[SQUEAKING]

[RUSTLING]

[CLICKING]

ZEYNEB MAGAVI: The Session 1 is Framing the Challenge, and we're going to go as high level as we can, looking at the whole world and all of humanity. And I couldn't be more excited about the three speakers. I will not do them justice by introducing, so I'm asking each of them to take a moment to introduce themselves. And we're going to start with Jason Jay from here at MIT Sloan School, who has-- I will just add one piece of introduction. He has the incredible distinction, which I don't know if it's on your LinkedIn, but of being a early HEET volunteer for an energy efficiency barn raising.

JASON JAY: That's right. I learned how to use a caulking gun from Zeyneb.

[LAUGHTER]

Good morning, everybody.

AUDIENCE: Good morning. Good morning.

JASON JAY: Good morning, everybody!

AUDIENCE: Good morning.

JASON JAY: All right. So I'm Jason Jay. I teach at the MIT Sloan School of Management. I'm the director of the Sustainability Initiative there. I've had the great pleasure to be part of this HEET journey from the beginning, as Zeyneb was saying. When I did my PhD here, I was studying something called the Cambridge Energy Alliance. And I was looking at the multi-stakeholder collaborations that were occurring here around our city of Cambridge, advancing energy efficiency topics. And part of that included participating in HEET's early barn raisings. And I did, in fact, learn to use a caulking gun from Zeyneb as we were weatherizing people's homes.

And then, I've gotten to watch as this whole thing has evolved, going to the gas leaks effort, the collaboration with Eversource and other utility companies, the advancement of the legal policy framework around better measurement of gas leaks, and then towards this transformational idea of geothermal energy networks, where now there's enough trust between the advocates and the utilities to actually say, hey, could we just not have you be a gas utility anymore? which is an audacious thing, and is the reason we bring in Zeyneb as a guest speaker into our courses every year.

What she asked me to do is to, as she said, go to the level of all of the whole planet and all of humanity. And the way I'm going to do that is using an interactive simulation tool called nROADS. Just a quick show of hands, how many of you have seen nROADS before? OK. About half the room.

So this is the result of a collaboration between the MIT Sloan Sustainability Initiative and Climate Interactive, which is an independent, nonpartisan, nonprofit made of mostly MIT grads, who do a simulation tool that behaves the same as the big supercomputer integrated assessment models but runs instantly on any laptop and is freely available in open source to anybody with a web browser. So you can't open it up on your phones. But on any laptop or iPad, you can pull this up and experiment with it yourself.

And I am not on the modeling team. I'm not a climate scientist. I'm not an energy scientist. I'm an organizations person. But I've been facilitating probably hundreds of workshops at this point using this tool. And that means that any of you can do that as well, which I would certainly recommend. What I'm going to try to do is just use this to expose a little bit about the climate challenge and how the things that we're talking about here today fit within that bigger picture and what some of the system interactions are because this is a system dynamics model. This is the interdependence of thousands of variables to produce the outcomes that we are facing.

So here you can see on the left, this is the stack of global energy. So she talked about a ZettaJoule that humanity is using about half of a ZettaJoule, so 500 exajoules. You can see that here on this picture. And that is made up of coal, oil, gas, renewables, biomass, and nuclear. If we were to invent nuclear fusion or some other new zero carbon, we could add that to the mix. We're not going to talk about that today.

On the right, we have the stack of greenhouse gas emissions that are partly related to that. So the largest source of human anthropogenic greenhouse gas emissions is CO2 from energy. That's about 35 gigatons a year right now. The second highest source is methane. So this is put on 100-year CO2 equivalent units on this graph, so 10 gigatons of CO2 equivalent from methane emissions. The third highest is land use change from deforestation and peatlands and so on. And then you have nitrous oxide and F-gases.

So this gives you a picture of the faucet into the bathtub of the atmosphere, how much greenhouse gas we are putting into the atmosphere every year. And the result of that faucet being on stronger and stronger every year as we grow the global industrial economy, is that the concentration of CO2 in the atmosphere is increasing. You've heard 350.org wanting to get that back down to 350, closer to preindustrial levels. We're now at about 424. And that increasing greenhouse gas, as Zeyneb said, creates this thermal regulation problem, which is that we're heating the planet.

And so the temperature is increasing. In 2024, the data is still coming in, but we're really pushing close to that 1.5 mark. And you can see in our business-as-usual projections on nROADS, we pass the 1.5-degree goal. We pass the two-degree goal. We, at the end of the century, hit 3.3 degrees Celsius, which is what this big number is. And unfortunately, the slope of this line is positive, which means that we're continuing to warm the planet into the 22nd century.

Not everybody has a visceral sense of what 3.3 degrees Celsius means. And so one thing you can do is you can use the impact graphs in nROADS to explore some of that. So for example, we can think about how much sea level rise might we see as a result of that warming? Or we can think about other graphs like the extinction risk from animal species, so the effects on biodiversity.

