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

Amy Jiron: Hello everyone, this is Amy Jiron with the Department of Energy. We are getting started right away because we have a jam-packed webinar full of information for all of you to learn from, and take and apply to your practice and in your daily lives and in your work.

So, this webinar is called Fall Tech Trends. Today we're gonna walk through the new technologies that are out there and available for purchase in the market. But we're also gonna talk a little bit about some of the technology that's gonna take us to the next level of energy saving.

So, let's think about technologies that use energy that's available as efficiently and in the most streamlined fashion such as CHP. And let's think about how we can use systems to our benefit. So, taking technology widgets and applying them together to maximize our energy savings, and also the other benefits that are associated with those. Like comfort, better operation, better operations and maintenance, better occupant satisfaction because they have more control. So, more on that later as we get into our speakers.

Next slide, please. I just want to remind you that we're gonna hold off on questions until the end. So, use the chat-box to submit your questions, and if you could say who your question is for, that would help us out a lot. So, enter your question into the top box on the right of your webinar screen, and please write down who your question is for. And it's okay if it's for all of us, or if it's for just Cynthia, or if it's for Kris. Just if you could help us identify who, that would be great.

This is our agenda, so here we are, welcoming instructions. I'm gonna talk a little bit about the commercial building program at the Department of Energy that's within the building technologies office. And then Kris Jorgensen from A.O. Smith is gonna talk about micro-CHP demonstrations that we have going on. And Cynthia Regnier from Lawrence Berkeley National Lab is going to talk about their really amazing rotating buildings in some of the demonstrations that we have going on in there. So, I'm just gonna do a quick introduction to our two speakers, and then I'll dive into overview of what we're going to be talking about.

Next slide, please. So, I'm Amy Jiron, I work on the Commercial

Buildings Integration Group, and I work on technology deployment which is basically market transformation for technologies where we've invested funding into R&D.

Kris Jorgensen, Dr. Kris Jorgensen, Lead Micro-CHP Development at A.O. Smith, including the demonstrations that he's gonna talk about in just a minute here. Cynthia Regnier is the Executive Manager of the Berkeley Lab Facility for Low-Energy Experiments in Building, otherwise known as FLEXLAB, and is also leading the systems-based demonstration called Beyond Widget that she's gonna talk about after Kris is done.

So, hopefully this is gonna be valuable for all of you and, as I said before, enter your questions into the chat box, feel free to follow up with us if you have others that come up later as you're going through your day, and let's dive in. Next slide, and then I think you can go onto the next slide, yeah.

All right, so this is what commercial buildings are right now. They represent about 410 billion dollars per year of expenditure, so that utility expenditure is on energy. They represent 75 percent of the nation's electricity. That's a little, that's a little electricity. No – that's a lot of electricity, and they also contribute 40 percent of greenhouse gas emissions.

So, that is really why we have the Building Technologies Office instead within the Department of Energy. Because there is a huge opportunity for us to implement different technologies, different measures, different strategies in order to reduce the footprint that buildings have in the world today. And I think there's lots of opportunities for every single building out there to make improvements, so we're gonna talk about some of those today.

But there are a lot of others that we aren't covering, and like I said, feel free to reach out if you have ideas and thoughts about those. The place for technology in specifically building efficiency products is quite big. Building efficiency products represent 60 billion dollars in U.S. revenue. That's up 43 percent over the last 4 years, so a significant opportunity to take advantage of energy savings or energy waste that's out there.

So, to improve the performance of our building, to save money, save energy, reduce our greenhouse gas emissions, and then all of the other benefits that I mentioned before. Such as occupant satisfaction, comfort, lower operations and maintenance charges, things like that.

Next slide. So, how do we figure out where we want to focus our time and attention? Because buildings are complicated. Obviously we have both residential and commercial, but within commercial we have a variety of different construction types, end users, climate zones, and technology areas. So, it's definitely a challenge to try to break this down into something where we can take bite-size pieces and make an actual trackable impact.

Next slide. What we've done in order to do that is developed a strategic approach which is like a framework to how we deploy technology. So, our market transformation framework for building efficiency products, and the first thing that we do is we gather up all the information about products that are out there.

The second thing that we do is we take a look at the national savings opportunity, the technical savings opportunity, and the degree of commercialization. So, is that product ready for purchase through normal market channels? If it passes those three tests, then we start workshopping, and we workshopped for a whole month last year in October, and solicited a lot of feedback. And at the end we come up with a list of prioritized technology areas.

I'm just gonna say right now that the two technology areas that we're talking about in this webinar are not included in our priority list for this year, because as I mentioned, these are kind of the next level of energy savings. This is our longer-term vision of where we're gonna go with efficiency.

