NATHAN PHILLIPS: Where we are scientists-- I'm speaking as a professional scientist-- and the wall they we're hitting in communicating our science, and having things translate out of there-- I'm aware of a paper that was just published a few weeks ago that's on the importance of storytelling in science. And that they found that some published journal articles that had more of a narrative structure are getting cited more because people want to hear stories.

The dry, scientific, just the facts aren't working. They want to hear stories. So I want to share my story with you about how I got involved in this gas leak stuff, and then I'll hand the baton to Audrey, and she'll take it from there. But I started about this thing about the methane gas leaks as a citizen. This started in 2010, November 2010, for me, walking two blocks away from our home in Newton, in the Auburndale village of Newton, with my 10-year-old son, who was 7 or 8 years old at the time, Julian.

And two blocks away from our home, we came upon a gas leak, and someone who was working on gas leaks, Bob Ackely, Gas Safety USA. He's a 30-year professional, non-scientist, but that curiosity, what are you doing there. He looked like Ghostbusters with a metal detector, but it was a gas meter. And that's how I got involved in understanding this problem with gas leaks. So it was as a citizen.

And for me, that has started a process by which I've grown as a scientist citizen and come into a community science framework, working with Audrey and a whole group of other citizens in a community. And we've defined, I think, a community that crosses all types of boundaries to address the problem of gas leaks.

So from that first chance citizen kind of experience for me, till 2013, the science part of this developed that we mapped out over 3,000 of these gas leaks in the city of Boston. And then we followed it up with a study in which we estimated that the

amount of gas being lost in Eastern Massachusetts amounted to about 10% of the Commonwealth's greenhouse gas emissions inventory.

So that propelled a coalition of a community to then say, how do we move our political leaders to actually create policy to address this situation? So it's been a really fulfilling thing for me. And I will say that the science that we did, actually, and what we published in the journals, is not new.

The problem had been known about for decades. It's just that it was not known to the public. So we found citizen after citizens in different neighborhoods of Boston that would say, oh yeah, I know about a gas leak. I smell it every time I go walking to the store.

And so what we realized is that there were hundreds of anecdotes that were completely siloed from each other. And once we put a map out there, the community, everyone could see the whole thing collectively at the same time. And that was the only thing we did. We just made it visible.

And Audrey took it to the next step, and I'll pass the baton to you.

AUDREY SCHULMAN: OK, thanks. So I'm just going to talk for one second about what actually gas leaks are, since-- from pipes under the street, right? So a lot of our pipes under our street are really old. Here's a close up detail of back bay, a National Grid map, very small detail of it, and you can see that two of the pipes running down-- the 1860 one is a pipe from 1860 running down Beacon Street.

And two streets away running down Comm Ave is one from 1882. And those pipes are still in use. So we've got some really old infrastructure around. The problem with gas leaks is, they're potentially explosive. This is a picture of the explosion in Harlem about two years ago, I think 2014.

As they gas percolates up through the soil it, pushes oxygen out and trees actually need to breathe oxygen through their roots. So they can die. And then it's, as Nathan said, a powerful greenhouse gas. If you burn natural gas, it's turned into CO2.

If you don't burn it, it stays as methane. Methane, on a 20-year time frame, is 86 times more damaging than CO2. And finally, we have to pay for it because the

utilities can pass that cost on to us, the ratepayers. So it's sort of just insulting.

So when I read about Nathan's first, I run an energy efficiency nonprofit. And primarily, we used to work in the buildings of nonprofits to help them lower their energy bills and energy emissions. And so then, a lot with Mass Save, which is the state's energy efficiency state-funded program.

And so I read about Nathan's research when he surveyed all of Boston and found those over 3,300 gas leaks. And there was one line in the article that said that the amount of gas lost in just Boston alone totally erased all of the state's energy efficiency programs. And so I was that was it. I was in.

