SPEAKER: I'm delighted to introduce Isabel Varela to discuss some of the research and learning we're trying to do at HEET.

ISABEL VARELA: I have multiple.

[APPLAUSE]

Thank you. So I'm Isabel with HEET, and I will be sharing with you today how HEET is trying to learn from these geothermal energy networks. So learning from geothermal energy networks and-- thank you.

HEET has a research project that is called Learning From the Ground Up, and it is funded by Massachusetts Clean Energy Center. And the goal of this project is to evaluate the potential of these geothermal networks in Massachusetts and, mainly, to really increase understanding of this technology and to optimize it, as much as we can. We want to share all the learnings with the stakeholders and make that knowledge public, open source.

Here is a brief organizational chart in bubbles. I'm not going to go into detail, but I just want to share, what are the different organizations that are collaborating with us? So we have this great consortium where we have NREL, that Juliet will be speaking today. We have LBNL. We have Boston University, Nathan Phillips. He was a speaker yesterday, Jonathan Buonocore, as well. They're part of that LeGUp research group. We're also collaborating with Buro Happold. And, of course, we partner with our utilities that are doing these systems and these installations here in Massachusetts.

So how is this project organized? At the core of this project, the project is anchored on the data demonstration projects that are here in Massachusetts. And then we're looking at core modeling, the impacts of these installations, and a scaling of these systems. So we'll go a little bit into these in more detail.

So in Massachusetts, there are different pilot projects or demonstration projects. As we heard from Eric Bosworth, there's the Framingham project. So that's the one that is installed already, already in the commissioning stage. Then there's Franklin Field, National Grid. Just is right now in the design phase of that, and they will be drilling their test borehole this month. And we also have the extension, the second loop in Framingham, and HEET has collaborated with Eversource and got a grant from the Department of Energy to do the design phase, and now we were selected for the construction phase of that project. So we're very excited to have that moving forward.

So what are the things that HEET is doing as part of this? So the data acquisition here is focused on temperature data, acquiring temperature data down the boreholes. So this is fiber optic cables that are being installed in a subset of boreholes. So there are 90 boreholes in the Framingham project, and 15 of those have fiber optic cable to measure temperature at every location down the borehole. And this is temperature that is measured constantly, and the idea is that we can analyze this data with the variations that we see in the days, with the seasons, and with the years.

So, really, when we have one year of data, when that system has been performed for one year and we get that sinusoidal curves that Connor showed earlier today, that's when we want to really leverage this data, and how do we think it's going to keep on performing throughout the years? So with-- this, we can monitor the systems and see if there's any change that needs to be made so that it functions optimally within the temperature range that the heat pumps work best.

The modeling part-- so we have two groups, LBNL and NREL, that are focusing on developing these core modeling tools. So LBNL has focused on developing a full physics model that is more complicated, runs in Modelica, software that are less accessible, if you will. And then NREL has been working on reduced-order models, tools. And I won't steal your thunder. Juliet will be talking more about that. That will run quicker, and you can still get the behavior of the system with these models. And the idea is that they're going to be open source as well.

And this is another slide from that model. And I'll just briefly mention that, for example, one of the outcomes that you can get is that you have this. In the horizontal line, you have the buildings going along that loop. And then in the summer-- for example, as you go from building to building in that ambient temperature loop, you're getting hotter and hotter until you reach the borehole, and then you cool down and then you go around the loop hotter, hotter. And then you reach the borehole, and you go down. So this is one of the advantages of having different borefields, as Brian Urlaub was mentioning earlier today. So we have that in this Framingham project. And then we have a similar example when we are in the winter.

This project is looking at, what are the impacts of these geothermal networks in a more holistic way? We're looking also at ecology, at the impacts on health, the impacts on equity. So this is a work that is being done right now, and Angie here is the lead for that in HEET. Impacts on emissions, impacts on the electric grid.

One of the things that we want to do is to have measurements at these demonstration projects to quantify the impact on the electric grid. So Zeyneb mentioned, what is the impact of ground-source heat pumps with this ORNL study if you had them at a national scale? And here, we want to quantify it for a particular project, these demonstration projects that we have in Massachusetts.

And we also want to know, what is the impact of costs? One of the things that we're working with Buro Happold and NREL is to make this survey about costs, costs of drilling, costs of the construction, of the main loop, and costs also of the retrofit-- so the three different phases that were discussed earlier today.

And all of this, the idea is to feed a study on this regional assessment. How would it look like if we had these systems installed for an entire city? Here in Massachusetts, say, for example, the city of Cambridge? How would it look like if we had it for the entire state of Massachusetts? So what are the impacts of that?

And this ties very well into the previous session. We were talking about data. Data is one of the things that is needed. And here, this is a database that HEET is making. The idea is to enable quantitative comparison between the systems to identify, what are the design parameters that work best? things like the diameter of the main pipe. What is the temperature range that the main pipe is allowed to fluctuate in? So all these kind of engineering technical aspects but also practical things.

So we want to capture the knowledge of the demonstration project in Framingham. We want to capture the knowledge of the project in Colorado Mesa University that will be presented later on that has been running since 2008. So all of this knowledge, we want to be able to capture it in a database that will be open source. And this interface HEET has created, it is up and running right now, our beta version, and we're in the process of collecting data from all these existing projects.

We also want to capture information about costs. We want to really, eventually, identify how to reduce those costs, right? But we want to first have that database. And we want to support the development of data-driven legislation and regulation, which connects to our session yesterday with Chair Van Nostrand.

So what is it? We're creating a public data bank of these geothermal network installations. And why? We want to do this to inform and to facilitate future developments of these systems. And how? This interface is linked to the HEET website, and it is stored in the Harvard Dataverse, which has the infrastructure to store data in perpetuity.

So as we, right now, have few of these demonstration projects-- for example, the one in Framingham and Colorado Mesa University. The idea is that when we have more of these systems, we want to be populating this database so that it is really useful, and that knowledge can be-- the knowledge from the database can be useful for those installing these systems for communities that are thinking of doing these installations. For example, we have the Kickstart program here in Massachusetts that is also part of this LeGUp project where 12 communities in Massachusetts are doing either feasibility studies or community-engagement projects as to, how can they move to have one of these geothermal networks in their community?

And we often get the question, is this database only for the US, or if we have a system in Canada, can it be there? And the answer is yes. So while the LeGUp research project is funded by Massachusetts Clean Energy Center and is focused on the demonstration projects in Massachusetts, this database is, really, open nationally and to projects in other countries as well.

So what are the different categories that we are acquiring in this database? Information about the buildings. We talked about the building retrofits in the previous session; about the system performance. That was the coefficient of performance that was referred to; about the emissions reductions; about the subsurface. That's where the borehole test information gets input; about costs; about the energy usage of the buildings before and after these geothermal networks have been installed; and about demographics. How many people are being benefited by these systems?

And these different categories can be also put into these three buckets of the thermal resources. What's happening in the boreholes, the distribution, the main loop, and what's happening in the buildings?

And now I'd like to close with one of the projects that HEET is working on. As I mentioned, this is the extension to the Framingham project that Eric mentioned earlier. This would be the extension to that project. And this is the original loop. Right now, we are planning a borefield right here, and the idea is that this is the very first extension loop of one of these systems that is connecting to an already installed and operating system. So this extension loop can be the model for how these systems can connect in modularity and grow throughout the city. So learnings about how to do those connections and grow these systems will come from this expansion project.

And with that, I'll hand it over to our next speaker.

[APPLAUSE]