Next slide. So, once we have our priority list we have a key set of core strategies that we use in order to create that market transformation. These are them. This is what we call a logic model. If you visit the Building Technologies Office multi-year plan, you'll see much more complicated logic models posted there for each of the different programs within BTO.

But these are our four kind of key, key strategies, key activities that we use with our partners in order to drive technology into the market faster. And today what we're talking about is the second one down there, tech demos. So, where we're trying to verify performance of emerging tech and real-time buildings to overcome risk. The end result is a report that all of you can access and use for whatever is relevant in your work, and hopefully build some.

Beyond that we look at procurements, resources, and then we'll cap all of our activities off with an adoption campaign, and I'm gonna talk about that a little bit at the end. Next slide, and I think that means I'm turning it over to Kris to dive into micro-CHP. So, Kris, take it away.

Kris Jorgensen: All right, well, appreciate the introduction, Amy. Just an introduction myself, I'm Kris Jorgensen. I work in A.O. Smith's Corporate Technology Center, and as Amy mentioned, I am responsible for the combined heat and power program within our company. And next slide, please.

Just to give you a background, some background information on what combined heat and power is, it's essentially a single system that uses a common fuel to produce heat or hot water, and electric power. In the case that we'll be talking about today and typically, it's a natural gas as the fuel. Larger systems are common more on an industrial or institutional level like hospitals, universities, things like that.

What we're talking about today is what's called micro combined heat and power, and micro's classified as any system that produces less than 50 kilowatts of electric power. Which would be considered a light, commercial-type application.

Next slide, please. Now, why does CHP or micro-CHP matter? Basically it comes down to two things. First is the inefficiency of power generation in our country currently. Right now, power generation involves converting thermal energy into electric power. And in that process at the central production plants, about 65 percent of the energy in the fuel is lost either as heat or in the transmission losses from the power-plant to where it's actually used. That's a considerable amount of fuel that's not being used in a useful way.

However, micro-CHP, because we are capturing that heat in a useful way, we have a significant energy savings if we look at the base fuel. And what I mean by base fuel, when you're buying electricity off of the grid from your public utility, you're not buying the coal or the natural gas that went into producing that electricity. But if you account for that fuel, that's what I consider a base fuel.

The other advantage that micro-CHP has is it can be located near the actual use of the electricity and the heat, which also reduces the losses for transmission, __ a little extra power into the fight. One thing to keep in mind, however, is this doesn't necessarily decrease the amount of energy used on the site. It just looks at the source fuel. But if you take all of this into account and look at the amount of fuel used to generate the power and heat in a given location, the U.S., it's – let's see – potentially a 33 percent source of energy savings.

Okay, next slide, please. Now, the value of the CHP comes from two sources. One is 'cause you're producing power onsite, you are purchasing less power from the utility, and you don't have to purchase that power. But you have to purchase the gas that produces that power, and so we take advantage of the fact that in large portions of the country we have a price discrepancy between the cost of electric power and natural gas. If you live in an area where electric power's high and natural gas's inexpensive, it'll make sense to be able to produce that, your own power, onsite using natural gas.

Not only do you save in power that you're not purchasing from the utility, you can also be saving on the demand charges. If you're running a CHP and it's running all day long, you'll lower the peak periods throughout the day, which will save you on the man charge, which can be significant depending on the utility.

Next slide, please. The main markets where this type of technology would be most useful are buildings and applications where they have a substantial thermal load and a power load. And so here are just four examples of the types of buildings where this type of technology can be useful.

If you look at health and fitness centers, they have swimming pools, they have showers, they have a fair amount, or a large amount, of power consumption with the equipment and lighting, and other applications. And so this can be a very good application for a combined heat and power-type system.

Assisted living centers or a multi-family housing complex, those are also good candidates for this, where in those two situations you may have a large domestic hot water load that you need satisfy throughout the building. And you'll quite often have common lighting and other power-consuming devices within the building. Hospitality, whether that's a hotel or a restaurant or something of that nature, these types of applications quite often also have a large hot water requirement that can be satisfied with the micro-CHP. And the power generated from micro-CHP can go to offsetting the requirement from those occasions.

Next slide, please. This'll kind of summarize some of what I've been saying. In order to capitalize on the value of the combined heat and power system, you'll want a high thermal load, you'll want a location where you have what we call a high sparks spread, which is really the difference between the electric and the gas prices. And so if you have electric prices on a per-unit energy basis that are somewhere around three times what gas prices are, that would be a good candidate.

There're also other factors that go into whether this would be a good opportunity for you, and that would be the regulatory environment, with the utility particularly in that meter if you can produce excess power, if you can sell it back. Most of the time, though, in most of the facilities you'll be using all of the powers produced, and so that metering is critical.