So I called up Nathan and said, how can I help? And he was kind enough to loan us his extremely fancy cool equipment, which is called the Picarro High Precision Natural Gas Analyzer. And we drove it all over Cambridge and Somerville.

So the yellow lines are where we drove-- or not, we Bob Ackley-- drove. And the spikes are where there is elevated levels of methane found. And it's sort of fascinating. We found no correlation between income level of neighborhoods. Because they're just-- you'll see them sort of somewhat clustered together because neighborhoods are built at the same time, generally, using the same infrastructure, same material.

Here's what I call the Alps of North Somerville. And we will be going, we'll be doing a leak survey in the fantastic van with the Picarro, so you can come along and see these on your own, and do some surveying on your own.

AUDIENCE: And smell it.

AUDREY SCHULMAN: Yeah, I mean we can also smell-- see what's fascinating to me, is like, near my house-- I would always bike along the Charles, and there was just one huge gas leak I would smell all the time. And I would always think, like, can't be because I'm looking around, and I'm seeing all the other people, and they're just walking by. So I always thought, like, I must just be making it up.

But then I called it in. And it was fixed. And after that, I never smelled it again. And that was so-- like we just don't believe our noses.

So after we did the Cambridge Somerville work, I thought, we've got to scale this up somehow. I found some arcane data on the Department of Public Utilities site, where they have to give a lot of information, including this, which-- over 300 pages of this sort of stuff. But you'll see that there's actually addresses there.

So as soon as I saw that there were addresses showing where the leaks were, I thought, cool, I can map it. So I mapped every gas leak in Massachusetts on Google Maps, so they're zoomable. Anybody can see them at squeakyleak.org.

The yellow map pins are where the leaks are unrepaired, and the reds are where they were repaired the previous year. And there's just a lot of them. And this was some of the-- really transformative for a lot of people, because then they could actually see where the leaks were near their home, near their kids school, near their business, et cetera. It made the, not only invisible visible, but it also made the global local.

And then I'll finally finish up with one last thing, which is some other parts of Nathan's research, as well as Margaret Hendrick, who is a graduate student, a postdoctoral student here at BU, is they surveyed a hundred gas leaks in Boston to find that just 7% of them emit 50% of the gas by volume. So that means-- as soon as you know that, you know, OK, the whole thing is to find and fix those leaks.

So through a lot of work, through all the different people who are interested in this, we managed to get, we helped to get a state law passed that those leaks will have to be found and fixed. And so one of the things we're going be doing is, at the hackathon, we'll hopefully be trying to figure out a method that's utility friendly for the utilities to measure the emissions off of each one of these theoretically high volume leaks.

Because if we don't have feedback for the system, they're probably going to find whatever leaks are convenient and call those high volume, and fix them. Because they don't know how to do it yet. Nobody does-- how to find the leaks. Yeah?

AUDIENCE: Have you checked on the response of National Grid or other utilities about their capacity to repair these leaks and also compare that to the new leaks that have emerged?

AUDREY SCHULMAN: Yeah, I met with a lot of other people. I met with National Grid on Friday. They say they've hired a whole bunch of new people, and they say they will have the capacity to do this, to fix all these leaks.

But what I want them to do is be transparent about their information so anybody can check that they fixed the right leaks, that the leaks were fixed, that you know, so on and so forth. Because the more transparency we have, the more researchers can look at stuff and citizens can, too.

AUDIENCE: Is there color coding near the [INAUDIBLE]

AUDREY SCHULMAN: No, in this case I was mapping, the pink ones are super-emitters, the high-volume gas leaks. The yellow ones are not. They're just normal gas leaks.

NATHAN PHILLIPS: Maybe I'll just add something about the community science and the opportunities for just being creative here. And I think it's just is embodied by the collaboration that Audrey and I have so well was, to do this study, we had to think of methods that were a little out of the box, a little bit about found objects fortuitous stuff.

