Gabe Arnold: Hello, everyone, and welcome to the 2020 Better Buildings Better Plant Summit. We hope you've been able to attend some of the sessions these past couple days, and have been able to get a lot out of them in this new virtual format.

Next slide please.

Thank you all for being with us today for the Next Frontier in Lighting: Getting Connected with the Integrated Lighting Campaign. We have a great session prepared and some fantastic speakers that we're going to introduce in just a moment.

Before we dive in, there are a couple of housekeeping items I would like to cover. First, today's session will be recorded and it will be archived on the Better Buildings Solution Center. So we'll follow-up with you when we're finished with today's recording and let you know that those are available.

Next, everybody is in listen-only mode, meaning your microphones are muted. If you experience any audio or visual issues any time through today's presentation, please send us a message in the chat window, which is located at the bottom of your Zoom panel.

Next slide please.

I'm your moderator, Gabe Arnold of Pacific Northwest National Laboratory. I'm part of the Advanced Lighting Team here at PNNL. Our team conducts scientific research and lighting technologies, systems and applications. We also support the US Department of Energy and programs and activities to advance the market development and adoption of energy efficient lighting, including the Integrated Lighting Campaign, which you'll hear more about today.

This Department of Energy campaign is really a collaboration. It's a collaboration with building owners and managers, with industry, with utilities, and many others working together towards common goals of more energy efficient and better performing buildings.

So we very much appreciate your time and your interest and your participation today, and we're looking forward to working together on this campaign.

Next slide please.

We have a great agenda today to introduce the campaign, and present some examples and benefits of integrating lighting with other building systems for deeper energy savings. First, we'll hear from Felipe Leon, who will tell us more about the campaign and what it is.

Then we'll hear from three guest speakers, who have been part of integrated lighting projects, and they're going to tell us about those projects and their experiences. Then finally, we'll bring in a couple other expert panelists on this topic for a live Q&A session.

So there will be a lot of good information. It will be fast-paced and you'll hear a lot of different perspectives.

Next slide.

If you've attended any of these prior sessions, you're aware of this, but we're very excited to announce that today we'll be using an interactive platform called Slido for both the Q&A and the polling. So we'd like to ask that either on your mobile device or on a separate browser window that you go www.Slido.com. Once you get there, you're going to enter today's event code, and that is BBSummit. Once you've entered this event code, you're going to select today's session title on the drop-down menu. That is the Next Frontier in Lighting: Getting Connected with the Integrated Lighting Campaign.

So let me give a moment, just for everyone to get connected on Slido. All right. Hopefully, we're all in there, and you're going to want to keep this open. This is what we're going to use for all the questions and the polls.

We'd really like you to ask questions of our panelists, and you can do that at any time through this Slido interface. We'll be answering your questions near the end of the session, during the Q&A panel. I will give everyone just a couple more seconds here to get this set up, and then we'll practice in a minute.

While folks are still setting up, next slide please.

I want to mention that we're on social media and we hope that you'll join the conversation. You can find us on Twitter at BetterBldgsDOE, BetterPlantsDOE, and you can also find us on LinkedIn.

Next slide please.

Let's give the polling capability and Slido a test drive here with some practice poll questions. Everyone, please go to that Slido interface on your phone or your browser that you opened. You'll want to keep Zoom webinar open as well, so you can see the results.

Let's ask something fun for this first one. What's your favorite type of lighting? Is it candles on a birthday cake, a campfire, sunset, sunrise or overhead fluorescent? This should be interesting.

So a question is what can you tell about a person by how they respond to this? Sunrise would be early risers, I'm guessing. Campfire, outdoors people. But it looks like most everybody, they're favorite type of lighting is sunsets. I was hoping we'd see at least some percentage on overhead fluorescents. Oh, there we go. Thank you for that. So now we've got one percent overhead fluorescent.

Okay, good. That worked well. Let's try one more. This question is more serious and we'll probably use this data. We want to see who we are and who we're representing. Are you a building owner or facility manager; an architect/engineer; manufacturer; utility; contractor/distributor; something else?

Okay. We've got a very diverse crowd, which is great to see here. A lot of people in "Other." I wish we had a way to tell exactly what other was. I see we've got a lot of utilities, which is great, quite a few building owners and facility managers, architect, engineers and design professors.

Thanks, everyone. Again, I think the diverse perspective in attendance we have here is great. I think it's going to really help with the input, and welcome.

All right. Let's go back to the deck. It seems like everyone's got the hang of Slido now for polling. When we're not doing a poll, you should switch over to the Q&A tab in Slido to submit any questions you may have about today's presentations.

With that out of the way, I'll now introduce our first presentation, who will introduce the Integrated Lighting Campaign. Felipe Leon joined PNNL in 2014 as a lighting engineer. He was a team

member of the Interior Lighting Campaign, which ran from 2015 through 2019, and is now the lead for the Integrated Lighting Campaign, which he'll be introducing here today.

Felipe has worked on the DoE's commercially available LED product evaluation and reporting program, otherwise known as CALiPER – you've heard of that – that provides independent testing and unbiased information on the performance of commercially available LED products, of the really critical and influential program that helped bring truth to advertising to some of the first products in the market. Felipe had a big role in that.

He previously worked at Eastman Kodak on OLED technology for display and lighting applications, and at Moser Baer Technologies as its lighting product manager. He holds a Bachelor of Science in Electrical Engineering from Florida International University. Felipe.

Felipe Leon: Thank you, Gabe, for the introduction. It's a great pleasure to launch and introduce the Integrated Lighting Campaign to today's workshop participants. I will refer to it as ILC throughout most of the presentation.

The ILC is the Better Buildings Alliance Technology Campaign, administered by Pacific Northwest National Laboratory, with the aim of helping to promote and accelerate the adoption of events, sensors and devices in lighting products, and the integration of lighting with other building and business systems. The campaign does this by providing relevant resources, documenting the adoption of these technologies, providing recognition for exemplary projects and support, and offering limited assistance to participants joining the campaign.

Next slide.

So why is integration of a lighting system important? Lighting systems today may already have sensors that inform the luminaires about occupancy and lighting levels, such as from daylight, enabling energy savings. Increasingly, lighting systems are becoming connected, allowing them to do more than just light a space. The sensors in lighting, sometimes as many as one in each luminaire, such as in luminaire level lighting control, can inform systems such as HVAC and plug loads, leading to deeper building energy savings from the mere sharing of sensor data across systems.

But it doesn't end there. Sometimes the value proposition of today's lighting use cases go beyond energy, and may easily help justify the investment. Occupancy sensor data, for example, over time can help a business understand how its spaces are utilized, potentially leading to operational efficiencies and even reduce space costs. Incorporating more advanced technologies in lighting, such as a mesh communication network or visible lighting communication, can enable use cases such as asset tracking, wayfinding, and new ways of engaging with staff and clients.

These use cases can result in increased revenues, improve patient outcomes and more. So though the initial investment cost may be higher for these systems, in the long-term, the integration of lighting can help businesses save money, get smarter, and operate better.

Next Slide.

So about resources. The ILC provides a list of resources that can be helpful to building owners considering a lighting project with advanced capabilities, utilities seeking information to support their incentive programs, and anyone interested in learning more about these advances in lighting. The resources include utility incentives lists, reports and fact sheets, webinars and training available, mostly for free and some even providing continuing education credits, and product search tools that may help you compare between systems you are considering or identifying the system that meets your particular needs. These resources can be filtered by both category and keywords, and the list will continue to grow as the body of knowledge builds up on these systems.