Other things that may influence the value of such as system are federal incentives; currently there's an investment tax credit of 10 percent on the insulation of CHP systems. And some utilities special gas rates for these, which helps the economics of the system as well.

It is important to point out there are certain regions in the country where this type of technology may not be advantageous for a particular building. And that may be in places where they have low electric rates, or their infrastructure isn't such that the gas is available in a way that would be useful.

Next slide, please. So, the project that we're currently working with Amy's group on at DOE involves a couple different engine manufacturers. We are demonstrating both types of these small or micro-CHP systems around the country. We're involved with Oak Ridge National Lab to do all of the measurement and verification work for us. So, we have a third party looking at that and be able to truly evaluate the performance-based systems, including cost and so on.

Next slide, please. Just to kind of give you an idea of where we are looking currently in the country, here on this slide I've identified several locations where we are installing various different systems. Four of the systems are 30 kilowatt, three of the systems are 21 kilowatt systems.

So these are being installed in different types of buildings. Multi-family housing, particularly in New York City. We have a fitness club we have an outpatient surgical center, we have a hotel, and a commercial laundry. In all of the cases that we're talking about here, we have a significant hot water load, and a high enough electric load where we do not need to sell the electricity back to the grid.

Also in all these locations, these are retrofit applications, so we're going into an existing facility, looking in the boiler room, and integrating this into their existing equipment, without having to replace any of the equipment. We're just augmenting their current system, so there's no risk of any degradation in their performance of their current building.

Next slide, please. This is simply an output of one of the installations that we have completed. The shaded-in area is the time where the system was operating and producing power. The blue line represents a line where the thermal load had – the level of capacity in the thermal system that we needed to satisfy. And wherever that line dips below 100 percent, the micro-CHP system comes on and produces a thermal load for the building.

In this particular day, as you can see, the system started up around – in the morning, sometime between 6:00 and 7:00 in the morning, and it finally shut off about 10:00 at night. And so it was running a considerable part of the day and producing power for the building during that time period.

Then the final slide, please. Next slide. That's all I have, and I appreciate you taking the time to listen to us.

Amy Jiron: Thanks a bunch, Kris. So, I just want to kind of reiterate that this is A.O. Smith looking appliancizing – yes, I did make up that word –micro-CHP. So, making it easier, more plug-and-play for different kinds of building applications. And this is a demonstration, so what we're doing is we're looking at limited applications or like a pilot essentially with Oak Ridge National Lab doing the monitoring and verification of that.

So, we will be publishing a report at the end to highlight any of the performance issues or even the energy savings opportunities that we may not have anticipated at the end of the study, which should be in the next year or so. So, this is kind of like a preview for you of what's to come and what we'll share more broadly when we actually have a report out there and available. And so thank you very much, Kris, for giving us that preview.

Keep those questions coming and I am, at this point, going to turn it over to Cynthia, who is going to talk about something completely different but also very exciting, and I think good for all of us to know and consider as part of our work in the future. Cynthia, take it away.

Cynthia Regnier: Thanks, Amy – *[clears throat]* excuse me. Next slide, please. So, we're gonna be talking a little bit about something very different as Amy mentioned. We actually like to call it "getting beyond widgets," where we're working with sets of utilities across the U.S. to develop packages of integrated technologies that enable deeper energy savings. And I'd like to just walk through the project a little bit with you, and share some of the results to date.

But I'd like to just basically say that everything that we're doing here will be very applicable to the building owner community, to designers and building operators. So, while it has been focused with utilities initially, it's with the ultimate goal of having people actually put it in buildings. So, the deliverables will be very applicable to that end as well.

Next slide. So, what are systems and why are they so important? Some of you may already know the value of an integrated system, but this chart is from an upcoming study that we publish later this year that basically looked at – it was a simulation analysis of an existing building, 80,000 square feet, where we looked at two different methods of retrofitting that building.

One was sort of a standard practice retrofit where all we did was we replaced one-for-one the existing equipment with minimally code-compliant versions of that same equipment. The Best in Class Practice section there is where we replaced that equipment with the most efficient versions that were commercially available of the same technology.

And then finally the integrated system approach is when we really looked holistically at the building and we challenged ourselves with questions like how can we – if we do a better job of designing the envelope, can we reduce the need for pooling? Or do better daylight into the space and reduce their need for lighting in the space and simplify the lighting design? And by doing that we got very dramatic energy savings, and while I'll admit this is a bit of a dramatic example, I do think it's illustrative of the potential for systems to really impact a building's energies.

