Automated Voice: The broadcast is now starting. All attendees are in listen-only mode.

Cedar Blazek: Hello, everyone, and welcome to the final edition of the Better Buildings Summer Webinar Series. In this series, we profiled the best practices of Better Buildings Challenge and Alliance partners and other organizations working to improve energy efficiency in buildings. While this is the final installment of the summer series, stay tuned for more information on our 2020-2021 series launching next month. Today's session is titled Succeed with Submetering: How to Make the Business Case. And we are going to get started right away. Next slide.

I'm your moderator, Cedar Blazek. I lead the US Department of Energy's Better Buildings Alliance, which brings together commercial building leaders to develop and share innovative and cost-effective solutions to advance energy efficiency. Thank you all for being with us today. We have a wonderful session prepared and some fantastic speakers that we're going to introduce in just a moment. Next.

If you hadn't guessed, today's presentation is all about submetering. Submetering building utility usage means measuring water, gas, and electrical usage below the level required for utility billing beyond the utility meter. This could mean recording usage data for individual buildings within a multi-building complex or campus, individual tenants or floors within a building, individual systems within one building, or even individual devices within one facility or zone.

When preparing this webinar today, I couldn't help but rely on the old idiom, "You can't manage what you don't measure." As energy and facility managers look to make better energy and water efficiency decisions for their buildings, granular data becomes invaluable. Submetering can reduce waste and costs, improve operational efficiency, and change user behavior in positive ways. However, submetering still isn't as widespread as you would expect. There are numerous barriers to adoption, including high costs, inaccurate performance, no clear link to return on investment since they don't directly save energy, and a variety of other barriers.

Our speakers today will present on their approaches to submetering and we'll hear from a speaker at one of DOE's national research laboratories on DOE's investments in submetering and its bright future. Next slide.

Many of our Better Buildings partners have identified submetering as a key focus area for their water and management strategies. To accompany this presentation today, we have developed a guide for helpful submetering resources available through the Better Buildings Solution Center. This guide contains information on the specification and procurement of submeters, how to make the business case for investment, tracking and analyzing submeter data, and highlights a few success stories and case studies. We hope that you will use this guide to your advantage. Next slide.

We're excited to announce that today we're going to be using an interactive platform called Slido for Q and A. Please go to Slido.com using your mobile device or by opening a new window on your Internet browser. Today's event code is #DOE. If you would like to ask our panelists any questions, please submit them any time throughout the presentation in Slido. You can take a specific presenter's name before the question if it's directed at them. We'll be answering your questions near the end of the session. You can select the thumbs-up icon for questions that you like, which will result in the most popular questions moving to the top of the queue.

We're going to start things off today with a Slido poll. So I'll give everyone a moment to join us over at Slido. If you have any issues getting there, please chat our tech support team through the GoToWebinar chat box. Okay. So, what we want to know for the first poll today is what industry do you represent? Again, you can go to Slido.com, start entering your answers. And Marissa, if you want to start to roll over to the results, we can take a look at who we have today.

Okay. Thanks, everyone, for submitting your responses so far. Quite the variety. Looks like we're mainly represented by state and local governments, as well as industrial and manufacturing partners. We have a number of folks that are consultants or from the federal government, as well as some non-profits and folks in K12 and higher education. We're still having some results roll in, but pretty consistent across the board.

Great. Well, thank you so much for joining us. I'm really excited to see that we have a number of state and local governments. Obviously, we will have a state speaker presenting today, as well as someone from higher education, so those sectors will be well-represented. Marisa, let's go back to the slides.

Here's a brief glance at our agenda today. We'll have three different speakers, and we'll be doing Q and A using Slido at the end of the presentation. Next slide.

We have a great lineup of presenters. Today we'll be hearing first from David St. Jean at the Maryland Department of General Services. Steve Kolb will be up next from Towson University. And we'll wrap things up with Ted Bohn at Argonne National Laboratory. I want to remind our audience that we will hold questions until the end of the hour. Please send in questions through Slido by going to Slido.com and typing in the event code DOE, and we'll try to get to as many of them as we can. The session will also be archived and posted to the Better Buildings Solution Center for your reference. Next slide.

All right. We're going to start things off with David, who is going to share his primer on the Maryland Energy Program. Mr. St. Jean joined the Maryland Energy Administration to help draft the state energy assurance plan. While at MEA, his projects included energy code adoption and the state building energy efficiency. He represented MEA at the Maryland Green Building Council, and on the PSE Smart Grid Working Group.

In late 2015, he left MEA to work as a project manager at US DOE's State Energy program, where he managed the cooperative agreements with several stakeholder groups, including Naseo, NGA and ACEEE. Mr. St. Jean was invited back to work for the state in early 2018, where he currently manages the Department of General Services Office of Energy and Sustainability. David, the floor is yours.

David St. Jean: Thank you, Cedar. And welcome, everyone. Good morning or good afternoon, depending upon where you're calling in from. And as Cedar mentioned, I will try to get us started on basically from ground zero, from a perspective of a state agency that has very little submetering installed to what we're trying to do to meter more of our buildings. Next slide, please.

So let's start with discussing first where we are with the data that the state currently collects on its energy usage. And that all comes from our Maryland energy database. So it's essentially a utility database that tracks energy usage, mostly through utility bills of all energy types. So, everything from electricity, to natural gas, to oil, steam, et cetera.

And it's an ongoing project. We've been working on this database for 12 years, now. I think originally for the first year or so, it was a series of spreadsheets that had been sent to the office by accounts payable officers throughout the state. And that became unmanageable very quickly. So we issued an RP, set it up as full-fledged database on an Internet-based platform. If anyone wants to go to the database itself, there's a public-facing side of it, and the link is there on this page.

So, the database was initially set up to help us purchase energy; electricity and natural gas. And we do this using some hedging strategies, including a lock in index and a reverse auction, which we run every three years. So in the last year or two – last couple of years, really – we've been thinking, we've been trying to move the database into the energy management sphere. Still using it, obviously, for purchasing, or making our purchasing decisions. But trying to collect information on buildings, their size, their age, primary use, et cetera, to put into the database to help us track building energy use, as well as overall agency or campus-wide energy use. And this also include developing the ability to store submetered data, as well. Next slide, please.

Right. So this is a screenshot of the State Energy Database. Again, if you go here and play around, it's fairly user friendly and you can get an idea of what a statewide energy database looks like. I can tell you, too, that from working at the state energy program and DOE, I think Maryland is pretty unique in this database and how well fleshed out it is. As I said, it has every agency, university campus, and really it's down to the building level at this point. Next slide.