On the screen capture of the website you see here, you'll see a sampling of some of the resources, including work performed by Lawrence Berkeley National Lab, aiming to unlock the potential of utility incentive programs for integrating building systems; search tools and qualified product lists from DesignLights Consortium; as well as a presentation on the energy savings potential of network lighting control systems; and an educational tool, Education Express, offered for free through the Lighting Controls Association.

Next slide.

Some ways campaigns help build this body of knowledge is by documenting. For example, you can see that interest in the integration of lighting is observed through the participants that choose to join, each expressing their commitment to exploring the advances in lighting that can help their business save energy and operate smarter.

Going a step beyond, these participants can submit their projects to earn recognition for those exemplary projects. Projects recognized are presented in a public forum with information about the measured and observed benefits of that lighting system. In this campaign, that would include how other building and business systems leverage the data to save additional energy or to improve operations. Case studies may also be developed for these exemplary projects to allow peer buildings considering these technologies to access directly relevant information about a real-world installation.

Next slide.

Participants are the primary recipients of recognition in the campaign for their exemplary projects. Some supporters of the campaign are also eligible to receive recognition for the impact their programs have to the integration of lighting or to the campaign. Yearly recognition is held in a public forum, such as a conference, as you can see on this slide, some pictures of recognition events from prior campaigns.

The categories we will seek to recognize in the first year include advanced use cases in lighting, lighting integrated with HVAC, and lighting integrated with plug loads. Then we have more categories to come, so we hope you will visit the campaign's website to learn more and see if your project qualifies for recognition.

Next slide.

Having mentioned participants and supporters already, I'd like to be a little more explicit about the distinction. Supporters are manufactures, utilities, energy efficiency organizations, design teams, and basically anyone that's not a building owner or facility manager. Participants include those building owners and facility managers, but also federal, state, local governments and the military.

On this slide, you are seeing those organizations that have already joined as supporters and participants, and thus have expressed their interest in integrated lighting systems. The ILC appreciates the guidance and support provided by our organizers also: The Better Buildings Alliance, which is a US Department of Energy program, the DesignLights Consortium, the US General Services Administration, the Illuminating Engineering Society, the International Facility Management Association, the Lighting Controls Association, and the International Association of Lighting Management Companies.

Next slide.

So how do you join the ILC? We've made the process very easy. We really ask just a few questions to help connect with you, as well as to learn a little bit about your organization. When you visit the ILC website, now that it has launched – the link is at the bottom of this slide – you'll see a Join selection on the menu bar at the top. Clicking that link will take you a Join page, where you will learn more about the roles of participants and supporters again. Then once you're ready to join, you can just click the Join Today button to begin your registration.

Joining is free, as is the limited technical assistance benefit that you're eligible for as a participant. We hope you'll join the campaign and help us deliver on the goals of promoting and accelerating the adoption of advanced sensors and devices in lighting products, as well as the integration of lighting with building and business systems.

Next slide.

This slide contains my contact information should you wish to reach out to me about the Integrated Lighting Campaign. I'm very excited to hear from our presenters today, because they're really going to share what this campaign is all about. Back to you, Gabe.

Next slide.

Gabe Arnold: Thank you, Filipe, for that introduction. Let's leave this slide up for a moment here. We're going to launch into some polls. Just in case some folks joined late, I want to give them some time to log into Slido. So go to your Slido.com interface in your browser or phone, and you're going to enter that code, BBSummit and select today's

session, in order to access our polls and Q&A session. I'll just give a couple of seconds for people to get there.

Okay. Here's our next poll question. Let's go ahead and launch that. We're looking to hear from you on what type of lighting system integrations are of greatest interest to you. This will help inform the campaign on where we might focus our efforts, and we're asking you to choose your top two here.

It looks like our clear winner right now is integration of lighting with building management systems, which makes a lot of sense. Then HVAC and Internet of Things are currently in a race for number two, then grid services coming in number four, and plug loads at number five.

Okay, fantastic. Very useful information. Thanks, everybody. Let's go to another question, and this is also helping us inform the campaign.

We're asking what types of resources the campaign might provide to help support integration projects. Again, you're choosing your top two here: case studies/demonstrations, how-to guides, resources to quantify benefits, energy savings or non-energy benefits, or product selection tools.

Okay, excellent. So we've got a clear winner here in resources to quantify energy savings. It sounds like some of those case studies we've got on the way, and we're hoping to do more, are going to be useful. How-to guides is up there as well, and product systems/selection tools are also up there.

Fantastic. We will definitely take this into account as we consider the resources we develop or make available for the campaign. Thank you, everyone.

We've got one final question here. This is just asking if you're interested in learning more. If so, please enter your e-mail address. I think we've got it set up such that your e-mail address will not be displayed. It's safe with us, so please let us know if you're interested and enter your information. *[Pause].* It looks like we're up to about a third of you have responded. I'll give that just a couple more seconds. It's still ticking up.

All right, it looks like we've maybe reached a plateau. Thank you very much for that. It helps us to know who is interested and we will definitely follow-up with you. Thank you.

Let's move on to our guests' presentations, and our guest speakers today will be talking about their integration project experience. We've got Kenny Seeton of California State University, Dominguez Hills; Kandice Cohen of Trane Technologies; and Michael Myer of Pacific Northwest National Laboratory.

I will introduce our first presenter. Again, we want to encourage you, if you have questions for any of the presenters, please write them in the Slido as we go and we'll answer them a little bit later.

Next slide please.

First up is Kenny Seeton. Kenny is the Central Plant Energy Manager at Cal State, Dominguez Hills, and he has occupied that position since 2011. He currently manages a team of nine employees responsible for the heating, cooling, and maintenance of approximately 1.2 million square feet of classroom and office space on campus, as well as the Central Plant equipment. As the campus energy manager, he also oversees sustainability, lighting retrofits, commissioning programs, and HVAC optimization and controls for the campus.

I think you'll enjoy Kenny's perspective here. Kenny tells us that while he's not afraid to test the untested, he also believes that if better is possible, then good is not enough. Okay, Kenny, take it away.

Kenny Seeton: Thank you, Gabe. Next slide.

All right, so occupancy-based controls. Why? Because we have to now, but considerable energy savings over the schedule based, reduced greenhouse gas, kWh, kW, reduced customer complaints. It's good for the space with flexible or variable occupancy, which is perfect for me on schools.

The challenges. Occupancy-based HVAC is not common yet. It should be, but it's not. It's difficult to cross those silos to integrate controls in different systems, and you've got to resolve a lot of zone issues.

Why, about. Well understood, widely implemented, required in Title 24, sensors are ubiquitous and available. So all of that stuff is out there. We should be doing it.

Opportunities. Make the HVAC occupancy based like the lighting. Currently, there are lots of systems. We can turn the lights on and off, adjust them to the right levels, the right color, whatever we want, but we also need to go to do that with the HVAC now. We can use the available sensors instead of redundant ones. Hopefully, we can unify the reporting and controls through BACnet, everything we bring into BACnet, building automation system in one place.

Next.

We're going to talk about one particular building that we just got done doing that I'm really excited about the results on. This is our main administration building. It also houses our police station, our IT server room and department, the president, the vice president, the provost. It's got a couple lecture halls. It was built in 2002 and it's much better now.

Next slide.

When we talk about the basis of design for controls, some of the things that we think about are the lighting has to communicate with the HVAC system. Submeters need to be brought into the building automation system. We have to be able to control the individual light levels and the HVAC in every individual office for maximum comfort and productivity.

I've already seen when we start putting in the lights and making it tunable to the individual users, people get really happy. In the past, we would do lighting retrofits and you would set them to whatever you thought was best, and not everybody likes what's best.