Because there's no real kit to measure gas leaks that you can buy from some-- we were making this up as we go. So, for example, we found out that the best kind of chamber to measure what's coming out of man holes is a turtle shell from a sandbox. So it fits right over with a known volume, and you get that for $20 instead of having a machine shop make it for $1,000.

So there's that level of creativity. And just yesterday Audrey came up with the use of a pinwheel that might be able the mix the air that we need to measure. And it's the kind of thing that it's like, once she said that, it's like, yeah perfect, you know, a pinwheel.

So I think, in the hackathon, there will be opportunities to think about how we might go about doing something in a cost-effective way without doing it kind of like, you know, NASA does in their multimillion dollar laboratories.

Did you find-- you had your test going out with the truck. And then you had the DPU emissions data. Did you find any leaks that were not on the DPU National Grid list?

AUDREY Oh, yeah. With Metropolitan Area Planning Council, HEET, my nonprofit, has done a

SCHULMAN: survey of 15 different municipalities. We found 1.7 times more leaks than the utilities reported. And there's lots of other stuff that we found that makes us question the utility data.

NATHAN PHILLIPS: Paul.

AUDIENCE: Nathan, thank you [INAUDIBLE] question and a comment. Question, how do you know where the super emitters are now on the map, given that you're still in the process of measuring, as I understand?

NATHAN PHILLIPS: So we did this survey, the driving survey, that measured 3,356 leaks in Boston. But that's just detecting leaks. That doesn't tell us how much is coming out. So then subsequently to that, we went out with these chambers. Some of them were the turtle shell. Some of them were five gallon buckets with a slot cut out so it could go up to a curd. Because sometimes it comes out these complex geometries.

And so we did the laborious task of going back to 100 of those 3,356 leaks. And measuring how much just coming out using this chamber technique. And from that the statistics of those 100 leaks showed that seven of them accounted for 50% of the total lost gas.

AUDIENCE: So you've done a sample, but not comprehesive in any regard.

NATHAN PHILLIPS: Exactly. It might be more like-- if we get the whole thing over again, maybe pick another 100 leaks, it may be that 10 of them accounted for 50%, or maybe 6. Right, it was a sample. We know that it's not a bell shaped curve, and you've got an average leak. And some were a little bit higher. And some were a little bit lower. The distribution has a long tail. There's a few big ones. And a lot of small ones.

AUDIENCE: Now my comment is antecdotal, but it's true. In one town that I was working with, I won't name the town, the report was that when they had a gas leak, and the citizen complained enough, that they would exactly come out and fix the leak. But they didn't fix it well the first time. They sometimes have to come back and do it five times.

And the reason for that is that the gas companies get paid based on the amount of work that they do. So if they do the same work over and over again, the get paid

each time for it. So as you're engaging in this mentoring and monitoring, I do completely agree with the fact that some amount of oversight, or review, or checking up on ones that they say have been fixed would be a good part of the plan.

AUDREY SCHULMAN: Yeah, I think transparency and watchdogs are good for any industry.

AUDIENCE: Have you projected, just in a dream-like way, how much gas could be contained, and how much that would reduce any demand?

NATHAN PHILLIPS: So the best estimate that we have for amount of lost gas comes from a study that we did in collaboration with Harvard University, Catherine McKain, Steve Wofsy and their lab. And we estimated that a little less than 3% of the amount gas that's delivered into the service area is leaked out.

So that may not sound like a lot, the 3%, but because of the power of methane as a greenhouse gas, it has an outsized effect. And so that's why a 3% turns into about 10% of the total commonwealth's greenhouse gas emissions inventory at that level. So if you took that 3% leaked gas down to zero, you'd save the commonwealth 10% of its greenhouse gas emissions inventory. And about $90 million dollars per year was the cost of the commodity at the time that the study was done. Gas is volatile so that number changes.

AUDIENCE: But there's another observation in that, which is that 3% just in itself would reduce to peak load demand for gas by 3%. And when they talk about new pipelines, they're increasingly talking about a 5% definciancy in our peak load capacity level. So you can definitely mitigate the need for disposing the new pipelines if you were to come out and fix the leaks.

