

Michael Myer:

Good day on this fine mid-December day, and based on what I'm seeing in the weather, we all seem to be having mostly mild weather in terms of cold in December. My name's Michael Myer. I'll be moderating this call for the lighting and electrical team webinar. We'll start by a slow start – oh wow, we do have 34 participants already. So we'll wait probably one more minute before we officially start, just to give everyone that grace period from running from their previous call or getting a drink of water or possibly using the restroom.

So if you are attending this, you are hopefully aware that this is the lighting and electrical team for the Department of Energy's Better Buildings team. We will be operating in a muted fashion. If you have a question, there is a button down on the bottom if you bring your mouse down there called the Q&A. That is where you can click in there and you can post your question. We highly encourage that at any time during the presentation and meeting. Because of the sheer size of the number of participants, we will not be opening the microphones just because there's too many issues with that if we do that.

So please, encourage you to use the Q&A function if you have some questions. Along those lines, if you have any issues, you can also raise those there. We will be pausing to address questions between the different sections and at the end of the meeting, I will be reading your questions as they come in in case there's any discussion points. We appreciate you attending and it became really popular, so that's why we had to mute the microphones for this call.

So, now it's 12:03. I used that housekeeping time to kind of slow down and pause the conversations. We'll go into our next slide for a second. So, as I mentioned, my name is Michael Myer. I'm shown on the far left. I will be the moderator for today's presentation and meeting. It's really more of a meeting, less of a presentation. We will be starting with some overview of two different programs, but really we're here to find out information, also share some information, but we'd like to learn what you need as either a building owner, a building operator, maybe a manufacturer or a program or maybe a designer. We would very much be interested in kind of how we can help get better lighting solutions out there and also, we do offer other programs as well, but today's focus is going to be there.

We'll first present – our first presenter will be my colleague Felipe Leon who will be presenting what's known as the Integrated

Lighting Campaign and again, we'll pause and take some questions after that. And then second presentation today will be my other colleague who's shown on the far right, Gabe Arnold. He'll be discussing a program called the L-Prize, and then also this new thing that we're trying to kick off, such as Connected Lighting and Educational Resources.

Each of us have been with the lab for a various number of times and we will be – we all have some varying levels of experience coming from industry to utilities and from manufacturing and design. So it'll be an interesting portion or discussion.

We will also have one speaker who is available to present who participated in the Integrated Lighting Campaign. He'll be sharing some of his experiences and his name is Jay and he's with the University of Minnesota and that'll be happening a little bit as well.

So, I have now addressed those type of things. I see a number of people again rolling in on the participant list and we are capturing that information for some follow up. If you are interested, and I'll say it now and I'll say it again later, we do share this type of information through different means.

The Integrated Lighting Campaign, that's the entire URL, it's integratedlightingcampaign.org, you can go there and – I'm sorry, dot gov, I said that backwards, you can go there and sign up for resources where we have a mailing list and you can find out additional types of these events as well as resources. So, we're going to mention that a couple times throughout the presentation, just as a way to stay informed about these topics. Next slide, please.

So here's the agenda, as I briefly touched on a second ago while I was queuing up all of our moderators, kind of see the rough timeline there. Next slide, please.

So this time, I'm going to briefly introduce my colleague Felipe Leon. He is an electrical engineer. He is also a former Navy – sailor, I shouldn't say Navy person, former sailor and he has been with our lab for about seven years and he previously worked for manufacturers in upstate New York both Kodak and then OLED manufacturer. He works on both this project as well as a project for our emerging technology program related to Flickr and then he does some non-energy efficiency work for another program at the Department of Energy at the Pacific Northwest National Laboratory. At this time, Felipe will present on the Integrated Lighting Campaign.

Filipe Leon:

Thank you, Michael. I appreciate the opportunity to present on the Integrated Lighting Campaign and some of those building owners that have joined some of the previous L&E calls may have heard a little bit about it, but we're past our first year and we're very excited. We've got some projects to share with you and we certainly look forward to hearing a lot more about new projects that are being taken on.

But let me give you a little bit of background about the Integrated Lighting Campaign. It's a collaboration between DesignLights Consortium, Illuminating Engineering Society, International Facility Management Association, The International Association of Lighting Management Companies, that's NALMCO, Lighting Controls Association, US General Service Administration and the US Department of Energy. So, you probably heard an organization that you're familiar with. It's because there's a lot of interest in what's going on here.