How did we do it? Slowly work on creating a campus standard. It didn't happen overnight. I started playing with this in about 2014, getting to finally this year I'm able to do entire buildings and tie it all in. I would do one classroom at a time if that's what it took, back in the day.

You have to get the mechanical design engineer to buy into your vision. So we built two new buildings this last couple years, and I had to sit down with them and explain to them what are the

benefits, show them where the LEED points are, show them how we're going to be able to control things better, how it's not as complicated. Depending on the system you use, it's actually cheaper to install labor-wise than some of the other stuff.

Next slide please.

Some of you will recognize this. We went with the Enlighted control system. This is one floor of the four-story building that I was telling you about, and you can see every one of these little green dots is a sensor and a light fixture. We were able to go in and adjust everybody's offices. Some people wanted different light levels on three different fixtures in their office. The one over their head was one level, and the one by the window or the one by the door was something else.

Next slide please.

So that took care of the lights. That was easy, right. We could adjust the lights. Now, we tie it into the HVAC. That's the most exciting part for me.

So if you look, you can see a bunch of square blocks. In a sense, that's a VAV zone. The VAV is the valve that opens and closes to let air into the individual spaces. In a perfect world, everybody gets their own VAV. In the real world, classrooms get their own VAV, and presidents and vice presidents, but office people have to share VAV. Three, four, five, sometimes six offices share one zone.

So when we control that space on the HVAC, we're pretty much setting a schedule from 7:00 in the morning until 10:00 at night. Now, with the lighting controls, we know if somebody is in this space or not, and we can group that into one control point that says, "Hey, all the lights in these four offices are on. Nobody is in there. Turn off the VAV."

But then we have to figure out how do we bring that into the building automation system. So let's go to the next slide.

There are two screenshots here. The one on the left is a – they're the same. The one on the right is sorted, but depending on what building automation system you have, we use Metasys at our campus, but all of the newer stuff should work.

It's as simple as doing a device search. I'm not a control specialist and I was able to figure this out. We do a BACnet device search. The system goes out there, scours the network and finds every BACnet point. You see at the top is has these CSUDH/NCIS and blah, blah, blah. Those are the Enlighted points, if the design is on or off. Then we have a couple of electric meters, E-Mon D-Mons. Then we have some more lights, more light, more meters, Shark meters, sensors, that kind of stuff.

Once it's brought into this view, you pretty much brought it into your building automation system. It then is a point, just like any other point, just like a thermostat, just like a pressure sensor, temperature. It doesn't matter. Any good facility control specialist should be able to program to that point.

Let's go to the next slide.

Here, we've gone and programmed all those points. If you look down at the bottom right, it says total count is 56. This is a summary screen of the fourth floor, all the VAVs on the fourth floor. So there are 56 different thermostats or VAVs on that floor.

If you look in the middle, where it says damper position, the first 16 are above zero, meaning all the zeros – and you can't see all of them – are because the damper position is at zero because nobody is in this space. So this is critical now with Covid, because that building is only 30 percent occupied maybe, and by doing this, we're able to shut down the air conditioning or the supply air to all those spaces.

Then the most exciting screen, next please.

This is we talk about bringing your energy data into it, so that you can see everything. This building has electric meters on it. So this is a submeter for just this building. This is from January to now – or the beginning of June. You can see in the beginning here, in January, we did the LED retrofit with the Enlighted smart controls on it. So we were working at nighttime, so our energy load went up a little bit. We were also not that populated the first couple weeks of January because of the winter break. Things ramped up. Then as the lights went in, the power density started going down and down and down.

Then you look at the first red line, that line is March 17, when Covid hit and the stay at home order went to everybody that wasn't

an essential employee. At that point, we had the Enlighted and the LED. We had the light levels set, most of them to 40 percent or less, and occupancy was working.

So you can see that we dropped down. It doesn't look like a lot, but it's significant if you were to draw a line across the top of the middle there, all the way to the left.

Then in April, the facility control specialist figured it out and got the lights brought into the Metasys building automation system and the power density just dropped.

If I had more time, we'd have another slide that shows this month. It still dropped even a little bit lower than that. So the top is our kWh, how much electricity we're buying. The middle is our kW demand, which is going to be important when we add batteries to this building and solar. And the bottom shows our fan speed, because that's what happened. When we were able to tie the lights into the building automation system, static pressure dropped way down. The fan speeds were able to turn way down. In the beginning, we were having issues tuning it and commissioning it, and you at the far right it just got nice and stable and it stays that way now.

Next slide.

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

Gabe Arnold: Thank you, Kenny. That was an awesome success story. You mentioned it and I think one thing this prompts for me is what do buildings look like with Covid? What do they look like post-Covid-19? How are they occupied and controlled? And are these controls and integration even more of an opportunity with that?

I've got a lot of questions like this and I guess one more reminder. If you have any questions on what Kenny presented, please write them in the Slido and we'll look to get to it at the end.

I want to mention here that Slido has this capability, where if you see questions you like that others have asked, there's a thumbs-up icon that you can click on, so those questions can be prioritized. So you can ask your own questions or you can give a thumbs-up to others.

Let me go ahead and introduce our next presenter. Kandice Cohen is the Director of Lighting Strategy at Trane Technologies, having worked previously in leadership role with major tier one lighting manufacturers. Kandice has spent her career focused on how efficient, well designed control systems can meet a building's fundamental needs, maximize energy savings, and create value to help buildings and occupants achieve their goals.

Kandice has almost 15 years experience. It was HVAC, and then lighting, and then HVAC, Kandice, right?

Kandice Cohen: Correct.

Gabe Arnold: So she's been working to bridge the gap between these two industries, so these systems no longer live in silos and we can really move forward with a smart building revolution. Kandice.

Kandice Cohen: Thank you so much. I want to start by thanking the DoE for this wonderful opportunity and putting together such a wonderful group. I feel honored to get the opportunity to speak with such esteemed and prestigious people on this call.

I also want to thank the DoE for giving me a reason to actually put business clothes on again today, and for the first time doing hair and makeup in about three months. I had to relearn that skill this morning.

Thank you all, and thank you to the participants for attending. I think this is a really phenomenal topic. I'm incredibly inspired by Kenny's presentation and by what he's been able to do on his campus. I think it's a very exciting use case that can tell the story of what these systems and this technology can do for your buildings and for buildings all across the country and the world. So thank you for telling that story. I'm going to tell you a little bit more and some projects that I worked on.

Next slide please. Thank you.

Studies show that lighting and HVAC consume 70 percent of a building's energy use, but typically, we take these systems and we control them separately in these silos, and very rarely do we actually go across and truly do a real integration, where we're sharing information back and forth, in a platform where we have two-way communication between the systems.

But your energy meter is on the building. Your meter is not on your HVAC system. Your meter is not on your lighting system. It's on the building itself. So if you think about intelligent buildings and smart buildings, these things that we think about for the future, that technology exists today. It's readily available.

Such tremendous advancements have been made in the technology that you can very simply pursue integrating those systems. As you're looking at your HVAC system and your building management system, as you're looking at your lighting system, that's such an easy consideration to start thinking about and pursuing, as Kenny talked about that he's been doing.

There are so many benefits to going down that path. One is simply just increased functionality and smoother ease of operations, if you looked at the slides that Kenny was showing and you saw the granularity of data and control. So I want to make a point about the fact that not all humans need the same amount of light, period.

