ZEYNEB MAGAVI: The more we can measure volume, the more we'll be able to follow the recent law we got passed that says they have to prioritize the highest volume for climate hazard. So that's a new law. They never got to do it, so now they need the information, and they've never gotten [INAUDIBLE] cared about explosion risk.

The president of Eversource Gas in the meeting recently, he was very talkative, and he started talking about how there's new research and development in natural gas restructure in the US period. They don't do it. No one else does it-- that they go to France, England, and Germany, because they invest in R&D for this field, and they find out what's going on. And they're way ahead of us. They're way ahead of us over there, which was really interesting to me to hear.

And they, in that room, there was no doubt they have no idea what the problem is. They don't measure it. They don't document it. And from what we can tell so far, there's no acceptable norm on how to measure it. So there is these two really kind of kludgy methods to me, and then there's-- I mean, we're trying to invent a method that's actually the utilities can go out and do. Because the guys on the ground have to do it.

DAVID OLIVER: You know what's kind of funny--

ZEYNEB MAGAVI: Yeah?

DAVID OLIVER: --is that you can find it when it's, you know, sort of naturally occurring and worth something to us, but we can't find it when it's going through our own system. It's sad. And it's three feet below the surface.

ZEYNEB MAGAVI: Piece of data on volume-- did you tell them about the Harvard study?

AUDREY SCHULMAN: Yeah, I did earlier. So we know how much there is from the top down from the, you know-- in the atmosphere, we know how much gas there is, but we don't know where the most-- you know, that 5%-- 5% to 7% of the worst gas leaks are. So this is-- we have to come up with a method to-- when they're about to repair the leak-- after they've pinpointed what they think is a high-volume leak, how do we--

SPEAKER 1: Verify that that's a [INAUDIBLE]

SPEAKER 2: Do we have on that global thing, gas in, gas out?

[INTERPOSING VOICES]

Over time, by--

ZEYNEB MAGAVI: It doesn't match the outside.

SPEAKER 2: Well, of course it shouldn't. Leakage is def-- but how is that changing all the time?

AUDREY SCHULMAN: So the utilities have crappy data. They have crappy meters. They have crappy everything. So they have no-- so your meter at your house is not a very good, you know, temperature changes--

SPEAKER 2: It's right, plus or minus x, where x is too big a number.

AUDREY SCHULMAN: Yeah, the margin of error is huge. What this is-- just to give the idea that we've come up with after months of working with the utilities and ripping information out of them is to use these two instruments when they-- so they pinpointed-- so this is that point that they pinpointed the high volume-- what they think is a high-volume leak. And in order to do that, they drill holes in the streets. So they found using this instrument and another one-- they found that there's gas in the area.

And they stuck this, with a probe on it, into the soil, and they found sort of the leak extent, the area in the ground that has a lot of gas in it. And then they drill holes in the streets. So maybe, let's say, it goes from 21 Smith street to 25 Smith street, and then they drill holes in the street along there and use this again. They put the probe in each of the holes in the street over the pipe. Should I draw a picture? Does this--

SPEAKER 3: They don't drill into the pipe-- just over the pipe.

AUDREY SCHULMAN: Over the pipe. And they stick this probe in and find out where the highest percent of gas is.

DAVID OLIVER: So they're working with a map of the pipes, right?

ZEYNEB MAGAVI: They usually have a printed out, like, sketchy little map with a line, and it's approximate. I've watched them do it. It's close. They kind of know where their pipe is.

AUDREY SCHULMAN: They drill holes in the street. They take this thing-- and stick the probe in those holes and find out where the highest gas is-- the highest percentage of gas is. And so, then they excavate at that point, because they assume the leak was right there.

SPEAKER 3: And they admitted how often they're right when they do that?

AUDREY SCHULMAN: They do not share any information at all of any kind.

SPEAKER 3: All right, the latest theory--

AUDREY SCHULMAN: They believe this method works very well, but anybody who's looked at streets, you'll see lots of, like patches, right, when at any time, they-- so sometimes they screw up. How often? We don't know.

SPEAKER 2: Go look at the [INAUDIBLE] wells. Just go look at it. They just repainted it, and it's already--

AUDREY SCHULMAN: So if they're confused. If say, this is 100%, this is 100%, this is 100%, they don't where the leak is, what they do is they use this. They stick that in down into the hole that they've-- one of these holes. They put a compressor in this side, and they open this valve-- so, already, I guess it is open-- so that 80 pounds per square inch of air is being blown across here. This is a hollow tube, so it sucks air up really quickly. And this plunger gets pushed down, so that it's sealed to the street. Does that makes sense?