Next slide. So, the project that we're working on for DOE involves working with three sets of utilities across the U.S. to develop packages of at least three integrated systems. And I'll describe what those systems are in a minute, but first the deliverables of this project are many things, one of which is developing specifications for each of these different systems, and those will be publicly available.

We're also doing – have done – some savings analysis and developed performance metrics for these systems. We're also looking at MMV, which is very important from the utility program perspective. We're asking the question of what granularity of MMV's required to be able to understand the energy savings of these systems? And basically what's the tradeoff of more metering versus uncertainty around energy savings?

We're also building a set of guidance around how to persist with the savings of these different systems. And developing a method to assess for a given building owner or customer's site with the potential for energy savings. And central to all of this project, as Amy mentioned earlier, is we're actually testing in FLEXLAB which is LB&L's newest building technologies test facility, where we're validating the energy savings of these systems. But we're also using FLEXLAB'S capabilities to understand the impacts and benefits of different granularity of MMV savings.

Next slide, please. So, the three sets of systems and utilities we've initially been working with are listed here. The first one is for ComEd. They're out of Chicago, and we're working there to develop a package of automated shading integrated with daylight controls. The markets are listed that we're targeting at, and the whole building, the potential savings are as well, which are quite significant. I should say all the savings on this slide at this stage in the project were simulation-based savings, but I will share actual test results later in this slide presentation.

The second set of system packages being developed with Xcel Energy out of Minnesota and Colorado, and it's a retrofitted daylight-redirecting film that's applied to an existing window, which is integrated with the daylight dimming retrofit. And effectively, that window film allows daylight to direct deeper into a space enabling daylight dimming to be applicable to more of your building square footage.

Very interesting, both of those first two system packages, while they're very perimeter-based technologies, they have very significant impacts on whole-building energy savings. Which is interesting. And then the last technology package is working with a consortium of publicly-donated utilities in California, both Northern and Southern California.

And there we're developing a retrofit of an integrated task ambient lighting system, which is retrofitting your overhead lighting system to ambient light levels through a variety of different means. And that's coupled with task level work station-specific lighting to supplement the light levels. And that task lighting is also integrated with a plug-load control system, and there we're looking at occupancy or scheduled base controls, or both. And there we're targeting small, large office, and also has some significant energy savings.

Next slide, please. So just a little bit more about FLEXLAB before we get into the system results so far. FLEXLAB is DOE's newest user facility for building technologies, and it was designed specifically to study integrated building systems under realistic operating conditions. So, we actually implement them the way that they would be implemented in a regular built environment.

The difference is that with FLEXLAB is we have a lot more measurements and instrumentation to enable us to understand very discretely how things are performing. And we can also very quickly change out and study the impacts of different technology types, different solar orientations, different climactic thermal loadings, and so on.

So, there's a lot of flexibility with the building structure. And while we're studying energy efficiency primarily, we also always study thermal and visual comforts, so we have a lot of capabilities on that end as well.

Next slide, please. So, I'm gonna talk a little bit about the automated shading and dimmable lighting system first. We mocked it up in our rotating testbed at ComEd that we mentioned earlier, so this whole entire test facility actually rotates so we can study the impacts of different solar orientations on energies. It also has two cells. So, we can do baseline comparison in a true apples-to-apples way, which is also very difficult to do in the regular-built environment but very easy in FLEXLAB.

Next slide, please. So, with the ComEd test and using the capabilities of FLEXLAB, we really wanted to study a wide range of permutations and have this technology packaged to be applied in the field. And so we studied different solar orientations, also different daylighting zones of depth. So, we have moveable partitions that basically allow us to represent a perimeter office space of different depths or open office space.

We also wanted to vary the window-to-wall ratio, so we had a means of doing that, and studied and 0.3 and 0.4 window-to-wall ratio. We also studied different types of lighting technologies to understand the difference in impacts for energy savings there. Again, always using this baseline comparison so we could understand impacts relative to the baseline.

And I mentioned earlier, we can also adjust for climate. So, we actually changed the interior temperature set point of the cell to match, to create an interior-to-exterior temperature difference real time, that would simulate the same temperature difference you would have as if you were in Chicago. I know that's a mouthful, but basically we can represent the thermal loading of Chicago in a real-time way, which is also helpful for looking at those impacts.

Next slide, please. So, here's a snapshot of some of our early results from this system. We've got six different configurations represented here. Normal refers to the larger window-to-wall ratio, and small is the smaller window-to-wall ratio. We have a couple of different solar orientations listed here, and already you can see there is a significant energy savings difference between west-facing glass versus south.

But there's still a lot of energy savings to be had. Also interesting is that there's relatively a very small impact for window-to-wall ratio on the amount of energy that you'll save. That's also quite interesting as well. But overall we're saving at least 25 percent energy with this system, and it's upwards of 45 percent for some conditions.

