SARAH BALDWIN: From the Watson Institute at Brown University, this is Trending Globally. I'm Sarah Baldwin. When it comes to climate change, we all know that carbon dioxide is a greenhouse gas and it's a problem. But it's not the only greenhouse gas. There's another one that Watson senior fellow Deborah Gordon says in many ways is even more damaging to our warming planet.

DEBORAH GORDON: It's invisible, it's odorless, it's minute, and it's 120 times more potent than carbon dioxide as soon as it's emitted.

SARAH BALDWIN: The gas she's talking about is methane. And when it comes to slowing down climate change, curbing the release of methane needs to be at the top of our to do list. This week, Deborah and her colleagues released a paper looking at one of the ways that methane gets into our atmosphere. Oil and gas production. In addition to the fossil fuels these industries create, they also release huge quantities of methane. Sometimes it's by accident. Sometimes it's not. It's a gas leak on a global scale. And it's warming our planet faster than we ever knew.

So Debbie, thank you so much for coming in to talk to us today.

DEBORAH GORDON: It's a pleasure to be here.

SARAH BALDWIN: Let's just set the stage a little bit. The Intergovernmental Panel on Climate Change recently lowered the climate accords 2 degree limit on global warming above pre-industrial levels to 1.5 degrees Celsius. And to even approach that goal despite all the focus on lowering CO2 emissions, your report that just came out states that policymakers, and industry, and civil society should focus their attention on short lived climate pollutants, which have nothing to do with CO2 like methane. So what our short lived climate pollutants? And why is methane especially dangerous?

DEBORAH GORDON: Short lived climate pollutants, which sometimes you'll see as SLCPs, include several other greenhouse gases. Methane being the one that I'm writing about here, but also black carbon, HFCs that caused the hole in the ozone layer, they are super pollutants. What they do is they act much more potently than CO2 does, but much more rapidly. Super pollutants, if you think about it more and in like layman's terms, would be as if CO2 was putting a blanket on the climate. One blanket.

A super pollutant, or a short lived climate pollutant, would be like putting multiple blankets on the climate at the same time. So in the case of methane, you would have 120 blankets. And then they're short lived. So they reduce their potency quickly. But when they're first released, they are extremely strong. And that means that the warming is more powerful immediately.

SARAH BALDWIN: Well, when you say short lived, how short lived are they?

DEBORAH GORDON: Well, let me compare it to CO2 because that is carbon dioxide-- the main greenhouse gas. That will live for hundreds if not thousands of years in the atmosphere putting out its multiplier of one. It's the standard of one blanket around the climate to warm it. A pollutant like methane would be 120 blankets. 120 times the effect of CO2 right away. And then will reduce itself over the course of about 20 years.

So it's still in the atmosphere in 20 years. But at 20 years, it might be 80 blankets or 80 times more potent than CO2. And in 100 years, it might be 30% or 35% more potent. So it's still a multiplier that's important and dangerous for the climate. But it is a multiplier that it's at its height right as it's emitted, and then lasts still decades but not centuries.

SARAH BALDWIN: Before we talk about how methane gets into the atmosphere, can you describe it?

DEBORAH GORDON: So methane is a stealthy gas. It's invisible, it's odorless, it's minute, and it's forceful. And that is it's 120 times more potent than carbon dioxide as soon as it's emitted. So reducing methane leakage will not only prevent dangerous warming of the earth, it will also benefit the local environment and public health.

SARAH BALDWIN: Well, that makes a lot of sense. I mean, it sounds like it's just filthy. And it was underestimated for a long time. Right?

DEBORAH GORDON: Well, the thing about methane is-- and CO2 for that matter-- they're not reactive. So they're not things that you know pollute the air in the way that we normally-- you don't see them as black soot that's coming out of a tailpipe. They're inert. Basically, they don't react. And so for a very long time, we ignored them because they weren't doing anything. They were just kind of in the atmosphere when they would be emitted.