Right. So we have the State Energy Database, and it helps us kind of figure out, gives us a general impression of where we are as far as metering in the state. And before we actually started collecting all this information on buildings, we realize that most state buildings are on some sort of a master metered campus. Either it's a university with 100-plus buildings that's on one large utility meter down to a state park that has maybe a couple of meters for 10 or 12 buildings.

But the end result is that you still cannot – you still have no insight into the energy use of most of our buildings. So, we guessed at the time that it was about 80 percent. We're on a master metered campus. And when we get all the building data into the database, we found out we were only off by one percent. So 79 percent of our 7,000-plus state-owned buildings are on master metered

campuses, which really sort of put an exclamation point on this need or desire of ours to start submetering buildings.

And I have the same issues that everyone has when they start mentioning submetering to management, which is, "That's – what kind of an investment is that? It doesn't pay for itself. It doesn't help us – in itself, doesn't help us – save energy." So, my response has always been, "Would you go out and buy a car that has no speedometer, has no gas gauge?" And they sort of like, "Oh, okay. Yeah. That makes sense. I actually wouldn't want to buy a building if I didn't know how much energy it was using, either." Next slide.

So, the question becomes why now? Why are we submetering now? And the reason we're doing it now is that my office decided a couple of years ago that what the state really needed was an executive order that set new energy savings goals for the state for state buildings. So we drafted one, along with Maryland Energy Administration. It was then issued by Governor Hogan in 2019, with a ten-year energy saving goal for state-owned buildings. And in that executive order, it requires my office, essentially, to track savings from efficiency projects associated with the executive order. And we can't do that until we've actually submetered some of the buildings that we're going to be performing these projects on. So that was – some of the impetus for starting the submeter came from there. Next slide.

So, to get started, obviously, we had to start the procurement process, which everyone in the state loves doing. We drafted an RFP. We took it out to the market. We had some proposals submitted last – or was it earlier this year? It was just earlier this year. Which we are actually now currently reviewing. But I think importantly, that RFP, as it becomes a contract under which the submeters are installed, we need to include things in there that you're going to wish you had if you don't put it in.

Which we have experience in this state, situations where we've asked a firm to install submeters. The submeters were installed. A year or two later we ask where the data is and, "We don't know. No one actually told us to collect and save the data. We just installed the meters." Or they weren't properly maintained, or they weren't commissioned regularly.

So, in this RFP, we have required the firms to commission them, I think, annually, to provide maintenance for them during the life of the contract, and we've given very explicit instructions as to what sort of data we're collecting and where it's to be sent. And in this

particular instance, at a minimum, we require them to send the data to the state energy database monthly. And the remote controls; we're looking at very basic submetering, even though we're doing it for steam and chilled water, electricity, of course, natural gas; we're not asking for all this to be connected to the DAS system at this time. We just want to know. We just want to, essentially, be able to create and EUI for every building that's being submetered. So essentially, these are building-level submeters, the very basic sort of submetering that you can do. Next slide, please.

So our first project, as I said, we got proposals out for the RFP. We've chosen a couple of firms. And now they are going through secondary competition for first project, which is the Annapolis Capitol Complex. It's a big, centrally-metered campus with a district steam and chilled water loop. Two million square feet is $3.8 million worth of energy going through these buildings every year. And this is a perfect example of us not knowing, essentially, where that energy goes once it leaves the meter. And this will, we hope, help us figure out which buildings are performing better than others.

Also, what we, since this is the first time we've done this, we wanted to sort of get our heads around exactly what it was we needed done and wanted to have done. So we paid an engineering consulting firm separately last year. We paid them to go out and survey the site, which they essentially spent all summer at this site and created a meter plan that's 252 pages long, with all kinds of details on metering for every building, lots of pictures, meter schedules, et cetera. It turned out to be worth our money and the effort because at least one of the firms that we've hired to do the submetering commented that they thought that the plan was so good that they were almost prepared to submit pricing proposals just based on the plan that they provided for them. But they didn't.

We gave everybody site visits a couple weeks ago. So, we're at the point now we're reviewing the proposals which were submitted last week. And within a week or two, we will have chosen the firm to move forward with the project. Which I'd love to be able to give you some pricing. I'm back in a couple of weeks, and I should be able to do that. But as it is now, we're not quite sure, certain, what this is all going to cost. Next slide, please.

Right. so this is just one of the meter schedules in the plan itself, and for every building, there's a separate meter schedule, and then there's a master meter schedule, which I think has about 150 separate meters on it for this particular project. And next slide.

And, as I said, fully picture. So, there are certain things that the installation companies will need to know. As far as having straight runs of pipe to put the meter in, depending upon the diameter of the pipe and what sort of energy the pipe is carrying. So all of this is in the plan, all submitted to the firms, which they've been able to develop, which I think are pretty comprehensive scope of work from. I think that might be it, but next slide.

Yes. That's it for me. Thank you very much.

Cedar Blazek: Thanks so much, David. All right. Before we go any further, we do have another poll for you all. If you could join us over at Slido.com, that would be great. And the question is if you are an end user, what's the biggest barrier to installing submeters in all of your facilities? Marisa, if you want to go ahead and pull up those slide results, we'll see them as they come in.

All right. So so far absolutely looks like first cost is pulling ahead. We know that's a big issue and really closely tied to that is determining that return on investment, making the business case is that first cost really justified? I'm hoping you'll learn throughout this presentation that it is, and it can be, and we do have some resources that help you calculate an ROI. And I think Ted's going to touch on that a little bit later, too. But this is really helpful and it looks like that's pretty common across the board. At least half of you say first cost. Okay. Let's go over to the slides. And thank you so much, everyone, for responding.

With that, I'd like to transition to Steve with more information from Towson University. Mr. Kolb is currently the assistant director of energy at Towson University. He's held this position since 2017. He joined the university in October of 2008 and served as the university's energy manager from 2010 up until 2017. And prior to coming to Towson, Steve worked at McCormick & Co., where he spent most of his career. He has over 20 years experience in energy management, electrical engineering, and power and lighting systems design. Steve, please take it away.

Steve Kolb: Thank you very much, Cedar. Thank you, David. So, my name is Steven Kolb. Good morning and good afternoon, everybody, depending on exactly where you're from. Hopefully, we all escaped the storm today. I know it went by our area just within the past hour, and seems to be letting up a little. Something we don't need.

So, wanted to talk briefly first about Towson and what we are. And we're basically kind of a medium-sized university, about 6 million square feet and growing, about 30,000 total students, faculty, and staff. And we're at about 60 buildings, currently. And our annual energy consumption is about 70 million KWH. And we have about 350 meters on campus and about 250 of them are connected to a building automation system. And we're going to look at that. And then there are some additional mechanical systems here that we just well. Next slide, please.