Then also, we need different amounts of light for different tasks. So if I'm sitting and I'm on my computer, I need a different amount of light than if I'm sitting and writing something or taking notes. So being able to give people that flexibility is a tremendous asset to making them feel more comfortable within that space, but there's also another aspect of this which is data-related.

Having the information about how a system is running, information is power. So understanding that we have a particular area that is using more energy. Why? Should it be using more energy? With this information, we can dig down. If you just have a standalone occupancy sensor, you don't have that data.

But when you have a system like this and you're integrating these systems, not only do you have the data, so you can fine tune the operations of your space very easily through one platform, you're going to get deeper energy savings by having that information, but all of that information is easily accessible to you through a single platform. So you don't have to go and make changes to the lighting system, make changes to the lighting system, make changes to the HVAC system. You can do it in one central location.

By integrating those systems, you really do bring the most value to the space. You make it more flexible and more comfortable for the users, and you can get the deepest energy savings by optimizing the use of those systems.

So this is something that we at Trane are actively focusing on, working with lighting manufacturers to make sure that this technology is accessible to customers, so that if they have a particular lighting control system that they want, we can make sure that we give them all the functionality that they need. Because really, what's important is that they have a seamless experience and that they meet the needs that they have.

So if you have questions, this is something that there are a lot of subject matter experts out there on. We're really focused on this and we definitely want to help you make your space – increase the ease of operations.

Next slide. I'm sorry. I forgot that I don't have control of the slides.

So let's dig into some of the benefits. We've talked about comfort, flexibility and energy savings. So if you do have that sensor and that individual control of each fixture within each space, really being able to fine tune the use of the system to meet each occupant's needs in their offices, not just the president, but anyone in any office. Even people within cubicles may have the flexibility to select their own lighting based on the task that they're performing, or based on a light level that works for them across all tasks.

A really simple thing to do with integration is to share schedules between the systems. So you have one place where that schedule resides, and when that building is no longer occupied at the end of the day and no one is in the space, not only shutting off all of the lights or changing the temperature set point, but being able to do it all in one place.

Probably one of my favorite use cases is using the occupancy sensor data to help extend those energy savings further. So someone walks out of this space. Ten minutes passes. No one else has come in. The lights shut off. But also, to Kenny's point, being able to close that VAV damper, so that we're not conditioning a space that's unoccupied. There's tremendous savings, as you can see, from utilizing that and it's very simple to do through integration.

Another really great use case, as you saw again through Kenny's slides, was being able to aggregate the HVAC and lighting energy reporting on one dashboard. So if that consumes 70 percent of your

building energy use, being able to have one place where you can go and where you can see that.

A lot of companies really care about their energy use and really care about saving energy. So being able to promote that and let employees know and customers know, "Hey, this is what we're doing to help our environment," and having one dashboard that you can go to for that.

I talked about the fact that 70 percent of building energy consumption is lighting and HVAC, but another really nice feature about these systems is that you can also control plug load with them. So you could say a bank of printers or a bank of coffeemakers, we want you to be controlled by the scheduled or, in office space, if the space is unoccupied, you can turn off the monitor of a computer or things like that. So you can do multiple different things.

I actually deployed that in a building in Texas years ago, and we controlled all the coffeemakers within a space, and we saved $16,000.00 in energy just essentially reducing the plug load of those coffeemakers with a few hundred dollars worth of additional material, because all we had to do was tie those coffeemakers to the system. Then once they were tied to the system, they were tied to the schedule. We could tie them to the occupancy status of that zone.

Another really exciting use case that gets used less frequently, but I foresee this becoming a bigger use case in the future, is deploying demand response signals to both the HVAC and lighting control systems. So if you think about your energy bill, and you think about the supply and demand of energy use on our grid, as demand starts to reach that peak of where supply is, having a demand response program, where people can reduce their energy use on-demand, helps us prevent brownouts and blackouts.

Additionally, if you look at your energy bill and you really dissect it, you realize that whenever you have a peak on your energy bill, that peak impacts your energy bill throughout the entire year. So you can do something called peak shaving.

Generally what people do in either peak shaving – or load shedding is another terms that's typical when you're reducing your building energy use on-demand for a demand response event – is they increase their temperature set point. Well, one thing that we

can do that's really slick with integration is we can, over the course of two and a half minutes, dim lights 50 percent, without a human eye detecting a difference because of the way our pupil responds to light.

So for a short period of time, a few hours, we can reduce the light levels in that space without it having a negative impact on anybody in this space. Your company can get revenue from participating in a demand response event. It can have an annual impact on your energy bill because you've reduced the peak on your peak days.

Then in addition to that, because we're reducing those light levels, we're also reducing the heat generating by that light. So as we're raising the temperature set points, we're making it more comfortable for the people in that space during those events.

Next slide please. Thank you.

So I want to talk to you all about a customer that I refer to as the Baker's Dozen. The reason I refer to them as the Baker's Dozen is because they are a commercial kitchen that's available for lease for tenants, and those tenants are using this space to bake products, and they happen to have 13 rooms accessible for lease to package those products. So anyone who's ever gone and gotten a baker's dozen of bagels knows that you get 13 bagels instead of 12. So there are 13 rooms in this space.

So when we started talking to them, the building owner manages the energy bill. So they're responsible for that. They also want to understand how their space is being used. They have tenants in this space 24/7. They're experimenting in this and they're figuring out their business model, so they wanted to have access to how is this space being used. How much energy is being used? But they also, as all customers are, are cognizant of what they're spending for a system like that. So they were looking for a cost effective way of getting this information, and being able to control their space and really optimize it.

Next slide please. Thank you.

So when we spoke to them about what a connected lighting system could do with integration to their building automation system, they had one platform by which they could control both systems. So only one platform that they had to get into to do any monitoring, any reprogramming, any information that they wanted, and that

one platform would pull in all of the lighting as well as all of the HVAC data. It would give them an energy dashboard, similar to what you saw Kenny show, so that they could see both systems on one graph and understand how their building energy was being used as tenants were occupying the space, as well as when tenants were not in the space.

It gave them occupancy reporting. That's something that we haven't really talked much about, but having visibility to when your space is being used and really understanding how that space is being used by those tenants, and being able to track that with energy use. How is energy being used when people are in this space? How is energy being used when people are out of this space? And using that information to make smart decisions about how to optimize that building.

The greatest thing about this was there was a sensor on every fixture. That sensor has occupancy control. That sensor has a photocell built in. It has an energy meter that's pulling that data. It has its individual address. And the payback on this project was under five years.

So a lot of people think that this technology is not accessible because of cost and that's absolutely not true. If you really understand what you're looking for, and you can turn to experts who can help you select the right system for you, you can do all of this truly very cost effectively.

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Thank you very much.

Gabe Arnold: Thank you, Kandice, excellent presentation. I'll now introduce our next presenter. Michael Myer joined PNNL in 2007 as a lighting researcher. He currently supports a variety of programs at DoE, including the Federal Energy Management Program, Commercial Buildings Integration, US GSA Green Proving Ground, Building Energy Codes, and Appliance and Commercial Equipment Standards.

Michael is very busy. I can vouch for that, working alongside him. He has authored or co-authored many technical publications and reports, and made several presentations at national conferences. So we're glad to have Michael's time here. Michael.

Michael Myer: Thank you, Gabe. I'm going to take the opportunity to say please keep the comments and questions coming. I've been getting to see a little bit of them as they've come in, while my co-panelists have been presenting, and some good questions and some good feedback. So thank you.

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One of the earlier questions asked about what are you all looking for, and one of those is energy savings and reported benefits. So I'm going to present some of that data. It varies.