NATHAN PHILLIPS: That is an excellent, excellent point. We'll do here and then there.

AUDIENCE: Don't you have a problem of how you put all these dollars together, because there's $90 million dollars that I understand that ratepayers paying the leak gas that we don't know about. We don't know her. And then there's this fund that they have for fixing leaks. And then there's the mountain lines that they're using for developing a

new pipeline. And those are all coming out of different pocketbooks, I think.

And it seems that if you don't figure out how to put them together, how about-- OK, stop making us pay $90 million for wasted gas. Let's use the $90 million and fix the leaks, and then don't use the money that we're going to build a pipeline for and fix the leaks. So because this is all about money at the end of the day. It's all anybody cares about when you [INAUDIBLE] company, either that or the people being mad at them in the public, which ultimately is about the money issues as well. So have you thought about how you [INAUDIBLE] to put those together?

AUDREY SCHULMAN: One of the things--

AUDIENCE: [INAUDIBLE]

AUDREY SCHULMAN: Well, no. One of the things, I think, that would be most effective is if the utilities had to pay for the cost of the lost gas. If they did, as soon as they did, I think we'd see a massive amount of repair happening a hell of a lot faster. That that's what happened in Texas. They passed a law saying that. And within-- and I'm going to get this wrong now-- within three years, they had 50% of the leaks fixed. So it's just incentives.

NATHAN PHILLIPS: What I heard was on the day that the legislature, the end of the legislative session last year, when the energy omnibus bill was finally passed at-- whatever-- two o'clock in the morning, I think that's when the provision that would include the incentives, the cost of the lost gas gets shipped into the companies was gone. So there's a lot of logging going on over who's paying for the lost gas. That's a problem.

AUDIENCE: Well, but what you're saying is that's the first place to start, start by not taking the $90 million and using it to fix the leaks, taking $90 million and say ratepayers you keep it in your pocket until the gas company's paying for it. But that's a really simple-- any legislator can figure that out, or any member of the public could figure that out. You make it really simple.

NATHAN PHILLIPS: That was the provision [INAUDIBLE].

AUDIENCE: Well, I know. But the public [INAUDIBLE] in the middle of the night is that the public is asleep.

NATHAN PHILLIPS: Right, exactly.

AUDIENCE: Just when they emit the gas.

AUDREY SCHULMAN: Yep.

AUDIENCE: So with the infrastructure being this old, I'm worried if you fix the leaks in one spot, because it's [INAUDIBLE] of pressure, then it will just create leaks in other spots. So has there been any study of what happens when you fix leaks?

NATHAN PHILLIPS: Do you want to take it?

AUDREY SCHULMAN: We both can answer.

NATHAN PHILLIPS: You go first.

AUDREY SCHULMAN: I think a lot in Boston, a lot of the pressure in the pipes is about half pound per square inch. So fixing a leak in one spot is really not going to make any discernible difference. And the pressure's supposed to be maintained evenly across the system, otherwise the people at the end of the line would not be getting any gas. So there is the question that hammering into the ground and moving stuff could potentially displace a little bit of-- move the joint of the pipe a teeny bit, although I wonder if that's actually true. Your thought?

NATHAN PHILLIPS: Yeah. It's a pressure-regulated system. So if you patch a leak, they're just going to turn down the flow to maintain the-- so it's not going to induce a higher leak rate elsewhere. But it is a Band-Aid solution to patch, because every 12 feet on a cast iron pipe is a joint.

And you often have a series of leaks, so then you're facing the question, do you repair or replace? And there's a whole other set of considerations in terms of money. Cost. And I'm still very ambivalent about whether we should triage the system that we have as we transition to electrifying our heating system and making the transition to a clean energy-- a non-fossil energy-- or do we actually invest in replacing pipes that are going to be down for another 30, 40, 50 years? So, it's a tough call.