So, I'll talk briefly about our strategy, and again I'm asked this question often by other universities, how we're able to continue to successfully fund metering and how we calculate ROI. And that's always a tricky question, especially the ROI. But any part of successful metering strategy really starts with the funds. And meet with whoever you have to meet with. Show them the data. Whether it's your budget office, whether it's your CFO, or all of the above; you really can't do anything within your energy department if you don't have good metering.

So a couple of bullet points here owner-installed submetering must be a priority. It is one of the most important components – I think it was even mentioned earlier – in any energy program. It needs to be a key focus. It should not depend on utility meters for billing or for trending or analysis or back charges. And we use, we like to think of utility metering as being supplemental metering. And all fuels and waters should be metering, ultimately at the building level at a minimum. But if you can add additional submetering, which we do in multiple buildings; especially if you had labs or you had fitness centers; higher energy areas of intense energy usage; you want to meter those, as well, and make sure that they're being charged for their energy use.

And connecting to a building automation system is really critical. Some folks are able to do that. Some aren't. A lot of universities that I talk to, especially the larger universities, seem to be on that track. It's always a work in progress, but connecting to a building automation system allows for so many additional important steps, which we're going to talk about briefly here shortly. And another really important point to keep in mind is you've gotta look at the data.

And David mentioned earlier it's great to put meters in buildings. But if you're not looking at the data, it really becomes useless. And so it becomes a challenge. Now, we're fortunate we have students who work in our energy department, and first thing we do is train

them on, again, looking at the data, putting data into spreadsheets, looking at charts, and then letting us know if something's wrong. And they're pretty easily able to be trained to do that, actually. And it's cheap. It's a cheap way to get some help in your energy department for universities, at least. And maybe even for non-universities, using different type programs that businesses often offer students.

And I'm always asked what meters cost, so this last bullet point. It's really tricky, again, to determine how much a meter installation. Because it depends on so many things. You could have some small electrical submeters that you might be able to have your electricians put in, and you could probably do it for $500.00. On the other hand, if you've got some larger systems – we just had a steam meter put in a ten-inch line. We had to rework the line a little. By the time we ran separate data to it, separate power and tied it into the actual, you know, cut it into the line, reworked the line, re-insulated, it was over $50,000.00. So we're actually going to look at that example, too, in a few slides.

So your meter costs can vary, and they're kind of all over the place. But you always want to look at good quality meters. Don't look for the cheapest. And you also want to use revenue-grade metering, if you can. Next slide, please.

So, one of the parts of our energy program is demand response. And as you can see, this is a 24-hour period where we had to shed load and without our metering, we would not have been able to determine the success of, number one, how much could we shed? And number two, were we able to shed what we promised we would shed when we contracted with our CSP, our curtailment services provider, who leads the demand response program for our area?

And it's easy money. It's usually between $30,000.00 and $50,000.00 of revenue for a one-hour test per year for us to be part of that program. And if there's an event, which there occasionally is, then there's even more savings. Because you actually save for the amount of energy that you are able to shed. But without your metering, you really don't have a good understanding of how you perform. Next slide.

And this is an example of how we are shadowing, actually, one of our main utility metering. And the real purpose of this slide is to show the interval data capabilities. These are 15-minute segments. And this is a 24-hour period in one of our large accounts. And

we're comparing against the utility meter. We've found many situations on our campus where the utility metering was incorrect and we were being overcharged. And we actually had one that we settled a few years ago where it was several million dollars that the utility had to pay us back.

So the value of having that owner-supplied or owner-provided metering next to the utility metering is really priceless. We love our utilities, we really do, but what's that saying? Trust, but verify. *[Laughs]* So, we've found that to be – that kind of return, how do you even sell that to your CFO? I think when they see that you're saving millions of dollars, that's a very convincing argument. Next slide, please.

So, this is one of our many, many electrical meters. We are a Square D campus. All of our switch gear is Square D. And we have many Schneider meters connected using this type. I just wanted to really show an example of one of our what we call building-level meters. And then we typically will have submeters below that. Next slide.

So, this is probably, again, one of the most important parts of our energy management system. It's a single-line representation of our campus. Most of our buildings are actually on this. It's really all of our electric meters – building-level meters, not the submeters below them – tied back to our Schneider metering network. And you'll notice two of them are red. And the really nice thing is that indicates – this is displayed in our energy office all day. So even our students can look and see that, okay, we have a problem. And as soon as you see red, you click in it, and then it takes you right into the meter itself, and then you can do historical trending, look at when the meter went offline, what's going on with the building.

Many times our electricians will stop in, and they want to click on a building and do some quick voltage checks because they got a call that something's not right. The value of this single-line network, and you can see at the top it's all part of the Square D power monitoring expert system. Again, well worth the investment, keep building it. It's a work in progress. As new buildings come online, they're added to this. Next slide, please.

So here's an example where we do what we're – this is our side-by-side measurement. The chart at the top is the utility measurement. Several years of month-to-month data, and then the chart right below is the submetering data. And you can see there are some differences. And as soon as that occurs it's pointed out to us by our

energy analysts or our students, and right away we contact the utility, and we let them know something's wrong.

Most of the time, it's a meter issue within where the utility meter will drop offline, or some other thing. And then in some cases, it's actually a billing issue, where we find that their billing could be incorrect. And because we have such good quality revenue great metering, the utility will always believe our metering over theirs. They will check theirs. But most of the time we end up letting them know when there's a problem with their meter. Next slide.

So here's an example of the value of connecting your submetering building automations. This is a month, typical month, in one of our buildings. And it's comparing 2019 August versus 2018. You can see for the first three weeks everything looks good. And then in the fourth week – or actually the third and fourth weeks – there's suddenly a significant increase in the baseline. And that raises the alarm. Now again, if the student is looking at this, they'll know that this doesn't look right, and they'll point it out to somebody. And then further investigation is required. And it usually results in tens of thousands of dollars of saving because of an equipment issue or some other kind of event that should not be going on in that building that would have otherwise not been recognized. Next slide.

So here's an example where a small change took place, where someone inadvertently for some reason decided to turn an air hammer on and defeat the automation and basically lock it on. And our office, the energy office through, again, good metering and good analysis, noticed within a few weeks that there was a significant increase in the night time usage of this particular building, which was one of our sports arenas. And it resulted in over $20,000.00, just because somebody locked on an air hammer and forgot to take the lock off and get it in the automation system.

It shouldn't have been done. It was a mistake. Most of the time when that's done it's not necessary. But these are the kinds of things that happen. And had that not been quickly recognized by our analysts, folks were looking at the metering data, this could have easily gone on and on and it would have been over $100,000.00, instead of $20,000.00. Next slide.