Next slide, please. And then the other system that we wanted to brief you on – the third system is still being tested as well, but we'll have all the results on our website I'll mention at the end. So, for this task-ambient lighting retrofit, we actually are developing two technology packages due to the fact that we're working with California-based utilities. And depending upon the rigor of the lighting retrofit, the California's Title 24 Energy Probe may get triggered.

So, we wanted to have two different versions that are more of a light version of a retrofit and a deeper one that would be able to deploy the system package. So, the first one involves a linear LED replacement lamp methodology for the overhead lighting, coupled with LED task lights.

And the second package is looking at trough or a pendant replacement with LED, and it involves more of the standard controls that would be required for Title 24. But in both cases, we're integrating them with plug-load and task-light occupancy controls options, looking at scheduling and scheduling plus occupancy-based centers.

And I should say that for all of these technology packages, we wanted to make sure that there were a wide range of manufacturers that were able to be represented and applicable to these technology packages, and that's very true for this case.

Next slide, please. So, a couple of quick results, and you might hit Enter again to forward the slide to the energy savings result on that slide. There you go. Sorry, this is cut off a little bit, but this is for packaged too, the overhead lighting energy savings is currently showing we've got 71 percent energy savings. And the graph that's listed there shows the variation of occupancy influencing the amount of energy the lighting energy has used.

Next slide, please. And if you could forward again to have the energy results shown. Great. So, this is also for the same package showing the influence of technology on the plug-load energy savings. And there's a lot more data in this slide, but the main message is that we are saving about 10 percent on the plug-load side.

And I should say that the types of technologies that we're controlling are really only types of technology that an occupant would be okay with going on and off, things like the monitor or a cell phone charger, that kind of thing. We actually kept it pretty minimal; we weren't modulating or controlling any hard drives. We also excluded things like coffee makers or copiers, which would only increase the amount of savings that are available. Overall, combined with the overhead lighting and the plug-load savings, we are showing about 46 percent energy savings.

Next slide. So, our next steps on this project. So, we're still testing different permutations of the technology packages and will be complete by the end of this calendar year. Early next year, we'll be packaging up the results, including evaluating what the different MMV approaches are, and their impact on certainty of energy savings.

And then working with utilities to launch these incentive programs next year. I've listed a website on this slide which has our draft system specifications for all three systems, as well as a white paper presentation with more details on the progress to date, that represented recently at ECEEE.

Next slide, and thank you.

Amy Jiron: All right, and thank you so much, Cynthia. I think that does it, right?

Cynthia Regnier: Yep, it does.

Amy Jiron: Okay. So, just want to have everyone recall that these are technology demonstrations essential for all of our work and partnering with others in the world besides the Department of Energy. So, you saw in Cynthia's presentation we have some of the utility partners on board there looking at the studies and hopefully we'll be transferring those directly into incentive programs. Yeah, you can go to the next slide, and then probably the next slide.

For Kris's project, we are asking for host-site partners, or we help negotiate some of that. And so partnerships, we're partnering with A.O. Smith, we're partnering with Lawrence Berkeley National Labs *[Break in audio]* you know, industry, and these organizations as a part of this to not only leverage the amount of work that we can do but also to make sure that people are aware of what we're doing.

So, the next three slides I'm gonna talk about ways that you all can engage with us on the partnership level. The first one is through the Better Building initiative. Specifically, you can work with us through the Better Buildings Alliance. Currently the Better Buildings Alliance is about 200 partner organizations representing 11 billion square feet.

Everybody pledges to become 20 percent more efficient by 2020, and there are a variety of mechanisms, and as I mentioned at the beginning, there are lots of opportunities to achieve that goal, and we provide the support to help you do that.

So, if you look at the bottom here there are two columns, the technology solutions team and the market solutions team. And you can engage in either of those depending on where you need the most help. And through those teams we convene other colleagues, people that might be doing the same thing that you're doing, to share best practices.

We provide technical assistance. We have webinars that are informative especially about issues that have come up repeatedly throughout our work with different partners. So, I would suggest taking a look at the Better Buildings website and seeing where you might be able to answer some of your questions, and engaging wherever possible if you can. The tech solutions teams are where we focus on technology, but the market solutions teams also answer some of the issues that come up. As I mentioned, such as leasing and tenant engagement and evaluation and data access.

Next slide. Another way to partner with us is to host a demonstration site. So, for example with the A.O. Smith micro-CHP project, we worked through the Better Buildings program in order to find co-site partners. And I think we were successfully able to link up A.O. Smith with one of those, and thank you if you're on the line.