The first thing to know about lighting, PNNL, we analyzed roughly 4,000 different projects, mostly retrofits. We found that by shifting from fluorescent to NHID, without knowing anything about your project, you're probably going to get about 50 percent energy savings. That's from, as I said, about 4,000 projects we analyzed.

We also were able to analyze a smaller set of projects using controls. That's somewhat typical, mainly because fewer projects utilize lighting controls. And they've had somewhere between 5 and 25 percent savings on top of those savings of LED.

Now, again, your space will vary. Your mileage will vary, that type of thing, but that's a type of soft rule that you can use when you're analyzing a shift to this technology.

Beyond 75 percent savings is possible, but it starts getting extremely harder. One reason is that buildings are not necessarily well daylighted, so it's harder to push lighting further and further into spaces. Also, we need to be in the spaces. So some level of occupancy sensors just can't save it because you're in there. Then finally, you're going to some load. But it is still a significant amount of savings.

Why it's important is that most buildings now require some type of lighting control and, as we've heard in the two previous presentations, you can use that control signal, primarily the occupancy sensor, and feed it into other types of technology. One example is plug loads. As Kandice mentioned, lighting and HVAC are representing a sizable portion of your building's energy usage. In time, lighting has really come down, partially because of use of LEDs and other things.

HVAC has had some savings as well, but not nearly as much as lighting has in the last few years. The one building load that is increasing more than anything else is what we call plug loads or miscellaneous electric loads. They are slightly different, but they are roughly the same type of thing.

That's an important thing to know and that's why we started really focusing on that plug load environment. We analyzed about seven to ten different projects and reports, and the savings is somewhere in the neighborhood of 19 to 38 percent, with most of it coalescing in mid-20 percent savings.

Most energy codes, whether it's the national ones of IECC or Standard 90.1 or state specific, such as New York or California Title 24, all require some level of automatic receptacle controls in certain spaces, in certain building types. Why that matters. If you're already going to be controlling your receptacles, how are you going to be doing it? Now, through smarter technology and integration, we are able to do that really with remote receivers at the receptacle level, thereby reducing some of your costs in those retrofit applications or new construction applications, and that's where some of this integration starts tying in.

Finally, we also analyzed a number of reports and projects related to HVAC integration using this occupancy-based control to set back either the temperature, fan, and other factions. That saves somewhere between 18 and possibly even 50 percent. That is a combination of modeled and measured results.

I'm always a little cautious on modeled results. Those tend to be a little higher than practice. So I will tell you HVAC controls, again, you're probably in the mid-20 to 30 percent savings, but that is substantial, mainly because of the size of the actual overall load of what your HVAC represents. So saving that portion is still really worth considering.

It's also worth noting, as Kenny mentioned, Title 24 as well as some aspects of national codes. They are requiring some interaction with HVAC already. Often, you're using that for direct ventilation control or other things, and it is beginning to grow, this more integration through lighting controls. So there is savings potential as well as code reasons why you might want to consider integrating your systems.

Next slide please.

The Department of Energy is either directly or indirectly in seven different projects that are actively in the field right now. They're all retrofits of integrating at least lighting with HVAC and, most often, lighting HVAC and plug loads. You can see from theses different photos that they can be a myriad of different projects.

The military is a combination of both high bay and low bay, also in federal government or university facilities. It really doesn't matter the building type of the integration. However, I would tell you that savings will definitely vary, both on your building type as well as your building design and your mechanical system.

Some of the comments or questions are asked about some of the non-exemplary elements. Sometimes we learn more from failure. I would tell you that the military installation, when they integrated their plug load, it went pretty well. However, they did have a setback in having to update the firmware. So that was a slight setback, but also, they didn't realize all the savings they could. They did recognize about a 38 percent energy savings, but not as much kWh savings as they would like.

I would tell you that when you are doing a plug load design, it's really important to have a champion onsite. You need somebody who is actively encouraging which loads should be in that switch receptacle.

Also, as an industry, we have really not done a great job of indicating what is the switched receptacle. There is a little NEC designation, but you really have to get down there. They almost should be possibly painted a different color or some level of indication, so that people are not negatively affected by plugging in something, like a computer, and then having to wait for a boot up overnight or other things.

A lot of corporations do push updates overnight, when we're not there, and that's the type of thing you don't want on a plug load. You can do it, but it just really requires that onsite champion to help, to remind people and really pay attention to what people are plugging in.

HVAC integration can range. That's some of the questions I've seen pop up in Slido. The military installation I'm referencing here, that had a really almost seamless integration. It really went every easily.

At other sites, the BACnet and lighting controls have had some BACnet limitations on the size of the objects, the number of the objects, as well as verification. I would tell you that was probably one of the harder things to do with this technology. On paper, it sounds like it makes sense, but because it's HVAC it's a little harder to verify in practice that it's actually happening. You need to let it run for a week or two, just so you can see that data, mainly because the thermal environment outside directly affects your loads inside.

So it's not like lighting where I walk away and I come back ten minutes later, and I know the light is off because there is no light. With HVAC, you really need to monitor the building for a longer period of time to make sure the integration is successful. You can also then make sequence changes as a result of that. It is a slightly slower verification process, but well worth it.

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These are just two sample plots from actual ongoing measurements, just to really show you the range of data that you can see. Over on the right here, this is just one project we refer to as the County. This is actual the outpatient facility of it. So can see on the x axis the dates and the y axis the load, and you can see by the blue and the red, when the space is unoccupied that load is dropping significantly.

We found that the majority of your savings are not occurring when you're in the space. That makes sense. But there's a significant amount of load that is just sitting there idle off hours, weekends. That's a great thing to capture savings.

Similarly, on the left, the fan data. We have gotten into an industry where we programmed fans and other things based on building occupancy, but space occupancy is not the same as building occupancy. This is a university and their building occupancy on schedule is something like 7:00 AM to 9:00 PM, but many of the rooms are not used that way. As a result, you can see by the high, significant peaks that once that space was unoccupied that fan was able to drop out and thereby saving additional energy.

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I'm going to take this opportunity to touch on a tangential Department of Energy program. This is the IoT-Upgradeable Lighting Challenge. The idea here is to help the industry move further along and actually address what end users are asking for, which is a solution that is future ready.

Next slide please.

Many light fixtures are being installed today, and they are not including sensors or they will be harder to integrate in an IoT device later in the future. Typical IoT applications might be asset tracking or space utilization or wayfinding or, and I know someone asked in the comments/questions about possibly Covid tracing. So you could imagine a sensor that was able to help determine how many people are in a space or even, if you have this level of data, who those people came in contact with. Those types of things can be accomplished with IoT applications.

The challenge is most fixtures being installed today are either using a semi-proprietary interface or they're not really thinking down the line, so that that LED driver can support it from a data point of view or a power point of view, and that is what this challenge is trying to get the industry to change to.

Why that matters is that a standardized port or interface for a sensor can allow for a faster installation of a sensor. So the example down at the bottom is those fixtures were shipped that way, with a hole for where the sensor will be installed. Then the sensors were shipped separately. Then they were installed in the field.

If in let's say two years you want to change out that sensor because there's a new, novel technology that is better or smarter, it's by having a standardized platform you can do that without having to send an electrician around to modify the fixture or anything like that. So it allows for an easier, faster and future-ready idea.

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So there are performance requirements. I provide some more information at the end of my slides, so you can see more about it. It is focusing on interior light fixtures, mostly interior commercial and industry, your troffers, your linear suspended, your parking garage, those types of things.