And this is another way of looking at the example that we've just discussed, which is, again, overlaying another time where, again, looking at period versus last prior year same month, and you can see that the, again, the baseline data is close to 300 kW, instead of

dropping down below 100 kW every night. These are significant real-world examples that result in tens of thousands of dollars if not quickly picked up through, again, submetering. And it's these kinds of examples that you take to your CFO, or your budget department and say, "This is why we need metering," when they said, "Well, what's the return?" It's often difficult to quantify, but it's these types of examples that can very often make it much easier. Next slide.

So here is an example of where we measure the EUI in all of our residence halls on campus. And this is really important because this really tells us how much it costs per year to run these buildings. So when we are making decisions on student tuition and housing, we use this information to actually assist with the budget office and other, on just deciding, again, on not just tuition costs, but housing costs – not so much tuition, but more housing costs.

In addition to that, it helps us figure, okay, what are we doing in towers A through D that we're not doing in Carroll and Marshall? And we change to get that EUI. I mean, we're talking about a 50 percent difference in energy use per square foot per year. And that quickly adds up to tens of thousands; in some cases, hundreds of thousands of dollars per year. Next slide, please.

So here's another example of, again, without good metering. This is one building that costs a quarter million dollars a year for utilities. And you'll notice the difference in the winter months, which tells us, in my opinion, if I was looking at that and didn't know much about the campus, I'd say, "Wow. You've got some pretty inefficient heating systems in this particular building." And then if you go to the next slide, this building was renovated.

And after the renovation, we installed a VRF mechanical heating system. Notice the drop in energy use throughout the winter months. This is a big eye-opener for us. And we saved almost $100,000.00 – $90,000.00, we'll say – by installing a VRF mechanical heating system. And notice the difference in the heating costs. That is unbelievable, and an energy manager's dream to see something like that. So again, this not only helps us decide which building we want to renovate, but what types of mechanicals we want to install. Again, you wouldn't know it without good metering. Next slide.

And this is just a quick snapshot of our campus since 2010, when we started our energy program, and you can see our total cost, kWh per square foot from 2010 to 2018. We're really proud of this.

I think it came out to 20-some percent, 25 percent, or so. This is during a time of significant campus expansion and student enrollment increase. And we're still able to do this through, again, good energy projects, good metering, good analysis. But you really wouldn't be able to show this to your stakeholders without good metering. Next slide, please.

This was also one of our recent projects where, again, we just made some improvements over time to one of our large sports arenas. And you can see we reduced our load in that building over a period of time from 200,000 kWh per month to less than 120,000. And these were all kinds of projects. They were air handler replacements, and LED lighting upgrades. But the point is we were able to show through good metering that, okay, we want more money to do these kinds of projects. If you give us more money, this is what we can do and other areas we can reduce energy by 38 percent in other areas.

I wanted to end with just a couple of pictures because I'm always asked. This, for example, is a new steam meter that we just installed in one of our utility plants. And you can see, it's pretty interesting-looking. When you cut off all the insulation and you cut a ten-inch steam line and tie in the metering, and you get down to it, it's quite a bit involved sometimes on some of these meter installations. Next slide.

And this is what the finished product looked of a recent meter install, as well, in our main central utility plant. And next slide.

And these are – we just recently installed on our chilled water lines – 16-inch chilled water lines. These are FLEXIM ultrasonic transducers you strap on the outside, and they are amazing how well they work. Very expensive, but much better than the older meters of years ago, where you had to penetrate the pipes and constantly pull the meters and calibrate them all the time. And I think that is it. If you go one more slide. It is. So, all right. Thank you very much. And Cedar.

Cedar Blazek: Great. Thanks so much, Steve. Quick reminder to our audience to send in any questions you have. Slido.com, event code DOE. We're collecting these for our Q and A period at the end of the session.

With that, I'm going to transition to Ted at Argonne National Laboratory to hear his thoughts on where submetering is going. Ted is with the Center for Transportation Research at Argonne

National Lab. He's a principal electrical engineer in the EV Smartgrid Interoperability Center, identifying and validating interoperability issues related to PEB charging systems, including grid impacts and opportunities. Recent research includes development of AC and DC meter solutions to reduce net installed cost of submeter systems for building loads, renewable energy sources and loads, or DERs, and bidirectional ED charging energy, up to the megawatt-level system for commercial EDs. Ted, please take it away.

Ted Bohn: Thank you. Next slide.

So, again, I'm going to apologize to everybody who wants to see more detail and to these images. We've got the ten-minute version going on here, so this is just going to be describing what and why, and not so much into the details. I'm also hampered a little bit that I can't actually point to the things on the screen, so I'm just going to direct your attention.

On the left of the screen is one of the compact past systems. So this is a 19-channel unit you see installed on the right. you can see a one-inch knockout with a little twisted wire going to a gateway. So that's how small these things are, about the size of a business card. So whenever I say "small" or "compact," I mean business card sized. And again, this is a 19-channel unit.

And I believe I can do something similar in a circuit breaker, like if anybody understands what the EDB series from Schneider, I think I can get about 80 channels into that. So, that's when I say "small." And then in the lower right of this image you can see row after row of the NCC12.1, you know, NEMA meter. That's what we're trying to get away from and have things that actually can be installed in a matter of minutes for what I call a low cost. So, next slide.

So, today, again, I just want to kind of put things into context on what I'm going to talk about today is what does it mean to succeed, and cost versus benefit. We're going to talk about local law 88 PC systems renewable. So that's, in fact, where most of my effort is.

Because as previous presenters were saying, you can find meter vendors. You can find out what labor costs. But these new things about linking large vehicle charging for both bidirectional, that you can use a vehicle as storage for the building, integrated TV, open energy market. So there's a whole bunch of new possibilities on revenue streams, and meters are part of that. And then we're going to talk a little bit about local law 88 on mandatory submetering.

And again, it's the reporting part, not so much the billing, but reporting.

Third bullet talks about equipment site factors. And again, most people don't count the cost of interrupted service or planning overhead, and then the communication pathway. We'll talk a little bit about the low-cost meter challenge. And then we'll close, finish up with some of my research on hardware software and other observations on how to cut costs. Slide.

So, again, scale. We talked about small scale, big scale, super big scale. Most of that is whatever your question is, the effectiveness of the submeter-gathered data greatly depends on what you're looking for. So kind of like a detective. It all depends on what clues you're looking for. That's the kind of device, or system, or implementation.

So at the plug level a lot of people want to identify miscellaneous loads, especially for active power strips and other things, and just see how much could I save on the plug or device level? So branch circuits, measuring each of the branches in a load center is good. You can also have distributed submetering that actually goes into the smart outlet strips, smart outlets. There's a lot of different ways you can measure the small loads.