And what are we focused on? We're focused on integration of lighting. We're focused on more advanced uses of lighting, advances in controls, things like asset tracking and space utilization, HVAC and plug load. That has an energy story still. And then you have internet of things and all these advanced lighting systems are creating an opportunity here to communicate with other building systems and enhance building performance and we'll talk a little bit about that.

The goal of the campaign here on the right is to provide relevant resources that inform your projects. We do that to promote the use of innovative lighting sensors, to encourage that integration with other building systems and we want to document and recognize those innovative integration projects that are leading the way so that others can learn about it and learn how they can apply those lessons to their buildings. Down at the bottom, you'll see our website, integratedlightingcampaign.energy.gov.

Please feel free to go to that and check it out. One, you can join. It's free and easy, so hopefully we'll see some of you on the campaign going forward. But also, there's some resources there that might be available to you, including a case study that we recently published, so feel free to check out our 2021 recognition, which will cover several of the projects that we have here and there's links to presentations and other resources that might be of interest. And I'll share my information. If you have any questions about the campaign, resources, technical assistance, please reach

out to me. Next slide.

So again, these are our organizing partners. So we are happy to have them support the campaign and also provide guidance as well as helping our outreach efforts. Next slide.

So in 2021, what did we do? We had recognition categories, and these are the ones for participants. I'll focus on those today because that's our main focus for these on the webinars. The advanced uses and controls for lighting. That one is looking at opportunities in lighting that extend beyond just your typical day to day dimming and occupancy approaches. Integrated controls for plug loads and lighting systems, integrated controls for HVAC and lighting systems.

Again, those two are very energy focused. The sensors in lighting can help inform those systems to lead to additional energy savings and controls. And the lastly, we understand that there are other opportunities beyond lighting that can be enabled when you use that sensor data, when you're incorporating new types of sensors or communication beacons into your lighting. So other integrated systems and lighting capture those projects that go way beyond the lighting system and we're beyond even energy systems within your building, and that can lead to operational savings and other opportunities in your building to be more efficient. Next slide.

So, in 2021, we received several, man projects and we recognize 13 organizations for their exemplary projects. You can see their logos here on the left, but as a summary here, some of the examples of exemplary performance were across seven building sectors. We had advances in controls where we had four recognitions in that area, integration with HVAC we had six and then we had integration with plug loads, which had two.

In terms of other integrations, we recognized three participants, so we had several projects and we're excited about getting some of these case studies out and published in our website. We also had outdoor projects. I want to emphasize here that the integrated lighting campaign is open to both indoor and outdoor projects. We understand that you might be using advances in controls in outdoor projects just as well. We're integrating with other systems such as communication devices. So congratulations to our participants. Next slide.

So, I'll go over some of these projects and the idea here is to give you a taste for what some of these projects did. I won't go into the

details. On our website, we had a recognition webinar, which goes into a little bit more detail for each one of these, but what I've done here is I've presented a couple of slides that give you the taste for, for example, you'll see on the upper right there's an icon. That one deals with the advanced sensors and controls.

So that's what I'll be doing here is just presenting these, showing you some of the benefits of these buildings and hopefully in your questions, what you'll submit to us is information of order. I'm sorry; when you submit questions to us, please feel free to ask a question about some of these or to share some of your own experiences so that we can talk about that at the end of the webinar.

So, Bryan Health, Bryan Medical Center here is a three million square foot – has a three million square foot building portfolio across two campuses and they did some retrofits that empowered office workers to set their own light levels in their workspace. They also, through the advances in controls, were able to reduce lighting related call to the help desk. The main achievement here was a 57 percent energy savings through their renovation. California State University Dominguez Hills is a multi-use facility in Carson, California.

They implemented Luminaire-level sensors with occupancy, photo sensing, temperature sensing, and energy logging, and also Bluetooth capabilities for the future. What they were able to do here is through communications with tenants, set their average luminaire set-point to about 40 percent of the full light output of the luminaire that they installed and that also led to a 34 percent energy savings. I'm going to say here that that 34 percent energy savings is primarily looking at the control savings. Next slide.