AUDIENCE: Is the technology-- are they discussing technology and the composition of pipes that would be more long-term and less susceptible to--

NATHAN PHILLIPS: Not really. Plastic is what's being put down now. And it's not leaking because it's new. They don't really know, as far as I know, how acids in the soil and weathering and all of these kinds of things-- what the influence on the plastic will be. There's nothing inherently wrong with cast iron pipe, except it's old. If it was new cast-iron pie-- of course, that's more energy intensive to make-- but it's really just the age factor, I think.

AUDREY SCHULMAN: Although I just want to say, I keep thinking dentists can come up with stuff that can fix teeth that are in saliva and acidic stuff and under incredible pressure and stuff like that. Why can't anybody come up with something that we could just coat the pipes on the inside? So, you know, go ahead.

AUDIENCE: I was curious how broad a number of the people who have been doing this sort of work, you might have across the country-- other cities around the world-- are you in touch with folks?

AUDREY SCHULMAN: Mostly Massachusetts.

NATHAN PHILLIPS: You know, the study we did in Boston was the first study of its kind in the world. So things started bubbling out from here, literally I guess. But I think there's been a very strong what we call the gas leak's allies. The working group that we have that meets-- is it once a month or once a week?

AUDREY SCHULMAN: Twice a month.

NATHAN PHILLIPS: Twice a month. This core group. And Mothers Out Front has been amazing in terms of, essentially, keeping that and growing that network. You know, you're seeing research communities and other people in the science community doing this work in other locations. I haven't quite seen the network expand the way it has here, but the other interesting thing, I think, is that we're also realizing that there's this urban to rural interdependency.

And so the pipeline issues connect us with, you know, rural Western Massachusetts. And the Kinder Morgan proposed pipeline going in there. The pipeline that connects us, in Boston, to New York, New Jersey, Connecticut. The Algonquin Incremental Market. The Spectra pipelines. That we are connected across the rural and urban communities by the same infrastructure.

So I think that the fossil fuel infrastructure expansion physically starts to organize a social network of resistance that is co-located with that. And that we're stronger when we, as people, make the connections that are being made physically, to resist it in a concerted fashion.

AUDIENCE: One more just quick technology, though. I read about it in [INAUDIBLE] Apparently there's a new kind of robot that they have.

AUDREY SCHULMAN: The CISBOT? Yeah.

AUDIENCE: That they can put into the pipes-- that can fix leaks from inside the pipe, without having to shut the gas line down and without having to dig up the streets. But they are phenomenally expensive robots, I guess. So that struck me when I read about it as a significant ray of hope that technology could once again come to the rescue here, so to speak. If we had more robots, then it might not be so economically difficult for the utilities to deal with the 20,000-odd leaks.

AUDREY SCHULMAN: Yeah. Yeah. That robot-- they have to dig down to put it in, and it only has a limited expanse. So it needs so much improvement, it's stunning to me. Maybe.

AUDIENCE: I'm from Chile. I work for an oil company in Chile. It's an operation company, and they'll have pipelines in the city, but only we extract oil and gas. We detect a lot of leaks of methane in operations, and it's really, really difficult to solve the problems.

Sometimes you can measure it in one corner, but the leak is two blocks to the other side, because [INAUDIBLE]. And from the perspective of the oil and gas utility companies, only the first-- the priority is for the explosion.

AUDREY SCHULMAN: Yeah, of course.

AUDIENCE: This is the problem. I can say 2%, 4%, 5%. But that's OK. It's the effort to do the business. When the general manager or the manager of some assets know that he has a waste-- structural waste in the area-- he's really charged with this [INAUDIBLE]. If you put this information at an address, they are ready to move forward.

NATHAN PHILLIPS: Yeah.