And methane was expressly ignored because it doesn't really lead to smog in any sort of rapid succession because it is so inert. But it's that inertness, that fact that it goes into the atmosphere and doesn't react like CO2 that they create this veil or this covering over the atmosphere that affects the way that that heat transfers. And that's what makes it so

dangerous. So ignoring it was really-- because the first thing we did was we went for the things that were leading to immediate harm to ourselves. Things that were smog, and they would get into your lungs like particulates.

These are reactive pollutants. They get into your body, and they change your chemistry. The greenhouse gases like CO2 and methane, they don't react. And that is the problem.

SARAH BALDWIN: They just change the atmosphere.

DEBORAH GORDON: They basically shield it. They're covering the atmosphere.

SARAH BALDWIN: They seal us in.

DEBORAH GORDON: Exactly. They're sealing us in. And they're sealing the heat in. Like a greenhouse does. Hence the greenhouse effect.

SARAH BALDWIN: So how exactly does methane escape into the atmosphere? What are the main sources?

DEBORAH GORDON: Methane's sources are mostly either biological like rice paddies and certain fermentation. That would be more natural side. They also come from landfills. So when things rot, methane can be released. And from livestock. From cattle. But the one that I'm writing about, and it's a huge contributor, and the growing contributor to methane, is the oil and gas sector.

So methane is natural gas. So when you go to your stove, and you turn on your stove to heat up your soup, you are actually burning natural gas to create heat to cook your food. So natural gas is a very important aspect of our daily lives. It's in heat. It's in steam. It's in power. But that's when it's combusted. So it does create CO2 no matter what.

You're going to get this baseline greenhouse gas from any fossil fuel oil or gas that you burn coal. But when you don't burn methane, and you leak it through its supply chain between the ground and your stove, when it's leaked as methane, that's when it has this shear enormous multiplier effect of say 120 as soon as the moment it comes out. Or even 35 over 20 years. You get this multiplier because the methane is so powerful.

So if we're going to continue to use natural gas, it's a very important part of our energy system. The most important thing to do is not leak it.

SARAH BALDWIN: And is the leaking intentional or unintentional?

DEBORAH GORDON: Both. So I'll talk about for a second the unintentional leakage first because that's the one that is probably harder to deal with. But I think is very important for us to recognize. And that would be every single fitting valve, seal, every connection in the system of oil and gas, every time there's something that isn't a closed system has the potential to have some of this methane seep out. And that would be unintentional. They call those fugitive emissions because they just kind of appear, and they leak out of a system.

The systems could be old. They could be faulty. They could be not designed perfectly. But methane can leak out. And that would be unintentional.

SARAH BALDWIN: And this is the infrastructure of the entire continent?

DEBORAH GORDON: Yes. This is wells, this is pipelines, this is storage tanks. This is underground pipelines in every city in the world. This is wherever met wherever natural gas moves since it is methane-- 95% or 98% methane-- that wherever natural gas moves methane has the potential to unintentionally be leaked.

And some of the biggest leakages that have been found recently are in Boston. They're old cities with infrastructure that's a century old. And it's no longer new. So it's going to have cracks, and faulty connections, and things that have loosened over time. So that's the unintentional leakage. And there's a lot of work being done to identify that and fix it.

SARAH BALDWIN: And who's driving that like? Who in whose interest? Obviously, it's in everybody's interests that there be less methane leaking. But we know that altruism doesn't drive a lot of our actions. So who's making sure these leakages are being repaired or at least detected?

DEBORAH GORDON: So methane is also-- I will say it this way. A downside of methane-- or any energy source for that matter but for methane. A downside of methane is it is combustible. In other words, if it accumulates, it will explode. So it becomes a safety risk. So safety determines having these systems be as leak free as possible. Because if you're going to have a pipeline that's cracked and leaking enough methane, you will have an explosion. Any spark will cause this methane to explode.

So safety drives a lot of unintentional methane leakage repair. And that's a good thing. It's also a reason why one of the policies that I've been thinking a lot about in the oil and gas sector from the safety side is that refineries that turn oil into petroleum products, these refineries

can't afford any leaks in them because they're such a hot, explosive, fire oriented enterprise. That there might be an opportunity here to design the tighter system that's used on refineries to actually use that in other parts of the system that have the methane can escape more easily.