And so every year, we actually come up with a new tranche of technologies that we want to demonstrate to produce that report at the end to help you understand better what to look for in the technologies that you might be selecting. Or to help you understand how you can incorporate those products into your designs, your retrofit projects, your upgrade projects, whatever it may be.

So, this year, this year being – actually last year 'cause we're almost to the end of September, which is the end of the federal fiscal year – we are still looking for energy management analytics demonstrations. We think we have good host sites here but we're still looking for more opportunity, so you can read through these yourself. But there are three different kind of variations of energy management systems that we're looking at demonstrating.

And then in the envelope space, we're actually growing our technology solutions team to add an envelope tech team, where we'll be talking about retrofits to shelves in existing buildings, and also high-performance design with the new construction.

The new technologies coming in that space are actually air barrier, so they're very easy to install air barrier or ceiling technologies to help you losses in your building. And they are meant to be applied in a variety of different climate and temperature scenarios, so we're looking actually at the ease of installation in those. And then coming in the next fiscal year which will be October, we are gonna be demonstrating R-5 windows.
Just so you know, we're actually working on R10 windows as well, so we're gonna try to demonstrate these R5 windows, in hopes that R10 windows are gonna come and take over that and be more cost-effective too. Cold climate heat pumps and brick from the refrigerance because of the outlets have to be by regulation.

Next slide. So, again all of those techs looking for buildings, so please step up and offer us a site if you have one that seems like a good fit. We do a report and pilot the case study as well. Finally, one of the – as I mentioned at the beginning – one of the key core activities that we use as part of our market transformation efforts are campaign, adoption campaigns specifically.

And so in an adoption campaign, we offer specific technical assistance. We offer national recognition and peer-sharing, and what happens is you commit to participating in our campaign. You can talk with the experts in the area and we ask you to kind of share what you're doing so that we can publish that as a best practice, so that others can learn from that. And this is a lot for early adopters who are actually doing this already.

So, the latest and greatest campaign that we have just launched is the Smart Energy Analytics campaign, and through this campaign, we will be searching out those early adopters that are using analytics platforms in order to create low-cost, no-cost energy savings, using monitoring-based commissioning specifically. But anything that uses energy information, fault protection diagnostics and metering-based energy savings measure.

So, that is my request of all of you that are participating today. The projects that we've highlighted today are really set on partnerships, and we continue to serve other partners throughout all the work that we do. These are some examples of partner now, but please stay tuned for other opportunities as well. And with that, I think we're gonna jump into some question and answer, so you can go to the next slide.

Okay, so I am going to let Cynthia recover from talking for a minute here and ask a couple questions of Kris. So, we have three questions that are kind of related, and maybe Kris can answer them together. Actually five questions that could be answered together by Kris. So, these are the questions, and I'll let Kris talk a little bit about them.

First question, do we need extra safety equipment during the integration of existing energy consumption systems? Second question, what type of engine does the micro-CHP use? Third question, are their power factor issues associated with this? How does the CHP produce electricity? And then what is the maintenance?

And actually that's a really good question because maintenance costs and payback are all factors that are really important to the demonstration here. That's what we're trying to look at. So, Kris, do you wanna take a crack at answering those?

Kris Jorgensen: Yeah, all of these questions relate to the technical aspects of the system for the most part, and the user just all together. When this system is installed, the utility quite often will have specific requirements on the safety of the system. How it's related to tying in with the grid. Most of that is standard off-the-shelf type equipment and is well understood.

There isn't a whole lot actually that needs to happen. Most of the, in fact, all of the safety control equipment is integrated into the system. So, it is monitoring the grid for power outages, will disconnect itself during an outage, and all that safety equipment is built into the system. So, there's nothing additional that you need to tie in when it's installed.

The typical CHP system integrates an internal combustion engine and produces power either through a generator or an induction generator. And the typical system will have a cooling jacket on the engine; we scavenge heat from that part of the engine.

We also recover heat from the exhaust system and so it is envisioned that these will be condensing units that will recover almost all of the heat from the exhaust and the engine. They're packaged into an enclosure to help us recover even more heat, and the overall efficiency will be somewhere around 90 percent when all is said and done.

The power factor, the specific question about the power factor, and that only comes into play when we have an induction generator, and in that case the system does come with a power factor correction. And so we handle that as part of the installation, and so we return the power factor before it ties in the building to essentially one.

And then finally on the maintenance interval, these systems are all designed to be for an annual maintenance cycle. So, once a year you'll have to come in and perform a scheduled maintenance on the system. That includes oil change, other consumable or wearable components: spark plugs, spark plug wires. But that only has to happen once a year.

The estimated life for a system, right out of the box these systems can run 40,000 to 60,000 hours before you may need to perform some more substantial maintenance service and maintenance on the system. As far as the cost, that sort of remains to be seen, but we are targeting a three to four-year payback for a particular installation.