AUDIENCE: Something happened, because they know. Something happened, [INAUDIBLE] I work for the oil company, but I know when you have risk, [INAUDIBLE], you need to take this risk into account. [INAUDIBLE]

NATHAN PHILLIPS: I would agree with that. You know, there's a nexus of issues associated with the gas leaks at the local scale, explosion risks, risks to vegetation and trees-- that's local. Air quality degradation is more of a regional thing. And then there's the global issue. And they're all issues, and they should all be considered. Because after our Boston study, I remember that I was on Greater Boston, the TV show.

And the co-panelist was the Secretary of Energy and Environment for Massachusetts. And he said, thank you for the work you're doing, because you're giving me a way to make this issue. You know, because the explosion issue allowed him to push forward the climate change part of this. So, yeah, that's consistent with what you're saying.

AUDIENCE: When you [INAUDIBLE] have you ever been talked to by somebody walking along?

NATHAN PHILLIPS: All the time.

AUDIENCE: So, why is the situation definitely like this?

NATHAN PHILLIPS: Well, he's been-- Bob Ackley has been a lone voice for the last 30 years who has been struggling to be not just the only person who has been calling this issue out. And I think he feels-- I don't want to speak for him, but-- when people started to join with him, that's when I think he started to feel some level of vindication. That it's not just me.

So as this network has grown larger, I think the changes-- the policy changes are happening because it's just everyone seeing that this is a problem. He's been struggling on his own for-- he worked for the gas companies to do leak surveys. So for much of his career, he was basically a worker for the gas company. Here's the leak reports. Here are the gas leaks. And he would notice trees were dying, and that the gas companies were not taking that seriously.

They're like, well, we're not going to worry about that. And that really bothered him. So at some point, he defected and went out on his own because the trees were-- he felt like his work wasn't being taken seriously, and so he struck out on his own. It's one person and these massive investor-owned utilities that has made it very difficult.

AUDIENCE: I saw your latest. You tweeted it. In Dedham?

NATHAN PHILLIPS: Yeah.

AUDIENCE: Is that a new line?

NATHAN PHILLIPS: Yes. Yes, that's the West Roxbury lateral pipeline.

AUDIENCE: And now it leaks?

NATHAN PHILLIPS: Yeah, so I'm going to just show it. So we went out on Monday. A while back. Me and myself and my son. So you see these spikes. Something like this, right? You see the red spikes. And this is on a stretch of-- it's East Street in Dedham. Very close to Dedham center, right by where the Boston and Providence turnpike-- whatever it's called-- fast-moving thing.

That stretch of East Street, which is about an eighth of a mile, is part of the pathway

of the new West Roxbury lateral pipeline, which is a 750 pounds per square inch, two-foot diameter transmission pipeline spur that has been part of Spectra Energy. It's their project to increase the gas flow into Boston. And what's really disturbing about what we found on Monday is that this is where, in the last year, they've trenched that entire roadway and put this new pipe.

Then they covered it up, paved new paving, new sidewalks, but they left leaking pipelines-- the low-pressure distribution pipelines-- they left them leaking, and that's where there's all of these leaks, one after the other. And so it was a missed opportunity. If you're going to dig up the street, don't leave hundred-year-old leaking pipelines there. Fix it. There's already patches, now, in this new pavement, which are going to mean potholes are going to form soon.

AUDIENCE: Are these leaks the spokes that run off of the main pipeline?

NATHAN PHILLIPS: They're the old distribution, low-pressure pipelines, that should've been fixed at the same time that they put the new pipeline in.

AUDIENCE: So two questions. One, what's the name of the instrument? Are we going to learn more about it? And then two, how does the EPA rule [INAUDIBLE] impact any of this work?

NATHAN PHILLIPS: OK. Yes, you get to go on the 31st.

AUDIENCE: I'm out of town, darn!

NATHAN PHILLIPS: Well, we can arrange something on another occasion, I'm sure. But we get in the van, you can see that the picture that Audrey showed-- it's called a cavity ring-down spectrometer. That's the technology. It's a laser technology. It has a little chamber in it that is evacuated down to about one fifth of a whole vacuum, so it's got about 20% of the air molecules that normal air would have in it. So it's pulled down to that level. It's about a one-liter chamber.