One of the things that-- if you haven't played with nROADS in a little while, we've now added is that we interface with maps that are from the Probable Futures site, which allows you to see what happens on a more regional or geographic basis to the places that we care about. So for example, this is a picture of the number of extreme humidity and heat days. So how many days per year do we have with wet-bulb temperatures above 26 degrees Celsius, which is where you start to have really serious health consequences of outdoor work, outdoor sports, and if you don't have cooling in your home, just even sleeping at night.

So you can see that the Southeast of the United States starts to have really dire conditions. And you can back this off by year and see how this evolves. So here's where we were in 2000 in terms of the frequency of those ultra high heat days. And you can see that that's all increasing throughout North America. And of course, if we look at other geographies in the world, in sub-Saharan Africa, where my wife's family is, in India, in the Eastern part in West Bengal, you can see that there's very serious consequences.

And so what this means is that we have to learn how to cool our buildings fast and quickly and cheaply and low carbon. And so that demand for cooling is a big piece of the puzzle of what we're going to be grappling with. So that's one thing just to be oriented to. What is the challenge, and why are we trying to solve for more efficient, low-carbon methods for doing heating and cooling?

Now, a couple other things I wanted to just illuminate here. So one is that the methane as a significant source of greenhouse gases, this lever here, which is about the waste-- oops, sorry, I'm not used to Windows. Can I make that go away? OK. Good.

This lever over here, which is about the waste and leakage of non-CO2 greenhouse gases, so if we look at methane in particular, what you can see here is that people talk about methane-- when we talk about methane, oftentimes we talk about cows and agricultural sources. And that is very important. You can see that agricultural methane emissions. But what a lot of people don't think about is the fact that a very significant part of our methane emissions, this is depending on the time horizon, 50, 60 times stronger than CO2, do significantly come from energy production.

So when we can move away from coal, which leaks methane out of the mines, gas, which leaks methane across the value chain, and oil, which leaks methane at the drilling sites and in the refineries, we can work on this chunk, right? So if we can decrease methane leakage from the energy systems, which was HEET's first major effort, yeah, OK.

So you can see this bent the curve a little bit here. And if I just do a little replay, you can see the change. So that bending of that curve of energy leakage is one opportunity. But if we can get off of those fossil fuels entirely, for example, by pricing CO2 and doing things that allow us to decarbonize energy supply, what you'll see is that those methane emissions from energy go down even further.

So there's a two-prong approach here, which is to reduce the leakage from the system that we have, which is the original gas leaks idea. And then there's the question of how do we transition away from these high-carbon sources of energy? I'm just going to revert back without those changes and just say that-- so then the question is, well, how might we simulate the effects of doing district geothermal, like we're going to be talking about the next couple of days?

And what I'll say is that that's a blind spot in tools like this because, as the first thing Zeyneb said today was that so much of our attention has been on electricity and light, we don't tend to think about thermal energy. And I'll say that that's also the case for nROADS. There is geothermal built into what we define as renewables so that when you're subsidizing renewables or you're doing other moves, like carbon pricing that do transition toward a renewable world, that does include, if you look at the details, geothermal. But it's largely thinking about that first bucket in her graph of using the super high-temperature geothermal to generate electricity. We're not really dealing with it from a heat standpoint.

The best way for us to represent that is for us to think about electrifying the building and industry space because what you're doing is you're often moving to some kind of a heat pump, a geothermal heat pump, in lieu of a-- but you're also doing that in a far more energy efficient way than you'd be doing otherwise with fossil fuels. So this is an energy efficiency and electrification play, which are important pieces of the puzzle.

The last thing I'll just say is that anytime you're electrifying something, of course, you'll have to-- and you'll notice if you play with nROADS that electrifying transport doesn't have a huge effect on the climate. Electrifying building an industry by itself doesn't have a huge effect on the climate. And part of that is because you're not decarbonizing the electricity supply. So you have to make sure that if you're running those heat pumps, you're running them off of low-carbon electricity. And that's another system interaction.

So if you can do things like stop building new coal plants, and therefore, work toward that decarbonization of the electricity system, if you do some really heavy reductions, either technologically or through policy, to reduce natural gas and so on, then you're decarbonizing electricity supply. Then the electrification actually has more of an impact on the climate.

So just to say that these systems are interactive, and we want to think about as we are going and trying to solve these thermal heating problems, that we do it in as renewably powered way as possible. But also just that there are blind spots in so many of these modeling tools and so many of these policy discussions, given the general tendency to focus very heavily on electricity. Is that what you wanted me to cover?

ZEYNEB MAGAVI: [INAUDIBLE]

JASON JAY: Oh, and I'll just say one more thing, which is that, of course, AI and data center growth is driving increase in all of these parameters in terms of energy usage. So we have to do everything that much harder and that much faster. Now, hopefully, the AI and the machine learning can help us. And we're going to talk about the ways that advanced analytics can help us identify geothermal opportunities and optimize for them. But just notice-- just remembering, whenever we talk about those types of computational things, we always want to think about the handprint and the footprint of those technologies. OK.

ZEYNEB MAGAVI: Thank you.

JASON JAY: That's all I got.

ZEYNEB MAGAVI: Oh, my gosh. That was amazing.

[APPLAUSE]

All right. That was amazing. And now we have to talk afterwards about getting geothermal in there with a little toggle switch. Yeah