SPEAKER 3: Mhm.

AUDREY SCHULMAN: So air is being pulled out, you know, really quickly. It's a vacuum-- drags all the gas out of the ground, and that way, they vacuum all the gas out from this entire area. And then they use the CGI again to this thing to see where the gas is coming back up fastest, and that's where they excavate to fix the leak. Does that make sense?

SPEAKER 3: Yes, I get it.

AUDREY SCHULMAN: So we want to use this tool in a different way to find how big the leak is. So instead, once they pin the leak-- once they found the leak, we want to take this and put it in the ground. Again, attach a regulate-- a compressor here, blow the air out, and put a combustible gas indicator here to see what the percentage is of gas coming out of it. By doing that, we will know how much the flow-through, right-- because it's 80 pounds per square inch coming out of here, and we'll know the percentage of gas.

And using that, we can get a rough idea of how much, how big the leak is, how much gas is coming out and how quickly. Does that make sense?

SPEAKER 4: [INAUDIBLE]

AUDREY SCHULMAN: This is a purger. We only learned about it on Friday. I am so excited to have it here.

SPEAKER 5: It's called a diffuser.

AUDREY SCHULMAN: Diffuser.

DAVID OLIVER: The message that you described sounds like it will tell you roughly how much gas was trapped in the area that you were evacuating, which might not be adjacent to the leak-- it could travel and then get trapped.

AUDREY SCHULMAN: So you have to wait for a steady state reading.

DAVID OLIVER: True.

AUDREY SCHULMAN: So the gas will pocket up underneath the pavement, because gas is lighter than air. And so, you will get a sort of pool of gas right up against the pavement, and for the first few minutes, you're going to pull out that residual--

SPEAKER 2: So don't you also [INAUDIBLE] nature of that substance-- sand, clay, dirt.

AUDREY SCHULMAN: Aha, yes. Whether it's wet, whether it's dry, and yes, the temperature is--

SPEAKER 2: --what the nature is of that diffusing material.

AUDREY SCHULMAN: To get an exact measurement, yes, we would. But the high-volume leaks are 10 times bigger-- more bigger than that the low-volume leaks, so got to--

SPEAKER 2: So that shouldn't matter --

AUDREY SCHULMAN: So you've got an order of magnitude difference, so all that stuff hopefully will be-- I mean, we'll have to find out. But I think this method will work enough to get us in the ball field, so that we can say, high volume, not high volume, higher-- you know, we just want to bucket the leaks, basically, categorize them.

DAVID OLIVER: I got a question. So they're fixing-- they're trying to fix what will be categorized as high-volume, right? They're not trying to fix everything that they find, right?

AUDREY SCHULMAN: Right, this law that got passed is simply to fix the high-volume leaks.

DAVID OLIVER: Yeah. But, you know, when they go and they do their testing, and they get a series of readings, they basically guess where they think the high volume is, fix that joint, and then they forget about what's 12 feet that way and 12 feet that way.

AUDREY SCHULMAN: Yes. You mean there could be another leak? Is that what you're--

DAVID OLIVER: Well, sure. I mean, in the case of they picked the wrong one, and there's still a high-volume leak there-- and it's that that doesn't get found until maybe they come back to the same spot.

SPEAKER 2: Well, back up. How do they determine? Is there another step once they picked the highest volume and dug to the ground? I've watched them-- a physical test of identifying a real leak-- you know, pipe, gas spewing out at the actual leak once it's uncovered. Is that a standard process, or do they-- to your own point, there may only be one leak. There's a physical identification of the leak once they've decided to take action.

AUDREY SCHULMAN: Yes. But we can--

SPEAKER 2: There could be five or six of them.

AUDREY SCHULMAN: We have to assume they somewhat know their job, so they can-- they'll find the leak, and they'll fix it. And afterwards-- and a lot of these might be weak complexes, which means many leaks along the way in which case the whole area, that 21 to 25 Smith street is a leak complex, and they have to fix all those leaks. So they should use this method to measure the emissions off of each one of those sub-leaks and then add them up into one high-volume leak. So the utilities use the word leak in a very different way than we do, which is like leak location.