If you're out in an oil field, and methane escapes and it blows away, it's not going to explode. It's just going to-- or you're offshore on a platform. It's windy. It's not going to explode. So safety doesn't always rule operations. It rules operations where there's the risk of hazards like an explosion or a fire.

SARAH BALDWIN: Well, can you talk a little bit about the oil industry, and how and where methane leakage comes into play there? Because that's more intentional. Right?

DEBORAH GORDON: It's both. So the oil sector will certainly have these connections that aren't always so tight. Or as tight as they need to be. These fugitive emissions can happen and do happen all over the industry. Because you think about these operating systems, these processes have a lot of different pieces of equipment. And they're each connected to the other. And so any of those can leak. And that would still be fugitives. But the oil industry, the gas industry, have a very perverse incentive to leak methane because oil is worth a lot more than gas.

The value that you get producing a barrel of oil will recoup you a lot more money than producing an equivalent barrel of natural gas. Or the equivalent heating value. So if you have the choice of either producing oil or gas, you really favor oil production. So that means if there's waste gas that you have no place to put it in your production-- because these oil and gas are produced most often together simultaneously. Very few fields in the world produce only oil or only gas. Oil and gas are stored under the ground together, and they come out of a well-- out of drilling together.

So there are often these decisions that have to be made. I've got oil. I want to maximize production of that oil. It's worth a lot more to me. I make more profit. But I have this gas and either I don't have the takeaway capacity for it. Or there was a burp in the system, and I don't want to shut down my system or turn it down. I need to keep producing.

What operators will do is they will vent their gas. That's purposefully releasing the methane into the air. And because it's invisible, and odorless, and if you're not in its place where it will explode, no one's looking.

SARAH BALDWIN: Well, that's the thing. This isn't tracked. Right? This is intentional flaring or venting I guess you said that is not regulated.

DEBORAH GORDON: Right. So here, let me bring up the third point. So there's the fugitive emissions we talked about. That's when it's unintentionally released anywhere in the system in usually relatively small amounts. There's the purposeful venting. And that's when you will have an operator open up a hatch or let a pressure relief valve pop. And then you just pump the methane into the atmosphere to keep operating.

But there's a very gray there of safety because sometimes those systems have to pop or else she'll risk an explosion in say your storage tank that's collected of too much methane at the top of it and it will be pressuring, and it will explode if you don't let it go. So there's a fine line on venting for safety and venting for profit. And that's what has to be really identified.

And then the third way methane comes out of the system is through flaring. Flaring people will recognize is usually the candlestick or the flame that's anywhere near a refinery or an oilfield. You'll see this tall pipe coming out of the ground like 30 feet, sometimes 50 feet, and a little or a large flame out of the top. That is turning waste gas into CO2. It's basically doing what you're stove does. It's burning the gas so that it's not venting methane any longer. It's actually transforming the gas by combusting it into CO2.

SARAH BALDWIN: Well, I mean, putting out CO2 is not the best thing in the world. But that is preferable to sort of this unmeasurable venting.

DEBORAH GORDON: Yes. Yes. So when you are combusting your methane instead of venting it, so if you're flaring your methane instead of venting it, you're not going to have that multiplier effect in terms of its import. It's still going to matter to the climate because it's CO2. And you shouldn't do it willfully for no good reason. But it's far less damaging than venting the methane. But the problem is, a lot of eyes are on those flares, which is a good thing because you want to make sure you're not overly flaring.

But there have been policies put in place recently to minimize flaring. And so when you are forcing an operator to minimize their flaring, they turn off the pilot. And they will vent the methane when no one's looking.

SARAH BALDWIN: So how can we incentivize oil companies to properly flare? If that's the least awful solution. How can we bring them in line with some sort of reasonable climate goals? I don't see what

their interest would be. If they're really interested in the bottom line and making their shareholders happy, I don't see how to sort of make them change these practices.

DEBORAH GORDON: Some of this comes down to my research on the oil climate index, which is about the heterogeneity of these resources. And how you can have certain resources that are lower emitting. They're cleaner. And other resources that are just naturally dirtier. And then you've operating practices. But because of the heterogeneity and the competitiveness of this industry, you can actually use policy to create competition so that the cleaner operators are favored. Whether they aren't divested in first. Or whether they are reinvested in first.

