportunities. And as long as there are willing people who want to make a difference, I am confident that we can make a lot of progress. Climate change is going to have negative impacts, absolutely. But I think we can prevent the worst of it. And that gives me a lot of hope.

Thank you for making EDF's game-changing methane work possible.

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