It does try to set some performance requirements, just so it's really focusing on lighting quality and color quality. It does focus on what end users have asked for. They like the idea, but they don't want to pay a significant cost premium. So it's saying, hey, it'd be great if this technology existed that was maybe only ten percent or a small dollar added on a baseline model. That way, if we didn't use it in the future, we didn't spend a lot of money, but we do like the idea of a future ready option.

It is asking for the LED driver to be D4i certified. D4i is the umbrella certification that addresses a lot of DALI standards. That's important because it really gets involved in how the sensor and the driver communicate with each other.

It also does require a Zhaga 20 Book interface. Zhaga is an international consortium, manufacturers and others. The idea is a standard electrical and mechanical interface for where that sensor actually plugs in, which allows things to be future ready. If it's a standardized port, in the future, if a better sensor exists or you maybe want to switch to a different technology altogether, by having it standardized people know how to design sensors that would fit that fixture without it having to be replaced.

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Finally, we'd love some questions. I'm guessing there might be some in Slido. Hopefully, in the Q&A we'll get some more. But more importantly, reach directly out to us at Lightingchallenge@pnnl.gov. And users and specifiers, we'd love to hear your ideas on this, your needs. We have a generic letter of soft support saying, "Hey, this is something I'm interested in." It helps manufacturers understand that they can make a product without having to get into a niche market, that people will buy it.

Manufacturers, we'd also like to hear from you as we are about to release our performance target. We'd like to hear your feedback. And ultimately, we'd love for people to build products that meet this challenge.

Thank you and I look forward to more questions during the Q&A.

Gabe Arnold: Okay. Thank you, Michael. Michael presented on a couple things there. One is the number of integration projects the Department of Energy has supported, and case studies for these will be coming

soon, and there will be resources you can find on the Integrated Lighting Campaign website.

He also presented on this separate but related DoE challenge under development called the IoT-Upgradeable Lighting Challenge. So let's launch a couple of polls around this. So please go to Slido and the poll tab.

The first question, we're going to zero in on IoT here for a minute, and we're interested in what IoT applications that might be provided by a lighting system would make you more likely to select, purchase or recommend that lighting system: asset tracking, wayfinding, people counting, space utilization, some of these new Covid-related use cases.

I know there are some interesting things already being done with large retailers using their lighting systems, and the sensors on them, looking at social distancing within their stores and congestion. I attended a webinar by a manufacturer just recently, and since seen press releases from other major manufacturers that they've added some of these Covid-related functionalities to their lighting systems.

Okay. So space utilization is the top. Very good. People counting is number two. Air quality, interesting, number three. I'll give that just a couple more seconds. Okay. You know what. We had intended to include a Covid option here on this poll. It doesn't look like it made it through. So maybe that's included in the space utilization response there. Thank you for that information.

Our next question is around this IoT-Upgradeable Challenge Michael presented that is encouraging industry to develop lighting that is more future proof, meaning it can be more easily upgraded in the future with new technologies, new applications. We're wondering what is the value of more future proof lighting. Is it not important? Is it somewhat important, but you won't pay more for it? Is it important and you're willing to pay a little more? Or is it very important and you'll pay for it?

Okay. So far, we've got a strong alignment around important and willing to pay a small premium for it. Excellent. That fits very well with what we're trying to do with this challenge.

I'll give just a couple more seconds to see if any more responses come in. Good. So thanks for that. It really helps us understand what you all see as important with respect to these efforts.

I've got one more question here asking if you're interested in learning about the IoT-Upgradeable Lighting Challenge, and to please enter your e-mail address if so. We won't display this. *[Pause]*. Thank you for hanging in there through these poll questions. They're really valuable to us. We've got just one more to go after this. *[Pause]*. It looks like we're still ticking up. Okay, we've slowed down.

All right, let's go on to our final poll question. This one, having heard all of our presenters on this integrated lighting opportunity and some of the experiences, what do you see as the top two barriers to implementing these integrations? Is it cost, unsure of the benefits, difficult in quantifying the benefits, cyber security, lack of interoperability, compatibility, or is it a knowledge and experience issue with how to do this or how to manage it once it's been done?

Okay. It looks like our top vote getter here is lack of knowledge and experience with how to implement the integration. Very good. Cost is way up there as well. Interoperability is another key issue. Then, again, a knowledge and experience issue. Okay, fantastic. This will really help us in figuring out what type of resources we can make available to support this. So thanks again for this.

So let's move on to our live Q&A session. I want to bring in a couple of others to this panel, Lauren Morlino of Efficiency Vermont and Ron Bernstein or RBCG Consulting. Lauren and Ron, can you guys wave? I can see you.

You'll note, when we combine them with our other panelists, we've got five topic experts here, all from a different perspective. Kenny is an end user. Kandice is a solution provide. Michael Myer, DoE research. Our new panelist, Lauren, utility energy efficiency program. Then our other new panelist, Ron, is a system integrator. So it's a diverse team. They've all got different angle on this and I'm really looking forward to the conversation with them around these questions.

So we've seen a lot of questions coming in. Again, I want to encourage you to participate and type in your questions or up-vote

the ones that you think are important. Let me give a brief bio of our new panelists and then we'll get going.

Lauren Morlino is an Emerging Technologies and Services Manager at Efficiency Vermont, the statewide energy efficiency utility. Lauren researches and prototypes exciting, innovative, and efficient technologies and services for Vermont ratepayers. Lauren has researched and designed efficiency programs for lighting, controls, refrigeration, consumer electronics, and horticulture, controlled environment agriculture. She is an external advisor on customer-centric program design and has published on lighting and non-lighting topics, and has presented at national conferences. So we're very happy to have Lauren.

Alongside Lauren, we've got Ron Bernstein and he's CEO of RBCG Consulting, providing consulting services to organizations needing help navigating their energy and automation strategy. He has over 35 years of experience in industrial, commercial, and residential automations and controls technologies. His focus is on specification development, master planning, control network, architecture design, and interoperability standards development. He's a published author and frequent lecturer internationally on building automation integration and interoperable control networking.

So welcome, Lauren and Ron.

Let me see. I'm going to kick us off with a couple of questions with our new panelists and then we'll go to audience questions. I want to get myself set up for this panel, so I can see everybody. Let me go ahead and ask this first question.

Lauren, I want to start with you. What's the utility and energy efficiency program perspective on this? Are utilities interested in integration? Will there be rebates or incentives customers can get for doing this?

Lauren Morlino: Great question. This is definitely something that is more interesting for utilities nationwide because of the increased customer functionality, potential energy savings, and also grid connectivity opportunities. I think most utilities at this point would be interested in giving custom rebates for integration, but people have to keep in mind that you'll need to involve them early and often, and also expect to provide them with data points and reports that prove that energy savings.

So far, utilities have already invested in research from the Lighting Research Center that is around HVAC and lighting integration. Then we also see LBNL continuing to expand the Beyond Widgets project, which worked with utilities to simulate energy savings, connecting at least two systems together. So they're working on lighting, automatic shading, plug load, and HVAC integrations.

Gabe Arnold: Okay, excellent. I know as we've been building up the launch of this campaign, we've been talking to a lot of utilities and we've already signed on quite a few of them as supporters of the campaign. There is a lot of interest by utilities in this topic.

Lauren, can you tell us maybe what some of these rebates might look like? What's being thought about or considered?

Lauren Morlino: Yes. As I mentioned, I think a lot of utilities will probably start out with custom rebates. At Efficiency Vermont, we're wading into the integration space thoughtfully, knowing that it's really imperative to increase customer engagement and create interactive strategies in the near future. Customers proactively contact us about integration of their systems all the time. It's usually around HVAC and integration.