And then M&V, very important to say before, when you made a change you expect a downward trend, but this is upward trend, or it went downward and had some bumps in it. That measurement and validation is a really good return on investment. And then concurrent loads. A lot of people measure A, they measure B; but they don't really realize what the impact of A and B operating at the same time could be. You know, air conditioning loads, vehicle charging, lack of PV, you know, these concurrent loads. That's where submetering can give you a composite of what's going on.

And then the area zone. So some of the people I've worked with are looking at floor-by-floor, where they'll try to find behavior within a manufacturing zone, and then a shipping zone. So that idea of just kind of going backwards. And then the campus-level stuff, which we saw in that I'll just remind you, but PPM storage, those things can affect what people are calling mesh micro-grids, fractal grids, all these different ways that systems interact with each other submetering, again, non-utility-owned metering can assist in that information. Next.

So again, some of the use cases and applicable standards. Again, a lot of people are only used to AC distribution systems, but DC distribution systems, especially for data centers and other ways to buy and sell energy are coming. The utilities are controlled by the public utility commission, and they have certain rules on how they specify meters for revenue tracking.

Non-utility-owned meters are covered by the Department of Commerce as commercial transactions when you sell goods or services or money changes hands, it's considered a commercial transaction. Handbook 44 covers that, and there's a lot of sections in Handbook 44 that talk about this coming market. If I can actually sell demand – not sell energy, but demand – if I can reduce my demand by X amount, I can actually sell that. Well, it turns out that would be covered under Department of Commerce transactions. And again, meter standards support that. So for the AC meter world ANSI C12.1, C12.20 are what are used by utilities and others for accuracy.

A new standard – pause – new standard ANSI C12.30 didn't exist before and it almost doesn't exist – or put it this way, it's on the verge of being published now. So I've worked with a group for about the last three years. We're very, very close to publishing this. But there will be an American ANSI standard for commercial transactions of DC energy. So when you sell sustainable recs, you can actually get paid for the DC energy. When you have a storage system or other way of moving DC energy back and forth, that can be done with submetering through the PUC world. Next.

So local 88. This is just cut right out of the page. So a lot of these slides are not meant to be read word-for-word. But just take out the key words of January, 2025 is not that far away; four and a half years – less than four and a half years. All buildings in New York City of 10,000 feet or more will have to have submetering for multiple occupants of less spaces, other things from sharing a meter… The takeaway is New York City is a big place. There's a lot of buildings that have 10,000 square feet per tenant, or per occupant. So that's a big deal. And so compliance is going to be a big deal and submetering is going to be a big deal, and cutting that cost out, pretty big deal. Next.

The Department of Energy Building Technology Office, BTO, launched a low-cost wireless – and again, wireless data, not wireless measurement – submeter challenge in June of 2013 with a goal of $100.00. And that was a UL listed one percent accuracy device. There were 30 manufacturers submitted their application.

And again, this is gold star. This is not a trophy – metaphorical trophy – but the idea was that anybody who can beat, reach that goal, will be attractive to end users who are on this call. So 30 people, 30 groups, submitted their applications. Nine were accepted at valid criteria, beating the $100.00 target, and UL, and all the other things.

So then down to the second round to submit their products for evaluation. Three of those were actually deemed to pass the cost and functional evaluation to meet the criteria on the challenge. Of that, two of them passed the UL criteria that had a UL-listed device that had one percent accuracy for $100.00 cost target. And then the communication Meazon was the only one of those two. You can kind of see 30, divided by three, divided by half, divided by half, divided by half, divided by half. So down select.

And so Meazon was the only one who made it to the end with their ZigBee solution. So they have that thin rail meter, and they've got this, just to be clear, it's a Greek company operating out of Detroit. So it's not a very big company. But they were able to submit the offering for $100.00 using ZigBee on a panel meter. And then there was a mission accomplished presentation in July, 2017, and the links, the references, you can watch that presentation and kind of see what they did, why they did it, and how it was done. Next.

So you can see the gateway or saw the gateway on the previous one. That's a big part of this. How do we communicate with things? So in the cost factors – and again, I'm kind of flipping things over. Everyone thinks that the meter itself is the most expensive part. But it turns out in the end the meter is actually often the smallest part of it. Subcontracting overhead, as you know, costs of managing a project, scheduling it, financing, all these different things, costs real money.

Loss interruption, loss of service and productivity loss. So you have to shut down machines or a floor, whatever it is, to update the meters. Because again, most places don't let you do live hot work. You have to lock out, tag out it. So at Argonne Lab, that cost, again, because of the national lab, costs me more to lock up the system and complete all the paperwork than it does for the things I'm installing. So again, these costs add up. Track labor costs. That's one's easy to understand. If you have to get an electrician for someone to both assess the system, to set up the job, basically, scope the job, and then to do the job and then commission it.

And then the software and commissioning part of, you know, once the meter is in place, someone has to set up and as we had in the previous presentation, a lot of people, they say, "I just put the meter in. I wasn't supposed to make it work." And it's like well, that's an important part of it with a real cost. And then maintenance on these type of things, to make sure the things stay working.

Hardware and sensors. We have the submeter equipment itself. And enclosures. And a lot of people underestimate what it costs to put an enclosure around a meter. They see this device. They say, "That's good. I'll just screw it right to the panel." It's like no. You should make sure that can't be tampered with. Has to fit in the space. And sometimes there's not space for it, to make more space.

Current sensors. That's pretty obvious. But when you run a multi-channel unit, you can come up to dozens or hundreds of sensors at $50.00 to $100.00 each. Greatly exceeds the cost of the meter. And the submeter system, again, can have a multi-channel meter, single-channel. Again, it all depends on what configuration, if it's AC or DC.

Communication. We talked about that, that often you need gateways, somehow to get the device data. The gateway can be built into the meter, or it can be separate. You might actually have to put in a 5G hot spot, because there's no Wi-Fi or other way to get in there. And then there's also cyber security issues of can this data be compromised, or spoofed, or stolen?

And then logic or power supply. A lot of people underestimate the need to have actually a separate supply circuit for the meter. The sense leads are often not used for that, so you actually have to have a second circuit breaker, or a wall outlet, or something. Next slide.

And then sensors. It's just a lot of people underestimate how much space it takes to put a sensor into a panel. So these are small images, but on the right you can just see lots of little white things that look like ice cubes. But as you can imagine, some electricians – and this is kind of a crowded example, but again, it's an example of what happens when you put a current sensor on each branch. Well, if you've got 30 branch circuits, you've got 30 sensors that you have to crowd into a space that's already full of wires.

Now, this one uses a concentrator hub, where every six or eight sensors go into a hub, and then the wire comes out of the hub. But then you have to have hubs. You can see it's a spaghetti mess no matter how you look at it. You can just see, of course, the donuts

that are needed for a multi-channel unit. And then the lower left, again, these are just references on how big or small sensors can be. And these are all in the 200 to 300 amp range.