Here the replacement of 1,732 existing lights in Wilmington, Delaware by the City of Wilmington included photo controls, wireless control nodes, light level programming, and streamlined maintenance. They netted a 69 percent energy savings, so congratulations to City of Wilmington.

Mass port replaced 23 existing pole lights. You'll see that these are two outdoor facilities here and at the Conley Terminal Container Yard, they replaced high pressure sodium to LED. Certainly there's some energy savings there, but I think what's exciting about this projects is that colocation of Wi-Fi and security, the ability to program their light levels based on what's going on at the yard, plus also they have a terminal operating system, which allows that operator to modify the light levels based on the needs. So

significant reduction of light pollution as a result of their installation and 55 percent energy savings. Next slide.

And this slide coverage IMEG who has 16,000 square foot facility, a corporate office in Chicago, Illinois. They implemented several aspects into their lighting system including tunable white lighting, luminaires with low UGR and integrated acoustic baffles, and they have ongoing research to better understand physiological and psychological impacts of these strategies that they utilized. There's 37 percent – they were able to get 37 percent below the IECC 2018 building code and they also – what we liked about this is when you install these systems, especially when they're more advanced systems is that communication approach just to let people know about how to use the lighting, how to use all the benefits that the lighting is now affording, so you know, the educational approach to support cross-generational and how they communicated the information about the new systems is something that we were impressed with.

Also, the US air Force Westover Air Reserve Base has a 200,000 square foot facility where they retrofit several different areas, a supply warehouse, a gymnasium, and an aircraft maintenance hangar in Chicopee, Massachusetts. And they were doing occupancy, heat mapping, which allows you to understand how your spaces are being utilized, and then also lighting activity and energy use as well as data visualization to understand how their spaces and how their energy is being used. They netted 460 kilowatt hour per year savings. Next slide.

So I'll move on from some of that advanced sensors and controls, and what we have here is Denver Water who was recognized for the HVAC integration that they had. They were new construction and they have a LEED Platinum building here and they're using radiant heating and cooling. They're able to do setbacks of three degrees and they're getting two to four percent energy savings anticipated. And this is a whole building energy savings resulting from simply the integration of the lighting systems to help inform other systems. So that's exciting to see additional savings on those other building systems at the whole building level. We also have Minnesota Department of Transportation, a 74,000 square foot maintenance facility in Richfield, Minnesota. That HVAC integration also does temperature setbacks, and you'll see that story again and again, that setting back of spaces that are not occupied leading to 82 percent energy savings in this case. And you'll see that asterisk there. COVID did impact some of these results. It is ongoing research that is being conducted by U.S. Department of

Energy. Next slide.

We have two buildings in the state of Vermont that were recognized, the Zampieri Office Building and the Costello Courthouse, so thank you to the State of Vermont for submitting those projects. They were doing temperature setbacks of two degrees. They're also able to control their water source, heat pumps, the run time of their VAB boxes as well as their supply fans and all of this netted energy savings of 88,000 kilowatt hours per year.

For United States Office of Personnel Management, OPM, they have an 850,000 square foot office building in Washington, D.C. where they were doing HVAC integration to do those setbacks. They were doing six degree setback temperature whenever nobody was in the space. Also, those occupancy sensor zones were mapped to 900 separate VAV boxes. So the reported benefits there was increased air handling unit efficacy as well as an energy savings of one million kilowatt hours per year. Next slide.

University of Minnesota has a 25,000 square foot office building in Minneapolis. They also did HVAC integration. We're happy to have them with us. Jay is on with us, so he'll talk a little bit more about this one here, but you can see the setback of six degrees as well as a 46 percent energy savings, so we're looking forward to hearing his perspectives.

And I have Colorado State University at Dominguez Hills here again because they were recognized in two categories. They were recognized in the advanced controls and you've seen them before, but this one is HVAC. So it's very brief here. You'll see that through their HVAC integration, they are getting 27 percent energy savings. So that's very exciting there to see that, the savings there in the HVAC system resulting from that integration of lighting. Next slide.

So, the next category here, you'll see that our archive on the upper right has changed. It's the integrated controls for plug loads and lighting systems. This one is using that lighting information, the sensors, to now shut off loads that are not necessarily based on occupancy. So Johnson Controls has 165,000 square foot corporate office in Milwaukee, Wisconsin. We recognize them for the plug load integration where they're using smart electrical outlets and circuit relay sensors to turn off the non-intelligent loads when they're not being used.