So then we will be adding up all the emissions, which means that this method should not suck the gas out of more than one leak. Or if it does, we will have to figure out how to--

DAVID OLIVER: Yeah, I think it might. I would imagine that if you have gas pooling, or you have multiple leaks, there's going to be some connection between them?

AUDREY SCHULMAN: Yeah.

DAVID OLIVER: So if you create a volume-- a vacuum here, it's going to start pulling from the other.

AUDREY SCHULMAN: Yeah. So one of the things we possibly can do is there's going to be somewhere it's just going to be one leak, and using that data, we can figure out what the average leak is. And therefore, when we have a leak location, a leak complex, we can hopefully figure out how much overage there is-- how much excess gas we're pulling in from the others. Yeah, so the things I think we need-- I think we need two things. One is some sort of regulator to step this down, so the compressor coming in at 80 PSI in.

ZEYNEB MAGAVI: Well, the other thing is this says 80 PSI, but the guys in the truck say their compressor is 120.

AUDREY SCHULMAN: Yeah. So some sort of--

DAVID OLIVER: [INAUDIBLE] crank it up all the way up though.

ZEYNEB MAGAVI: And so, how do we make sure what-- because if we don't know pressure.

AUDREY SCHULMAN: If we don't have the known rate of speed across here, the data's crap. And we also don't want to vacuum up higher than the operating pressure of the pipe. So the pipe--

DAVID OLIVER: Because then you'll just draw it out of the pipe?

AUDREY SCHULMAN: Right. And it will be increasing the leak, and it will be crappy data again. Does that make sense?

ZEYNEB MAGAVI: Yeah.

AUDREY SCHULMAN: So these pipes can be anywhere from 0.5, that we're going to be working with, to 60 PSI, so 120 times-- so that's a difficult problem on its own. So we need some sort of regulator that will not increase-- you know, that probably is going to at 0.5 PSI, so we have to step this down enormously. So that's one problem, and I don't know if that's true. So I am not a scientist, so anybody who wants to--

DAVID OLIVER: Yeah, I mean, putting 80 PSI on that doesn't mean you're going to create an 80 PSI-- a negative 80 PSI vacuum, but there is a correlation [INAUDIBLE]

AUDREY SCHULMAN: OK, so what's the regulator here? How far do we have to step it down? What regulator, I need the doohickey that goes here to be able to step it down in a correct-- you know, in a way that it will not--

ZEYNEB MAGAVI: We need to control this--

AUDREY SCHULMAN: Yeah, and preferably just one setting, because these guys are going to be like, you just turn it on. Just do it. You know, I got to go for lunch.

DAVID OLIVER: Without modifying this?

AUDREY SCHULMAN: Yes, without modifying it. So it's going to be another doohickey. They're going to take this off, put the other doohickey in, and crank it on.

DAVID OLIVER: Because if they're-- yeah, if they're-- if you measure PSI here, then you're getting sort of a direct reading of the vacuum that you're creating, right?

AUDREY SCHULMAN: Yeah. So there is this valve, but we don't know if this valve is working.

DAVID OLIVER: Yeah. But, I mean, if you take the 80 PSI that you're putting in, you can calculate what that vacuum should be, so, you know, that could be simply a lookup chart or something like that for them.

AUDREY SCHULMAN: Yeah, we got have it-- you know, the whole thing is to make it so simple they just write down one number in the end-- error-proof, and you got to imagine. You've seen the contractors out there, right? This is not of their interest. They are doing this unwillingly, so we have to come up with a super, super simple method that can just bucket the leaks.

ZEYNEB MAGAVI: So there seem to be two techniques in the literature for volume measurement of gas. One is the chamber method, which is a closed sample and measured over time to get flow rate, and the other one is the flow rate, which is the rate of air movement-- you know the speed of air movement, and then you take one point sample. So the idea of this, we're actually going to be doing the chamber method on the leaks in the street. It's error proof.

And the idea of this is to try to get the flow-rate method measurement, so maybe we will also take some capsules that--

AUDREY SCHULMAN: They're not going to go for it.

ZEYNEB MAGAVI: They're very concerned. They're very risk-averse. They're very concerned about any capturing of gas.

AUDREY SCHULMAN: I meant I can't tell you how unusual it is that they are willing to do this. This alone is a stunning step forward.

DAVID OLIVER: Are these guys employees of the utility companies or subcontractors?