And then for higher-current ones, you see the blue loops in between of the Rogowski sensors. You say, "Wow. That's great. It's just a piece of rope." But it has many, many coils of wire inside of it with a signal conditioner that you see just to the right. But it needs power. And it's expensive. So each one of these loops can be $200.00 to $300.00. For the sensor on the current sensors in the lower left, they run – the tiny one down there is $10.00 to the bigger ones who are hundreds of dollars. So, not zero.

So going down, we have these solid and split-core current sensors. We have Rogowski-type flexible rope sensors. We have passive Rogowski sensors, which are the ones that are kind of in the middle of that stack. They're low-cost but they have phase immunity. They have some noise issues that if you put them too close to other signals, they interact. We have passive current shunts for TT systems, and then we have hall type sensors and flux gate magnetometer sensors, which again, are great, but they're in the hundreds of dollars for cost. And then again, you have to have the space. Next slide.

So this is what I'm working on. So that's my hand. And that's the business-card size meter in the middle. Direct your attention to where the red arrow is. The red arrow is not this but I'll use it as a key. The fast-on terminals are a quick way to make connections. Every time I pull a screwdriver out, even sticking a wire into a hole and attaching the screw takes longer than crimping on a wire much like an appliance connector.

So, I did a lot of studying on speed and how long it takes me to connect things. And if I have everything pre-wired with pigtails, crimping a connector on the end of a wire is faster than stripping a wire, and putting it into a hole, and turning the screw down. So that's – and again, sometimes you make a mistake and you have to do it twice. So that's why I just focus on removing connectors.

So on the right – and I'll speak a little bit more slowly – you can see what looks like a card on top of a card. Those are called castellated diodes. And on the edge, you can see some what look like soldered connections. That's actually how the sensors are connected to it, and that other one's how I connect data, is as much as connectors are cheap – they're only $2.00 to $3.00 each – when you're going for $100.00 meter, then each connector, even at

$3.00, is pretty significant cost. So again, removing connectors and then –

So over the past few years I've worked at shrinking these down. But these are examples of a scalable unit that can run from three amps to three. So onboard, I have a 60-amp current sensor in that area where you see the pass on connectors. I apologize I can't point my finger. But anyway, you can see the image on the last, where there's a red arrow, in that area there is a current sensor built into the board that comes out the tips, 30 amps. So, like I said, I like to say that I can connect 3 amp to 3,000 amp, and 30 volt to 300 volt, to 1,500 volt DC. So I have 5,000 volts of isolation between the left and the right side where you see the little break in the middle.

The left side is the isolated loads, and the right side is the data connection. You can even see a USB connector. So again, ways to power this quickly, and less verbally, and then using off-the-shelf IOT solutions. Again, I focus on not $200.00 to $300.00 gateways, but on the $20.00 gateway. So a lot of people, when you know that processors are under $1.00, and that's what this processor that's on this circuit board – under $1.00 – you can get a lot of computing power for a buck. And so that's what I'm focusing on with my research at Argonne Lab. Next slide.

So this is, again, examples of okay, that was a single. What do I do with multiples? So on the lower left, you can see the Dent and AccuDC and GreenEye Monitors. You can see lots and lots of connectors. So that's kind of an issue. So in the upper center, I have press-on vectors that go to ribbon cables. And then in the upper left is an example of a DDB circuit breaker, basically, a three-base, switch-rated circuit breaker that has the meter. It's like a dictionary that's hollowed out.

So instead of the circuit breaker mechanism, in the same footprint, I can actually put in, in this case it's a 15-channel unit, but I think with a new design I can get up to 80 channels in that spot. And a lot of it has to do with how do I connect the current sensors? And then where you see the red circle on the center, that's the 19-channel unit that I mentioned earlier that fits into the box you see above, our qo circuit breaker footprint. So basically a regular single base two-pull circuit breaker is where this 19-channel meter clicks into it. And then the AC disconnect is the middle. You'll see that opened up on the next slide.

So on the upper right, what I wanted to focus on here is cost. So you'll see in the middle there is a one-inch nipple with a lock ring.

And so that I found is the fastest way to mount a meter, is to use – on the right is a $5.00 forward closure, and the red board on the right is that sub-$20.00 gateway. The meter in the center with the power leads – in this case, the power goes directly in and out. On the one it would just be the signal for the current sensors. And then this nipple one. So I've installed these in under ten minutes, start to finish from taking the panel cover off and commissioning it. So that's what I've been focusing on is time and materials and labor. So, next.

I'm just wrapping up. We always talk about end-use measurement devices. So, and people recognize the brass thing, the T handle in the back that's a shorting block, a 60-amp air condition disconnect. This is a meter that fits into that disconnect, so with the right radio, if you're going to use Wi-Fi, Bluetooth, whatever it is, connect it to this, you can put this, you can take the shorting block out on the disconnect and put the meter directly into the hole. So this is just one of those applications. And with that, that is my presentation.

Cedar Blazek: Great. Great presentation, Ted. And a big thank you to all of our panelists for being here today. We won't have time to answer audience questions today, but we've collected all of your great questions in Slido, and we will be answering them in a document after the presentation. The answers to your questions will be included as part of the webinar transcript and will be sent to you when the presentation is available online. Next slide.

Here are links to some of the resources our presenters discussed today. Once the slide deck is available online, feel free to click on these and explore more. Next slide.

As previously mentioned, this is the final installment of the Better Buildings Summer Webinar Series. During the past month, we have taken on the most pressing topics facing energy professionals with new experts leading the conversations. All previously recorded webinars are available on the on-demand webinars library. Stay turned for more information on our 2020 to 2021 webinar series in the weeks to come. Next.

In addition to our on-demand webinars library, the Better Buildings program recently launched its E-Learning Center, a collection of online webinars, courses, and other e-learning training resources, covering a range of areas relevant to Better Buildings Better Plants partners. So if you're looking to up your game during shelter in place, please check this out on the Solution Center. Next slide.

And here we have a look into the Better Buildings Solution Center, where you can find over 2,5000 publicly-available solutions. You can explore by topic, solution type, or go to one of our program and partner pages directly. By searching for submeters, you can find our submetering resources for commercial buildings document that contains a variety of resources intended to help end users gain better access to energy data through the use of submetering. The search results also highlight Better Buildings partners implementation models and showcase projects related to submetering. You can go to energy.gov/BBSC to explore all the Better Buildings Solution Center has to offer.