And so you're looking at a three to four-year payback and if you're looking at 60,000 hours, depending on the life cycle of the system, or the digi-load of the system, you may have a lifetime of 8 to 10 years on that particular system.

Amy Jiron: Thank you very much, and for clarifications, go ahead and type those into the chat-box if you need that. I would also like to ask all of you to submit any other topic areas that you'd like to see more information on. Such as one person commented about a specific sector in technology or product applications they'd be interested in hearing more about.

So, we'd love to hear that from you. It will help us plan for the next year, and also help you engage more in some of the work that we're doing in other spaces.

That said, I have a question for Cynthia. So, the question is: wouldn't the system make the greatest impact during initial design of the building before construction? And how can we make existing buildings more, I think, of a target for our work, so how can already existing building easily make some of the changes necessary? Such as plans of windows and walls *[Break in audio]*. Can you answer those both at the same time rather than each one at a time?

Cynthia Regnier: Yeah, I think I can. Thanks, Amy. So, I think they are related. I would say that these systems absolutely can be applied to new construction. I think there, there is an additional layer of opportunity in being able to design and lay out a lighting system that might be more optimized. Or design a window and envelope system that has more – understands the tradeoffs between daylighting and cooling and heating loads more discretely. And optimizes on that from that end of things.

But I think that, in general these systems do provide a lot of opportunity for energy savings, and they can be applied both to new construction and retrofit. And I will say that part of the challenge for the existing building stock is that we very much historically have been a very widget-oriented in terms of lighting energy impacts and energy retrofits.

It's much harder to do things like envelope-level changes in an existing building, although they certainly can be done. But it's a lot more effort. So, one of the challenges that this project is trying to address is how can we make those types of investments easier?

Can we package some technologies together in such a way that it's easier for the consumer to understand the potential for impact in their space and be able to deploy it?

And that's why we're doing such a wide range of different tests in FLEXLAB as well, because we wanna cover a wide range of permutations of how this could get applied in the market. So, I think that the opportunity's certainly there, and everything that we're developing can be applied to new construction, but it also is very targeted for existing buildings.

And part of the challenge we're trying to address for utilities and the customer is how to access all these energy savings of systems without having to go to the full extent of the whole-building energy model to understand what those impacts are. So, we're pretty excited about where this can lead, and I will say utilities are very interested in this as well.

Because one of the challenges they're seeing is that as individual technologies have gotten more and more efficient, energy code is right up behind it getting more and more stringent. And so the opportunity to save energy on a widget-based level is decreasing. And yet utilities are still very much on the hook to deliver energy savings, and so they need to start looking towards systems to be able to do that. And it's very exciting I think, that they're now trying to think about ways to put incentives on the table as well to help customers actually get those systems applied.

Amy Jiron: Yeah, and I think a lot of current programs are – they encompass that through their custom programs, but the kinda holy grail here is getting them on a more prescriptive basis. So, take the packages that you've put together, and try to make those – to incentivize those specific packages. And I think that's where we're trying to go with that, right Cynthia?

Cynthia Regnier: Absolutely, yeah. That is correct, and I should say the other end of that, Amy, is that from a utility perspective, it tends to only be the larger utilities that have these custom programs that do these whole-building energy models for some customers. And even then, because that is a cost and labor-intensive process, they will typically only do that for larger buildings or more energy-intensive facilities.

And so that leaves a large part of the market out, and it leaves a lot of small utilities without the ability to provide that service to their customers. And it provides medium and small commercial without access to these deeper levels of energy savings and the benefits of the custom program. So, you're right, it's the holy grail. How do we get to packages and system technologies in a way that doesn't require these deep levels of investigation and whole-building simulations? So, that is absolutely what this project is about.

Amy Jiron: Awesome. Great, thank you so much. Okay, another round of questions for Kris here. So, all these kind of go towards how micro-CHP could be applied. So, the first one is would it be a good fit for a full-service restaurant? And I think we certainly had interest from some of our restaurant retailers or food service retailers in those. So, I think that's a really good question.

And then on the more climate or maybe spark side, what does the blue versus beige color represent on the installation slide? And then the price to see Texas with low-electric rate assuming low spark spread. Also please talk about the Texas installation if you can. So, any of those three in order or altogether, Kris?

Kris Jorgensen: Okay, to begin with, a full-service restaurant would be a very good fit for this type of technology. The problem we ran into when we were trying to find a full-service restaurant for the demonstration was space. A typical full-service restaurant wasn't designed to have a piece of equipment this size installed in the building. And so we were not able to find a full-service restaurant that we could install this in.