AUDREY SCHULMAN: Probably both.

DAVID OLIVER: OK. Is there a possibility of kind of developing somebody-- I mean, developing a core of trained professionals who would then contract with the utility companies who do this?

AUDREY SCHULMAN: So we're going to do a training basically with the utilities to teach them how to do the technique, but first we need to come up with the exact technique. And that's like in three weeks, so we're on a deadline.

ZEYNEB MAGAVI: And we're trying to figure out a way to incentivize it for the guys. We've been talking to them, and actually they're not all the same age. There's a wide array. Some of them are actually pretty interested, so to be fair. It seems like we have three different ideas so far. Does that make sense? We have the one we just said at sensor-- what are we calling this part of the doohickey? Inlet.

DAVID OLIVER: Inlet--

ZEYNEB MAGAVI: --into inlet two. Two is no sensor used pressure to pressure, and 3 is attach--

SPEAKER 2: Sensor-dependent output.

ZEYNEB MAGAVI: --sensor to output. OK, so each of these definitely have pros and cons. That's where we're at, right?

SPEAKER 2: Yeah.

DAVID OLIVER: Number two is also doing the sort of baseline measurements, correct?

SPEAKER 2: Yeah, that's the pros, and we don't know if two works. I would argue that if two works, that meets your operational issues better than anything else, because you-- all you're asking them is to read this meter That's the change in process, basically.

DAVID OLIVER: The good thing about one is that they see something that may alarm them, as opposed to-- well, actually, if they do enough for the calculations, and they may see the pressure reading, and say, oh, something's wrong. But if they see something new that says, ooh, problem.

SPEAKER 2: Yeah, no, I'm with you, but--

DAVID OLIVER: The red light goes on.

ZEYNEB MAGAVI: Should we go through a new pros and cons?

SPEAKER 2: It might be worthwhile.

ZEYNEB MAGAVI: Or is this the kind of thing where maybe we should just test all of the options. Like, work them out. Break into a group and work out what we would need to do to test it.

DAVID OLIVER: Or, you know, you said the pressure variation in the pipes is 0.5 PSI to--

ZEYNEB MAGAVI: To 60 PSI.

DAVID OLIVER: --to 60, jeese.

ZEYNEB MAGAVI: And that's just the pipes that we need them working on.

DAVID OLIVER: Don't be standard or OK.

ZEYNEB MAGAVI: So that's one of the reasons why this is a hard problem. That's why I want to step this down, so that we don't ever, like, pull the gas out of the pipe faster than the leak would normally be.

AUDREY SCHULMAN: So should we break into groups to look at these three possible methods and sort of come up with some of the questions, the experiments that need to happen, the products associated?

ZEYNEB MAGAVI: A next-steps list?

AUDREY SCHULMAN: Yeah.

DAVID OLIVER: First of all, they can control that. They can control the input pressure, so they can control the pressure drawn, and there is ton of resistance in the soil. So in order to do that, you would have to really crank up the pressurized--

SPEAKER 2: I don't know. I'm just--

DAVID OLIVER: I don't-- you know--

SPEAKER 2: I don't know if I'm even in the right ballpark.

DAVID OLIVER: I think there is so much resistance in the soil.

SPEAKER 2: If there's enough resistance, it's not a crack, and then I don't care. But if it is, if it's close--

DAVID OLIVER: Maybe it's dried sand. The other thing that's going to happen is where you have a leak, you're normally going to have some diffusion in the soil so they're going to be finding wherever their path of least resistance is, but then you introduce a vacuum where it's-- you're going to want to draw the gas towards that? Whether the leak is here, or it's over there.

ZEYNEB MAGAVI: Right. So maybe the distance between the leak and our drill hole doesn't matter, and maybe it does. Sorry, if I made it--

SPEAKER 2: What is clear about this is this all eminently testable.

ZEYNEB MAGAVI: Yes.

SPEAKER 2: This is all experimental research and try it and-- but it doesn't sound like you have [INAUDIBLE]

DAVID OLIVER: So to do these--

SPEAKER 2: That's a plus.

AUDREY SCHULMAN: So there are, like, the Gas Technology Institute that's [INAUDIBLE] and there's the Montreal Research Institute?

ZEYNEB MAGAVI: And they have a buried pipe in the ground. You can turn the valve flow.

AUDREY SCHULMAN: But that costs money to do that in place and test things. Whereas, you know, a small non-profit --.