With that, I'd like to thank our panelists very much for taking the time to be with us today. Feel free to contact our presenters directly with any additional or specific questions you have, or if we couldn't get to your question today. If you'd like to learn more about the resources discussed, please check out our website, or feel free to contact me directly, Cedar Blazek, at the e-mail shown. For general inquiries or program support questions, click on the green icons, and they will direct you to the appropriate contact.

I encourage you to follow the Better Buildings Initiative on Twitter for all the latest news, and we'll be sending you an e-mail notice when the archive of this session is available on the Better Buildings Solution Center. Thanks, everyone.

[End of Audio – see additional Q&A on the following page]

Additional Speaker Q&A:

Better Buildings does not endorse or recommend any product or technology provider. The answers in this document are solely the opinions of the speakers based on their professional knowledge and experience.

General Questions:

Audience member: Has any study been conducted to optimize up front electrical distribution panel design to minimize metering hardware requirements?

Response: Not that I am aware. But as technology continues to drive down metering costs and improve hardware, we are seeing more compact design in our electrical gear along with lower meter hardware costs.
There are a number of manufacturers with purpose built distribution panels with built in metering, that are lower in labor cost than retrofitting/adding metering later, but much greater in hardware cost than a non-meter enabled load center. (TB-ANL)
- Atom offers digital circuit breakers with build in measurement/control functions
https://www.atompower.com/
- Eaton offers Energy Management Circuit Breaker (EMCB) products that include measurement and control of loads.
https://www.eaton.com/us/en-us/markets/innovation-stories/energy-management-circuit-breaker.html
- Siemens, Veris, Schneider and others offer load centers with metering built in.
https://new.siemens.com/us/en/products/energy/low-voltage/digital-power-monitoring/sem3-branch-circuit-meters-accessories.html
- Schneider BCPM- page 156; https://download.schneider-electric.com/files?p_enDocType=Catalog&p_File_Name=PowerLogic+Catalog+%5Bdigital+file%5D.pdf&p_Doc_Ref=3000CT1701

Audience member: Are there any special considerations for submetering with new construction?

Response: New construction is the ideal time to install metering. In most cases, we have seen it be less than half the cost of installing metering in existing buildings/systems.

Audience member: Do any of these programs have end-use submetering of HVAC systems, lighting, plug loads, etc. separately?

Response: Yes, this is common especially in LEED designed buildings.

Audience member: What do the presentations have to do with submetering within buildings? What regulated utility companies use the revenue grade meters shown for billing customers?

Response: I think the title of the webinar is clear; *"Better Buildings: Succeed with Submetering*". This is not about revenue collection but identifying the nature and relationships of energy consumed in a facility being evaluated. The last presentation (Ted Bohn-ANL) discussed the difference between utility owned meters (regulated by the PUC) and non-utility owned meters used in commercial transactions (governed by the Department of Commerce, Weights and Measures enforcement). NY Local Law 88 is an example of this- energy use is required to be reported to tenants, separate from any billing/revenue pathway. (TB-ANL)

Audience member: What are some easy-to-install or plug-and-play commercially-available sub-meters that would work to monitor kwh generated by a solar array that could upload meter data to the web?

Response: There are many low cost that you could by on-line but TU has standardized on Schneider.
There are many online resources, including Amazon.com and https://www.powermeterstore.com/ (TB-ANL)

Audience member: Are there ultrasonic devices that can be used for gas submetering?

Response: Not that I am aware.

Audience member: How do you get the data from the submeters? Wifi? Cellular? And what is the best interval for the data?

Response: TU uses hardwire connections for all our metering systems. (Though wireless is becoming more popular.) We found the best interval to be 15 minutes. This can easily be changed through our BAS to any interval if necessary for unique situations such as troubleshooting. But we have to be mindful of bandwidth/network traffic.
The data pathway from sensors-to-end-location is usually tied to capital investment and available (secure) communication resources at a facility. The cost reduction studies conducted at ANL focus on minimum equipment and monthly operating costs. The low end is via IoT narrow band links (LP-WAN); such as NB-Lora, or Sigfox, with cost per data delivered, with minimized interval data. https://www.sigfox.us/, Summary/comparison at https://www.iotforall.com/iot-connectivity-comparison-lora-sigfox-rpma-lpwan-technologies/
https://www.sciencedirect.com/science/article/pii/S240595951730

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In the mid-range is utilizing existing WiFi/broad-band connections to a cloud hosting site such as AWS, accessed via view portal. Many submeters offer free data hosting if routed through their cloud- such as eGauge and EKM.
https://www.egauge.net/commercial-energy-monitor/#power-analysis
https://www.ekmmetering.com/pages/software
On the high end are dedicated 4G/5G hot spots for poor connection areas where measurements are taken- most secure but expensive pathway. (TB-ANL)

Questions for David St.Jean:

Audience member: Among the 20 buildings in the Capitol complex project, what is the breakdown of meters required among electric, natural gas / fuel, water, thermal energy (CHW, HW, Steam)?

David St.Jean: The meter schedule is six pages long, but here is an example of a couple buildings (*Figure 1*):

MASTER METER SCHEDULE

Meter #	Building	Service	Line Size	Primary Equip Served	Estimated Design Flow	Min Flow	Max Flow	Accuracy	Suggested Meter Type	Turndown
1	Central Plant	Natural Gas	6"	Steam Boilers	50,000 CFH	650 CFH	65,000 CFH	±2.0%	Thermal Mass Meter	100:1
2 & 3	Central Plant	Fuel Oil Supply & Return	2 1/2"	Steam Boilers	4,000 GPH	50 GPH	5,000 GPH	±0.5%	Positive Displacement	50:1
3	Central Plant	Steam	16"	District Loop	45,000 LBS/HR	2,000 LBS/HR	60,000 LBS/HR	±2.0%	Insertion Turbine Meter	30:1
4	Central Plant	Steam Condensate	6"	District Loop	90 GPM	5 GPM	900 GPM	±1.0%	Clamp-On Ultrasonic	200:1
5	Central Plant	Heating Water Supply & Return	4"	Entire Bldg.	200 GPM	5 GPM	500 GPM	±1.0%	Clamp-On Ultrasonic	200:1
6	Central Plant	Chilled Water Supply & Return	16"	District Loop	5,000 GPM	50 GPM	10,000 GPM	±1.0%	Clamp-On Ultrasonic	200:1
7	Central Plant	Chilled Water Supply & Return	8"	Entire Bldg.	1,000 GPM	5 GPM	2,500 GPM	±1.0%	Clamp-On Ultrasonic	200:1
8	Central Plant	City Water	4"	Entire Bldg.	200 GPM	5 GPM	500 GPM	±1.0%	Clamp-On Ultrasonic	200:1
9	James Senate Building	Steam	6"	HW Heat Exchanger	2,500 LBS/HR	150 LBS/HR	4,000 LBS/HR	±2.0%	Insertion Turbine Meter	30:1
10	James Senate Building	Steam Condensate	4"	Entire Bldg.	90 GPM	5 GPM	300 GPM	±1.0%	Clamp-On Ultrasonic	200:1
11	James Senate Building	Heating Water Supply & Return	5"	AHU'S	250 GPM	5 GPM	500 GPM	±1.0%	Clamp-On Ultrasonic	200:1

Figure 1

Audience member: Is the list of submetering vendors that you chose public? can we have the name of those companies?