Then we have rebated one project so far in Efficiency Vermont territory and we have more in the queue. In 2021, we plan to launch a structured custom program around integration, where we'll help Vermont businesses pay for 50 percent of the cost of integration done by a local controls contractor or integrator. At this time, the plan is to pay for 40 percent of the cost of the integration upfront, and then 10 percent when the project is complete and we receive data reports showing that the building has been commissioned and all of the points are working properly.

So this is a really strategic and important project for utilities, because if we can foster that integration and communication within our customer spaces, then it helps those customers become better grid citizens outside of their walls indefinitely.

Gabe Arnold: Okay, excellent. I know that that LBNL program you mentioned is also looking at whether there can be packaged prescriptive rebates offered. So if you install a lighting fixture that's connected to your HVAC system, can there be sort of a set rebate amount? So there's some different approaches being considered out there, but it's really exciting to see what's potentially coming.

Ron, let me go to you. I think your perspective is unique here in that you've been doing this for quite some time. It's a new topic for a lot of us. You've worked with I know a lot of national accounts, large and small businesses on integrating building systems. What do you think are some of the key use cases here for advancing integrated lighting systems?

Ron Bernstein: First, Gabe, let me say thank you to the panel here for the great insights and for the summit. This is a great opportunity to kind of advance something that has been needed in the industry, which is this reduction of silos that I think Kandice was talking about.

The world that I live in is figuring out a way how to make an overall master plan for the building automation control systems, such that the owner can get value out of each system, and then integrating those systems into a common platform. I love the concept of this single seat frontend. Most of the clients I work with are frustrated with having 10 or 15 different user interfaces for all the different siloed systems.

So specifically about the use cases, I've already heard the three that I was going to talk about, but I want to maybe expand on them a little bit. So the first one is all building systems have some sort of sensor information that could be useful. The lighting system, we've heard about the occupancy sensor, a common piece of information, but some of the newer sensors that I think Michael was talking about expand on basic occupancy of presence/absence detections, to add in things like directionality, density, to track where people are, how many people are in a space and for how long.

That also can be combined with things like air quality. A simple thing like CO2 level in the same sensor can not only provide a mechanism to control the HVAC, but maybe if the occupancy level is getting too high, there could be some sort of warning. Or also providing that information through a security system, and the security system can then say, "Hey, there are a lot of people in this space. Is that the way it's supposed to be or is there some grouping that's happening that we weren't aware of?" So these new multi-sensors and new capability are a great opportunity.

The second one that's been mentioned many times is the demand response. Demand response is mainly thought of from the utility side to control the load, but it could also be used by the facility to manage how the facility is operating during things like a

distributed energy resource activity, where you bring on a solar panel on cogeneration, so that it's not only the utility that's involved, but it could be a more transactive energy model between an aggregator or even the facility energy response team.

So the demand response could be directly down to the lighting system, not just an overall building management system that then goes down. HVAC then goes to lighting. It could be built into the lighting system, where there could be some balance between the energy and the occupant comfort and safety.

The third one, which I think ties in, we've already mentioned it, is the energy monitoring through real time metering. Now we've talked about that from the standpoint of being able to capture data to report back over time, but I think there's also an advantage to looking at the energy monitoring from a real time basis for things like out of range or maintenance alerts, where equipment or a piece of equipment has failed and is either using energy when it shouldn't, and that happens a lot on HVAC equipment, but it could also happen in other systems as well.

So those are three things that we mentioned, but there are some advanced capabilities there that could lead to both the consumption side and the energy side and the occupant comfort side. So I'll leave it at that.

Gabe Arnold: Okay, thank you. I want to jump to some of our audience questions. I think we've got some really good ones here. This one, I think I'll start with Kenny and ask others to please weigh in, if you've got more thoughts on this.

The question is, "How do you handle VAV response and space temp when occupancy is sensed? We have found that it takes a long time to go from standby temp to occupied temp and we get complaints."

Kenny Seeton: That question gets brought up all the time and it's a great question. Every building is going to be different. It depends on what the building envelop is and how much thermal mass you can keep in the building.

What I've found is that most of the time, if your AC system works correctly, even if it's warm in a space and people walk in and all of a sudden it comes on, they don't complain. There are some spaces that are a problem, and we change the controls based on those

problems and opposed to changing it globally and giving up all the savings.

So that's pretty much the answer. Once you go to this system, where you can control everything, you have to actually control everything and not do it as a global overbite.

Also, I'm going to throw this out there and hope it doesn't get me in trouble, but I love to share this stuff and network with peers. If anybody would like a demonstration in July, anytime after July, shoot me an e-mail and we can set up another Zoom meeting, where we can see live data and talk about it.

Gabe Arnold: Okay. Would anybody else like to weigh in on that question from our team here?

Kandice Cohen: I'd like to, if that's okay.

Gabe Arnold: Yes.

Kandice Cohen: I think Kenny's answer is perfect. It also depends on what type of system you have. Do you have a system that has a variable frequency drive? It's very dependent upon the actual makeup of your HVAC system. But again, I think the point that's very strong is if you have that level of granular control, you have the ability to, like Kenny said, still do it globally, but just take these spaces that are problematic for you, where you're getting complaints, and address them differently.

Gabe Arnold: Okay. Anyone else on this questions? Go ahead, Ron.

Ron Bernstein: I think, Kenny, you talked about this a little bit. The most important piece of this is having a good infrastructure and that ability to bring the information from one system to another without – I think one of the polling questions is having a Ph.D. in integration in order to make that work. So I think, Kenny, you mentioned it, having the knowledge and having some level of interoperability or standards at the equipment level and at the system level is going to be so important.

I think it's not only the type of system, but it's the architecture of the system as well. How do you share that data? I think Michael mentioned it as well. There are challenges even within the BACnet standard. How do you do that? How do you make sure that the

information going from one side to the other is not understandable, but is repeatable and it doesn't cost a fortune to do that integration?

Gabe Arnold: Okay. Let me go to another question here, another really good one. "How do we address the silos among electrical and HVAC contractors? With integration, this issue becomes pertinent with regard to training, setup, commissioning, and callbacks." Who would like to take that one?

Ron Bernstein: I can also talk to that. In the world of specifying a project, there are many different divisions, the electrical division, the mechanical division, the voice/data/video divisions. In specifications, we've been writing specifications that silo each of those systems since the beginning of DDC for going on 20, 30 years now.

The challenge is that we've got to get a way to build the integration into those specifications, so that all the different parties know what their roles and responsibilities are. So there is a division called Division 25. I've been writing things that look and smell like a Division 25, but really are a comprehensive controls specification that helps define what contractor is supposed to do what, especially in this world IoT and IP-enabled devices.

We need the IT department and the OT, the information and the operations departments to work together. So we need those better specifications, and they need to be done upfront with the thought process in mind of what you want in the system, "What are your desired outcomes," not just bells and whistles, but the functionality and the performance of the system more than, "Hey, I really want a whiz-bang frontend that I can have lots of fancy graphics on it." That doesn't help with the equipment and the interoperability at that level.

Gabe Arnold: Would anyone else like to weigh in on this question of silos? Go ahead, Lauren.

Lauren Morlino: We're definitely seeing interest from contractors in various industries. For example, our HVAC Efficiency Excellence Network contractors sometimes ask about lighting now and vice versa. So I could definitely see us cross-training those folks in the future, for them to maintain their professional credits to stay in our program.