However, what we did find was a resort complex, or resort and spa, that had five restaurants within this hotel, and we installed it on the kitchen. And that was kind of our for a full-service restaurant. But we've done a lot of work in full-service restaurant and modeling low profiles for that in our lab, and we feel that is a great application if we figure out how to integrate into the building.

To address the map that I showed where the installation and sort of the demonstrations were – that map of the United States. There's some blue states, there's some beige states. The blue states represent states that when you look at the spark spread and the other regulatory environment of that state, our typically favorable states for micro-CHP type applications, or CHP-type applications.

There, that slide there. The location that we are doing the installations are those little circular dots. So, we're not actually doing one in Texas, but you're correct that Texas does have a low electric rate. The state average is 8 cents, but it also has a very low gas rate, among the lowest part of the country. So the ratio between those two still works out to be a somewhat favorable location.

But anytime you install something with this type of equipment and this type of technology, you have to look at the conditions on the ground right where you want to install it to determine if it makes any sense. Okay, I think that's about it, so –

Amy Jiron: All right, thank you. Okay, great, good. Okay, so we have about five minutes and I wanna get last question for Cynthia, and then I want to shamelessly promote our next webinar and also the Better Building Summit.

So, let's ask this question first. How does the task-ambient lighting system perform in real practice? Do occupants feel the *[laughs]* – do occupants feel the ambient light levels are too dim? And I think in general it's a good question about how occupants respond to some of our energy measures, whether it's task-ambient or if it's just plug-load control or if it's lighting control. And also maybe you can talk about your robot, or your people that you use in the FLEXLAB. Those are very interesting I think for study purposes.

Cynthia Regnier: Thanks, Amy. I wanna talk about my robot; that would be awesome.

Amy Jiron: Everybody loves robots.

[Laughter]

Cynthia Regnier: I love a robot, but we like call them thermal occupant generators. It's really not a great name, but we have basically mannequins that simulate a thermal load of occupants that are used in some of the test-bed. They're great because you can schedule them, you can know exactly how much heat they're giving off, and you can tune them for that.

And they're great for that purpose and understanding their tradeoff of their heating in this space, and how they're impacting the loads in this space. But you don't use them for things like occupant feedback because they really don't engage that way. *[Laughs]* I should've mentioned we also have an occupied test-bed in FLEXLAB.

It's about 3000 square feet of permanently occupied office space, and it's permanently occupied by other lab people. They're not researchers that work on Flexlab, and so they actually have had the task-ambient lighting system retrofitted in their space. And they actually – so they had been living for quite some time with a regular overhead lighting system before we implemented this technology.

And none of them noticed, honestly, that the ambient light levels were a little lower. I think there, in general, is a pretty large opportunity for energy savings just in tuning light levels, is my feeling with that. But overall, the system has been well received. Occupants do like the lights; they actually don't want to give them up. We've had that comment already in some cases.

And I will say that in general, we definitely do feel that need for occupant feedback with any of these technologies is really critical. And as part of working with these utilities, we're making sure that this is still part of their rollout process, so that they understand that the occupant side of things is important.

And part of that implementation guidance that I mentioned early on, we're gonna be developing some best practices that they can work with their customers on to make sure that occupants are well received and served by these systems. And I think that's it.

Amy Jiron: Perfect. Great, thank you. So, yeah, making sure that people are happy in spaces is a pretty important goal for us in the building world, but also saving energy and making sure that spaces are effective and efficient is important. So, balancing those two is probably a good answer.

Okay, so moving on, thank you both, Kris and Cynthia, for being a part of our webinar today. And thanks all of you for joining us, and please continue to join us. I said, "Please participate and partner with us," and there's a really good opportunity to learn about all of this stuff that we're doing on September 29th.

It's what we're calling an open-house webinar, so this is like your virtual open house where you can find out about everything that's going on. We don't have real tables, but we might have virtual tables, so you could stop by a table and ask a question through the chat window. And so please join us for that at betterbuildingsinitiative.energy.gov. It's on many of the slides here.

And then on September 22nd, which is next week, we'll be talking about commercial mortgages for scaling energy efficiency investments. So, if your mortgages are your thing, that's the webinar for you. Please join us.

Finally, with two minutes left, I wanted to plug the Better Buildings Summit which we're having in May. I know it seems like a long way away, but we're already planning for it. It's gonna be really good. I think you would enjoy it if you came. So, please try to join us. Time will fly, so get those travel reservations in right away.

Okay, and again, thank you for joining us. Feel free to reach out. This is our contact information – and thank you for progressing the slide. Feel free to e-mail us, visit the Better Buildings website, ask us questions as you roll on in all of your work, and once again, thanks. Have a great rest of the day, and we'll see you next month.

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