So I think using this heterogeneity, and better operating practices, and pitting kind of better operators against their competitors that are worse. Because why should we actually reward bad operators. No good operator wants to see their competitor who's doing things that are damaging. Being given a market. A market edge. So a much fairer system is to either-- there's so many policies you can use this kind of favorability unfavorable rating. Whether indexing. Whether it's through taxes or fees. Whether it's through policy. Whether it's through divestment protocols. You can actually start to pick and choose the better operators.

SARAH BALDWIN: But in a 2018 report, didn't you write that there's no designated authority on inventorying greenhouse gases? Like who's going to do that?

DEBORAH GORDON: This is the big brand new question that this report is about that it's going to take a hybrid approach that's going to be a combination of detection mechanisms to force better reportability of this. And we're going to need things like the satellites that both government and the private sector are putting up right now. So we're partners with NASA on their whole constellation of satellites.

The Environmental Defense Fund is putting up a new satellite I think in 2022. The California Air Resources board is putting up its own satellite. There's going to be a lot more detection from this sky to observe methane.

SARAH BALDWIN: So you can observe methane because of heat sensing?

DEBORAH GORDON: So methane is interesting. And it's not perfect. That's why you need a hybrid approach. It would be fantastic if we could see all the methane easily from the sky. But the problem with methane is you need to actually-- It's very light. It's lighter than air so as soon as it's released it floats. So the first thing you need to do when you detect methane in the satellite-- What you

what you basically do is you need to then reverse engineer through climate models where, given all of the meteorology on the ground, where that methane came from on the ground.

SARAH BALDWIN: Oh, my god. That sounds hard to [INAUDIBLE].

DEBORAH GORDON: So is all part of what NASA is doing with their researchers. We're working with researchers at Harvard that actually do this reverse modeling. To do attribution. So that's one issue. The other big issue with remote sensing from the sky with methane is it can't pick up methane over water.

SARAH BALDWIN: Why?

DEBORAH GORDON: Reflectivity from the water. So you can't pick up the light signature. So it's the satellite detection is only good over land. And that's a huge problem because so much of the world's oil and gas is over water. It's offshore.

SARAH BALDWIN: Right.

DEBORAH GORDON: Or with liquefied natural gas it's going to be on ships moving around the world. And if it leaks, it's going to leak in the ocean or when you're on the ocean. So this is why again we need a hybrid approach because satellites are really important, but they're not sufficient. So you've got that. The next level of detection are flyovers. So you have airplanes that go much lower to the ground or even drones that go very close to the ground that are actually observing it before you have to do a lot of this reverse chemistry to figure out where it came from. Because you're much closer to it when it comes out of the ground.

We even have Google cars now that have actual instrumentation on them to pick up methane for the leakage that will happen on city streets and pipelines.

SARAH BALDWIN: Like LIDAR or something?

DEBORAH GORDON: Yes.

SARAH BALDWIN: That's amazing.

DEBORAH GORDON: So all of those levels, atmospheric levels, of detection even that though, isn't necessarily sufficient. Because you want to know how much and how long. So what we've devised in this engineering model is a bottom up approach that actually uses that satellite data to build up

engineering models that can run scenarios and do projections of what pieces of equipment are most likely to be releasing. And when they release, how much was in the system so that you can know how much actually came out.

So this oil climate index is this engineering model which is bottom up. Again, that's not itself. It's necessary. But not sufficient. So when you combine these top down satellite flyover drone Google car with the bottom up engineering models, you actually can start that tell the most complete story of where methane is, and where in the system it's most faulty, and where it's most likely the leak? And you can create much more proficient projections for pointing devices at where it's most likely to come out.

SARAH BALDWIN: So who are you hoping will read this report and use the index?

DEBORAH GORDON: The report is as much geared to industry as it is I think to policymakers and investors. I think a very big part of this enterprise, the oil and gas enterprise, is driven by money and by who's going to invest, divest, reinvest. So I'm hoping that they call them ESG funds-- ESG is environment, social, and governance.