Then I'd also like to see the silos broken down by manufacturers. So it's really great to see that manufacturers are hiring people like

Kandice, who is really straddling two technologies. That's been a really huge challenge for us in working with customers, where they call their manufacturer and then the lighting manufacturer is pointing fingers at the HVAC manufacturer and vice versa. So the local controls contractor being able to facilitate both of those things is really important. Then also, manufacturers being open to working with other types of technologies is also really important and a huge barrier right now.

Gabe Arnold: Okay. Go ahead, Kenny.

Kenny Seeton: I speak from painful experience on this. We built a brand new building. We integrated Enlighted into the building, got it wrote into the specs, but because this is so new that nobody understands it, the electrical contractor, all they paid for was a commissioning agent to bring the lights into the Enlighted software, turn on and off, and set the dimming levels. Their Johnson Controls contractor said, "Look our job is not to go in and create your points. Our job is to control points." So I ended up having to do the integration or at least the Enlighted portion to create all those points.

Moving forward, like Ron said, you have to have a standard. So as we move forward with this stuff, the lighting commissioning agent has to be the one that creates those points that you're going to touch. And I guess it depends on the manufacturer. If it's a BACnet device, then somebody has to created those BACnet devices and it needs to be the lighting person because that's their software.

Gabe Arnold: Okay. Michael, did you have some thoughts as well?

Michael Myer: I was going to echo a lot of what Kenny said.

Gabe Arnold: All right, let me move on to the next question. We've got a couple that are related here, which are around, "How do you justify this investment for integration, especially if you've already updated to LEDs? The LEDs lower energy baseline can be an obstacle to additional investment in control." Would anyone like to take this one on? Go ahead, Michael.

Michael Myer: I'll come back to the if you've already upgraded. In that military project that I showed, which had lower than national average both gas and electricity, the lighting with controls had a longer payback. Once they integrated with the HVAC, the HVAC savings actually

pulled down the whole project savings. So it made it a shorter payback by integrating it.

So I would say, first, we're already spending money. So the more systems you can get one sensor to talk to, you're just increasing your savings.

I would tell you integrating with plug loads is a little more challenging, in that if you don't actively try to get the right loads on there, you're spending money and not saving enough. So you really need to be much more active. But integrating with HVAC, there's definitely a lot of savings on the table for not a lot of cost, because you've already spent that on the HVAC side. So you're really increasing your operational savings, without having to buy a lot of equipment or those types of things.

If you've already done LED, if you don't have sensors on there, you're kind of stuck. You really need the sensors. You could redeploy some type of sensors and those types of things. But if you have sensors now, some devices can still be done. This isn't something that has to happen right then. It's easier if you do it then, but you might want to investigate what signals you can pull off your occupancy sensors and connect it into the BACnet system or other APIs.

So I would say it's definitely worth doing it. It can actually make the project more cost effective, not less.

Gabe Arnold: Thank you. Does anyone else have thoughts on this question? Go ahead, Kenny.

Kenny Seeton: I would say that in almost a sense we need to stop talking about this as lighting retrofits. It's really HVAC optimization So everybody says, "How do I justify turning the lights on and off for this amount of money," but I've been chasing this since 2014 and finally have a whole building, and the numbers are astounding, as you saw in the graph, of what we're able to do on the HVAC side, like Michael said.

Putting in LED lights is a giant money-saver. Controls is better. HVAC, it just goes through the roof. So you need to sell it based on the whole package and not just, "We're doing a lighting integration." It's an HVAC optimization, and that's a bigger project that people understand better.

Gabe Arnold: Go ahead, Kandice.

Kandice Cohen: One of our colleagues did some phenomenal research and found when people just upgrade to LED and they're not looking at the technology that they're using to upgrade to LED, they save on average about 36 watts per fixture, whereas when you put in an LED that's going to really maximize your energy savings and you add a network lighting control system, you can save on average per fixture 65 watts per fixture. Did I get that right? I think that's correct.

Then on top of that, you layer on what Kenny was talking about in regards to that. Then you add the integration and you add all the HVAC savings. Then you add the savings of the intelligence between both systems communicating, where you can kind of fine tune it.

What we've found is that it really does pay for itself and the costs justify themselves. It's just about taking a measured calculated approach and really thinking through what's important to you. What's important to your facility? What's your budget? And what can you do within budget?

Gabe Arnold: Thank you. Does anyone else have thought on this topic? All right. We've got a lot of questions. I know we're not going to be able to get through these. Maybe I'll just ask a specific one. Let me find it.

"For plug loads, what are the most common energy users that use power that should be switched off, with the exception of copy machines?" We've got to go quick here. We've got about two minutes. Kandice.

Kandice Cohen: Michael made a great point and it falls very well into alignment with my approach here. You get into trouble when you start to switch off people's computers in their personal spaces. So my recommendation to customers is to always focus on the common areas, so banks of printers, banks of coffeemakers, in the kitchen, things like the microwave, anything that's a common use area.

Once you start going into individual use spaces, where people have their own things, that's where you start to – to Michael's point, you really need to be much more communicative with people in the building, to ensure that they know that you're doing that and it doesn't run into a problem.

Michael Myer: I'm just going to build on it and say the Department of Energy's Better Buildings Program has a plug loads group, where we actually provide some of those resources, and we'll make sure we follow-up and include a resource on the integrated campaign, if it's not already there. I think it might be there, but we'll make sure it is there.

Gabe Arnold: Okay, Ron.

Ron Bernstein: I've got two other quick ones on plug load. One is the additional space heaters underneath the desks, especially in a common area where there's an outside door – huge, huge energy consumption, and maybe monitor when that's coming on and help adjust the temperature, so that you're not offsetting all your energy savings by putting in these space heaters.

The other one is hot water heaters, supplemental hot water heaters that are running 24/7 that really don't need to be, especially if they're electric heaters. They can be throttled down in the evening and throttled back up when there's greater occupancy.

So just two high-end energy-consuming devices that are really typically thought of as plug load, but they certainly are.

Lauren Morlino: Miniature fridges underneath people's office desks is something we see alongside those electric resistance heaters that pull a lot.

Michael Myer: Gabe, I just want to clarify one other detail. The integrated campaign does have resources about this as well as a list of incentives for smart controls and smart plugs, so more information there.

Gabe Arnold: Okay. Thank you, everybody. I'm really sorry I have to cut this off. We have some fantastic questions. I wish we could keep this going longer, but we have strict instructions to finish on time.

So I'm going to go ahead and move on, if we could move to the next slide here. We just want to highlight a couple things in concluding.

We have some additional resources available on the Better Buildings Solutions Center. You can see some of those on the slide here. These are some lighting specific related resources. There's all kinds on there, so we really encourage you to visit that solution center to learn more.

Next slide please.

We want to invite you to attend our Better Buildings Summer Webinar Series, starting in July. We've got some really great topics teed up here. The way this works is that partners are going to be discussing some of the most pressing topics they're facing, and really sharing best practices on innovative ways to approach sustainability and energy performance.

So if you're interested in any of these upcoming webinars that's, again, on the Better Buildings Solution Center. Go to that site and then click on the 2019/2020 Webinar Series.

Next slide please.

With that, I would like to once again thank our presenters and analysts very much for their time to be with us today, and especially to all of your, our attendees, for your contributions and attendance today to this workshop. If you'd like to learn more about what was discussed today, you can check out the Better Buildings Solution Center, or feel free to contact any of our presenters at the e-mails that are shown on the screen.

Please remember to visit the Integrated Lighting Campaign website and join, so that you can stay informed about its activities, receive technical assistance, and submit your projects to earn recognition.

With that, we'd like to conclude with this video. Thank you very much, everybody.

[Video plays]

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