Minnesota Department of Transportation, again, they were

recognized for plug load integration, so they received two recognitions here. In this case, they were getting 71 percent energy savings, resulting from that plug load integration, so congratulations to both of those participants. Next slide.

So, I've talked a lot about right now before I jump into the last category, which I haven't covered yet, there's a poll here on your screen and it basically is trying to understand how you as either building owner, a facility manager, if you're an occupant and you know how your building operates and have a little bit of detail, please fill out this poll and let us know how you are actually maybe already applying some of these advanced integrations with HVAC and plug load systems. So please choose the one that applies to your building.

If you know your building integrates with that HVAC system, please answer like the first one. If you know it integrates with the plug loads or if it integrates with both of them, please select those and if it has no integration and you know that, please select that one. If you don't know, please go ahead and select the last item. So we'll give people another 30 seconds and I'll ask – I see a question here.

Okay. And I think we can hopefully close it up and see the results. All right. We are hearing that many people feel that they have no integration or they're aware that they have no integration. So hopefully through the presentation that you've seen here, hopefully through going through our website, you can learn more about this. Whole building energy savings, being able to save in those other energy systems for lighting, using advanced lighting systems is really an opportunity to net additional energy benefits but I'd like to segue this to say it's not the only thing that you can benefit from when it comes to advanced lighting systems. So thank you for contributing. I'll talk about other integrations now, but thank you for submitting your answers into the poll. Next slide.

So, one of the goals in the campaign that we had was trying to understand those other integrations too, whether it was with the interactions with the grid, interactions with people or spaces, how else are we using sensor information or the lighting system to inform other business systems, for example. So, here's one example. We have Walgreens. They have four retail buildings in Georgia and Illinois – Georgia, Illinois, and Tennessee. They did a life safety pilot where they have automated reporting of luminaire conditions, which leads to a reduction in maintenance costs.

There's also to understand store operations, basket tagging pilot, which helps identify store traffic patterns, relocation of entry and inventory management plan so they don't interfere with the shopping experience. So that's a general retail aspect of some of the benefits that you might encounter in a building. So on the right; you'll see some of the pictures of a store, how it's traffic during the day, throughout the day and then how it might be traffic at certain times of the day to better understand your operations.

Some other integrations, for example here in Johnson Controls' corporate office in Milwaukee, Wisconsin were doing an adjustment of the color temperature throughout the day. That can be done to, for example, match the outside conditions of lighting, automated shades where your lighting system integrates with your shade system to reduce glare and increase the amount of light that you're getting to the building; and then also connected faucets, flush valves, and disinfectant lighting in rooms when they're not occupied, if you can turn on UV lighting to help disinfect that space, that's something that can be done; and then visual guidance via geofencing. So these are just some of the other applications. I'll look forward to getting some input into the Q&A chat there maybe about how you are doing some other things or some questions about other possibilities. Next slide.

So, those are all the benefits, but enough about – enough of me talking about all of these projects. It's a great opportunity to have Jay Amundson. He is – I'm sorry. Nope, we're not there yet. My bad. Other integrated systems and lighting, here you'll see we also recognize Bryan Medical Center here for their other integration. In this case, what we have is a medical building where you are able to now have preset scenes and a foot switch that controls the environment when you're doing x-rays.

That leads to efficiencies and a better diagnostic experience for those that are doing that. Staff in the emergency department are able to control heliport lights from six floors down using a network switch through lighting, and also remote control switch allows nurses to open the ambulance bay doors without leaving their station. So these are all things that are being enabled by the more advance lighting systems. Next slide.

So, some of the keys to success, our exemplary participants, one of the things that we ask them all to share is what are some of the best practices, some of the things that you learned as you were integrating your project, integrating your lighting with other building systems. So here you can see, starts small, learn, and then

iterate and scale up so you can take those lessons and apply them as you try to do, for example, a whole building. Identify ways that you can meet the users' needs in a simple and intuitive way. Get IT involved early. These systems are not communicating.

Getting IT involved early can help certainly to insure success and getting them on board early can certainly help them inform you about anything you should be aware of as you're either considering these systems or selecting a system that might be a better choice in terms of IT. Share information about the project with design operation teams early and often. Also, specifically the capabilities desired and follow through on implementation. One of the things that we heard also was when it's installed, go out and talk to your tenants, talk to people that actually live in the building and get that feedback so you can make adjustments and tweak the systems.