ESG funds that are actually pots of money in the trillions that need to be put on projects that are actually going to be less damaging to the environment. So I think the investors are a very important part of this as well. And of course the Ngo community and civil society.

SARAH BALDWIN: Are any of the big producers doing anything significantly promising in terms of climate?

DEBORAH GORDON: The most hopeful thing about the largest producer is the big oil companies. The international oil companies are that they're almost too big to fail. So all eyes are always on them. It's very hard for them to do the wrong thing and not get noticed. I think that the risk with methane immediately tends to be the smaller producers, often the wildcatters, the ones that don't have takeaway capacity for their gas that are making fast money that they need to make on their oil. Those are often the riskiest corporate actors.

The big thing is that when the larger companies fail, they fail big. So you'll get these hot spots or these super emitters that will come out of like Aliso Canyon in California. This was a storage facility in Southern California a few years ago that there was an accident in. So it certainly wasn't purposeful. But whether there could have been better maintenance on the facility is always a question. But a storage facility broke and there was this huge plume for months of methane. I think it ended up being more than California's entire methane budget over the

course of years leaked in a matter of months.

So when there is a failure, where there's a lot of volume, either in storage or production that becomes a major contributor to what then lives in the atmosphere for the next 20 years. And that becomes a big problem for the climate. I think that all actors matter with this. The biggest problem is it can come out. Methane can be released in so many different ways throughout an entire supply chain from production, to shipping, to refining, and processing. All the way to pipelines and city streets And delivery at your own home, where you have a stove or a furnace.

So it really matters that we have-- over time we develop the tightest net that can detect methane for its quick repair. And methane-- Let me tell you the positive side-- the story on methane. The positive side of the story on methane and climate change because of its potency being so great and so rapid, policymakers don't think about things in 100 years. So when we see these maps that lay out problems for flooding to the year 2100. Or even 2050.

People are thinking 30 years from now-- that's 80 years from now. Like I'm not going to be around. It's not on my watch. Thing about methane is, it's so rapid so quickly. So policymakers can make a huge difference on their watch. And I think that that's what makes methane's management so much more productive and possible. Because if these policymakers move to manage methane, they're going to get credit for doing so. It's going to happen while they're in office.

SARAH BALDWIN: And it's going to matter.

DEBORAH GORDON: And it's going to matter.

SARAH BALDWIN: And it will be tangible.

DEBORAH GORDON: So one of the policies I've been thinking a lot about recently that falls out of this paper is that we've been working for a very long time to do carbon taxes or to price CO2. I'm not saying, we shouldn't ultimately try to do that because this is a gas. CO2 that lives the atmosphere a very long time. And we're going to have our grandchildren, great grandchildren, and their great grandchildren live with these fall outs. But pricing methane matters now.

So if we're going into a test run on what it takes to really price and use the power the market to deal with climate change, doing it to price methane now will not only help you know help

remove a pollutant and change the incentives like you were saying in the investment community but we'll also tighten the net on measuring it and monitoring it because when you're paying for something, you want to make sure that your neighbor and your competitor are accurately reporting what they're doing. Because you don't want to be the one paying when it's their fault.

SARAH BALDWIN: That's a great idea. And in fact, I'm going to let you go so you can hurry off to Washington, and tell everyone you know. That's fantastic. This has been so interesting, Debbie. And thank you for that note of hope at the end.

DEBORAH GORDON: Oh, thank you, Sarah. It's a pleasure.

SARAH BALDWIN: I hope you'll come back and talk with us again.

DEBORAH GORDON: Anytime.

SARAH BALDWIN: This episode of *Trending Globally* was produced by Dan Richards and Babette Thomas. Our theme music is by Henry Bloomfield. I'm Sarah Baldwin. You can subscribe to us on iTunes, Stitcher, or your favorite podcast app. If you like what you hear, leave us a rating and review on iTunes. It really helps others find the show. For more information about this and other shows, go to watson.brown.edu. Thanks for listening. And tune in in two weeks for another episode of *Trending Globally.*