David St.Jean: The firms that submitted winning proposals are Schneider Electric, and Siemens.

Audience member: What do you consider to be a good quality submeter?

David St.Jean: Fortunately, the Meter Plan developed by an experienced engineering firm being paid directly by us includes recommended meter types and minimum quality specifications.

Audience member: How did you fund/what was the fund source for development of the metering plan and submetering projects?
David St.Jean: This project is being funded by a 2009 federal ARRA grant to the State of Maryland that was used to fund a loan program for MD State agencies. The funds were converted into a grant last year.

Audience member: Is it possible to see the RFP that was posted?
David St.Jean: Send an email to david.stjean1@maryland.gov with Submetering RFP in the subject line and I'll send it to you.

Audience member: How do you make a business case when DR revenue is not an option?
David St.Jean: DR revenue will become a possibility only after the meters are installed, additional functionality may be installed at a later date.

Audience member: Is it too late to be considered for the MD state sub-metering. Will there be future projects for RFP/RFQ's for this program?
David St.Jean: It is too late for the current contract, which has a five year term.

Audience member: How granular will the monthly data from the meters be?
David St.Jean: The proposals look like the meters will provide 15-minute interval data.

Audience member: What hardware are you using to collect the meter data?
David St.Jean: That depends on which proposal wins the project.

Audience member: Have you done a master energy plan to start tackling the ECMs that could be implemented that will reduce your energy consumption?
David St.Jean: The Executive Order requires my office to perform energy audits on 2 million sf annually and the audit reports and the submeter data will be used to prioritize buildings.

Questions for Steve Kolb:

Audience member: Are most Towson project examples associated with Building-level meters? Or submeters?
Steve Kolb: Both-- we have about 100 or so building level meters and about an additional 250 sub-meters.

Audience member: Have you deployed wireless sub meter systems, and have a cost/ benefit analysis been done?
Steve Kolb: We have not used wireless yet but are looking at a pilot using wireless. We have not done a c/b analysis yet.

Audience member: Are any of the Towson energy savings statistics normalized for HDD/CDD/RH?
Steve Kolb: All TU energy analyses are weather normalized using HDD/CDD. In some situations we will look at RH as well.

Audience member: Who is the DR service provider for Towson University?
Steve Kolb: CPower through a multi-year contract.

Audience member: What BAS/EMS is Towson using that is providing all this valuable analytical data?
Steve Kolb: Automated Logic is our BAS and Schneider is our electric metering network. Both are top-notch!

Audience member: How did you first convince management to invest in submeters?
Steve Kolb: It's a little tricky at first but showing data and cost savings of energy projects are the key.

Audience member: How many collective student hours go toward data analysis/error detection?
Steve Kolb: Average would be about 20 to 30 per week.

Audience member: Not every business has hordes of free analysts to look at the data, how would a business capture these anomalies?
Steve Kolb: You must convince stakeholders using data that a dedicated energy professional or two is necessary.

Audience member: Question about Towson's experience: how common are utility metering errors, such as the several million dollar settlement referred to in talk?
Steve Kolb: Not very common. But when it occurs, it is usually quite substantial.

Questions for Ted Bohn:

Audience member: What was that nifty small form factor meter the size of a business card?
Ted Bohn: Having more time/room to expand on the evolution of the form factor, it is based on embedded metering and direct measurement (meter attached to sensor for high current applications). The AC

60A disconnect format/volume and single phase circuit breaker footprint led to this single sided meter board at ~1.5"x2".
As discussed in the presentation, a focus of this work is on reducing net installation cost, including enclosures. The compact meter footprint allow use of lower cost NEMA4 sealed enclosures, like the $5 version shown in the slides.

Audience member: What is the difference between Ted's business card meter(?) and the Meazon $100 solution?

Ted Bohn: The Meazon submission was part of the DOE-BTO Wireless submeter challenge (2013-2017) criteria, including UL listing. https://meazon.com/
The ANL/DOE funded compact submeter research is aimed at End Use Measurement Device (EUMD) embedded applications as well as at the premise level or load center. There are dozens if not hundreds of models of DIN rail mounted meters/submeters from Asia/other markets. The ANL approach aims at 'better than needed' 0.1% intrinsic meter accuracy, limited by sensor selection/accuracy, in lowest hardware cost leading to lowest net installed cost when labor and packaging is factored into the process.
Another point of clarity is 'cost vs price'. As a researcher, I can only work on component costs. Manufacturers and retailers set the 'price' of a device. I.e. Meazon can discuss and declare a price; national labs/DOE cannot go there.

Audience member: Do you predict there being more laws like NYC's LL88 requiring covered buildings to sub meter being passed in other cities?

Ted Bohn: In the context of opinion and speculation, the motivation of the submeter part of LL88 in NYC is to get building occupants the information on consumption/usage of their space, even though they are not directly paying the bill. Yes, I think that like water conservation, submetering of unit electrical energy consumption will be mandated in other cities.

Audience member: Are these New York City Local Law 88 submeters on the owner side of the meter?

Ted Bohn: Yes, the building owner/landlord, Coop Association, Condo Association, etc is required to show compliance. There are MANY vendors lined up with solutions and certified reporting/compliance processes. The same with checklists for the process. An excerpt on the what/who qualifications is "*It is important to note that LL88 does not only require lighting upgrades and submetering, but also a report certifying that the work has been completed. The report must be submitted by a professional with either of the following*

qualifications:
- Registered design professional
- Licensed master electrician
- Licensed special electrician

https://www.ny-engineers.com/blog/local-law-88-lighting-upgrades-and-submetering
https://www.urbangreencouncil.org/sites/default/files/ll88_checklist_15.05.11.pdf
https://www.enertiv.com/solution/tenant-submetering

Audience member: When will this submeter be commercialized?

Ted Bohn: The DOE Technology Commercialization Fund process for CRADA and other agreements are under way. I expect by the end of 2021 (or sooner) that this will be offered as a bundled services product from the ANL-Amzur TCF partner. I.e. not as a device in a catalog, but as a measurement system that is part of an application/use case. We have field testing activities now with Amzur and other partners.
https://amzur.com/netsuite/carbon-sustainability-reporting/