And in that chamber, there are three mirrors that are pointed at each other. And then they pulse a laser into that that is tuned to the unique absorbance span for methane. And that pulse of laser bounces around the three mirrors. That's called ringing down. It's ringing in that thing and bouncing around. And the more

concentration of methane there is in that air, the faster that pulse will decay to zero, because the molecules of methane are absorbing.

So if there's no methane in there, it'll take a long time for that thing to decay-- that light pulse. So that's the basic method for the cavity ring-down spectrometer.

AUDIENCE: Did you build that, or [INAUDIBLE]

NATHAN PHILLIPS: The manufacturer for the instrument we use is called Picarro, and they're based in Santa Clara. The technology and the patents were mostly from Stanford University scientists. There's another firm that's doing the same basic kind of technology called Los Gatos out in that area of California as well. There's a few different flavors of this kind of method.

AUDIENCE: So do you think that there's-- because this is an expensive instrument. How much does it cost?

NATHAN PHILLIPS: This one was about $60k.

AUDIENCE: So I'm thinking more in the community science direction. I think cheap lasers are becoming real, right? While maybe the mirror configuration might be the expensive piece there, is there a way to combine the pulse lasers and, using data, and other techniques to get more cheap results?

NATHAN PHILLIPS: Well. Do you want to answer? I'm doing all the talking.

AUDREY SCHULMAN: Go ahead. I'm happy.

NATHAN PHILLIPS: I'll just say that I'm going to come back to some comment there. MIT, the people here? The robot thing? Yeah, we could have swarms of little tiny robots fixing pipelines, and MIT is a great community to come up with those types of solutions. And then, as well, low-cost sensors that could do this would unlock opportunities for a much wider group of people to be doing this stuff.

AUDREY And I don't think they'll have to be expensive. Like there's this one technology

SCHULMAN: where it's just something that goes on the pipe seal, between the two joints, because that's where most of the leaks come from. And if that link is broken, it tells the office. That's simple. Let's do something simple like that. That's not expensive. That's not hard.

AUDIENCE: You can detect the leaks in operations, we use infrared camera--

AUDREY SCHULMAN: Yeah.

AUDIENCE: You can see the flows, you couldn't measure--

NATHAN PHILLIPS: Right.

AUDIENCE: Less flows, or more--

NATHAN PHILLIPS: Yeah. More qualitative--

AUDIENCE: But you can see, [INAUDIBLE]

AUDIENCE: Very briefly mentioned that the town of Brookline has now passed two resolutions opposing natural gas pipeline expansion in Massachusetts. We're the first community to do such a thing where a pipeline was not scheduled to go through in our boundaries. And we'd be happy to-- Brookline town meeting-- to look into the issue of somehow pressuring the gas companies to more speedily address some issues and leaks in our town. Kind of a general pressure thing. [INAUDIBLE]

AUDIENCE: I think that's something that Mothers Out Front is already doing.

AUDREY SCHULMAN: And we want that. The more pressure they have, the more everybody takes it seriously. As it should be.

PROFESSOR: So, we have three more sessions on the 23rd, which is the coming Monday. We have a hack-a-thon. and And again, we will be playing with two different ways of hacking with this data. One is more data-centric, more code-centric. The other might be more design charette-centric. So--

AUDIENCE: Visualizing.

PROFESSOR: So visualizing the data. Again, depending on what your interests are, you can do one or the other. Do sign up on the CLIAP site, if you haven't already done so. The next session, on the 31st is driving around town, and smelling. I think that's going to be what we'll be doing. And finally, on the first, we will come back together and say, what can communities and citizens and scientists do with this? Can you take this to court? So, how do you build an ecosystem that addresses these challenges, and not just do it individually?