So these are just some of the keys to success and we look forward to if any of you have some additional ones to add, please go ahead and put it in the Q&A. Next slide. So we're excited, 2022 recognition categories for participants. You can see the four on the left are still there. We are still looking for all exemplary projects that are integrating with HVAC and plug loads, some other integrations as well as the advances in controls, but I want to emphasize the ones on the right here. We are looking at integrated lighting and horticultural controls.

Are we leading to either savings of water, additional electricity or how are we enabling higher crop yields, for example. So we have information about that new category on our website. We also want to learn how you're financing and maintaining and operating these in a more efficient way. For example, if you had to decide between just a basic system and an advanced lighting system, what was it that made you go for that advanced lighting system? How were you able to finance it to make sure the numbers were right and we'd love to hear about that so we can tell others how to do that? Next slide.

So, again, University of Minnesota was recognized for HVAC and lighting systems. We're happy to have Jay Amundson. He's the district engineering manager at University of Minnesota and Jay is on with us. Jay, feel free to – there you go – unmute yourself and turn on your camera. And Jay, please tell us a little bit about your project so that people can get a sense for how to live with these systems and how the process was for you.

Jay Amundson:

Yeah, thanks Filipe. I had a clue I'd be first with your earlier mention to University of Minnesota, but anyway we're excited to share with you about this project. We call it successful. We were really mostly interested in the HVAC integration, but for us, it started with finding the right building.

Jones Hall, as you can see in this photo, was built in 1901, but significantly remodeled in 2005. It had mostly fluorescent tubes and basically VAV box control for the heating and ventilation and air conditioning. And this building was really suitable because it was small enough to measure accurately and less distraction, if you will. And it also had the majority of office spaces with probably 20 percent classrooms and then it had an auditorium.

And the auditorium was probably used – is probably used a couple hours a day, so it's got that in and out occupancy pretty often. Same with classrooms, a little more frequently used and as you all probably know, offices are a wildcard. Some are used all day and some are not. But, you know, the HVAC integration was the important part for us.

Basically, we installed pre-light fixtures, the LN fixtures, which basically has an onboard photocell and an onboard occupancy sensor, which turns lights on and off. We do that quite a bit on campus at the University of Minnesota and by the way, we have hundreds of buildings to manage, but we do that pretty predominantly.

What we did in this project was we used that signal that the onboard occupancy sensor gave out and what we did there is we integrated through back net, so we had in one of the keys to success that Filipe was talking about is really understand and get ahead of your OIT process for getting everything – for instance, in our case, onto the wireless network and then through back net.

So what we did then is we took that signal for every single light fixture and we grouped them. We grouped them per space and not per fixture and when that grouping was off, then that signal was sent to our Johnson Controls medicine system, and then we used the back net point to develop an interlock between the occupancy sensor and then the occupied command for the VAV box.

Now, in the future, we anticipate having less VAV boxes as we try to be more energy efficiency with our air site, but for now, we have hundreds of buildings with VAV boxes, so the beauty there is instead of having the occupancy of a classroom, let's say be driven

on a timer, a schedule, so the building is open at 6:00 in the morning and closed at 10:00 at night, it allowed us to on and off turn those VAV boxes to a standby mode which is basically occupied is one mode, unoccupied is another and then a standby allowed us to drop our temperature a few degrees, but not too much that it couldn't covered in just a few minutes if somebody walked back into the room.

So, yeah we were really happy with the success of the project. I think one of the things that everybody knows, we finished this project just ahead of the pandemic and so getting good measurement of our success has been a little more difficult and I think we're maybe a year away from really understanding the value, but we are reportedly showing forty-some percent savings. I think right now, we have a lot fewer people in the building, so we're even showing more savings, quite frankly, but we're not at back to normal yet by any means, as all of you are aware.

But anyway, thanks again for time and Felipe, I'll let you go on to the next one.

Filipe Leon:

Great. Thank you, Jay, for sharing perspectives and detail. And congratulations again. Next slide.

Great. So now we'd love to hear from you. I shared the categories here for recognition for 2022. If you had to think about a project that you might be undertaking, I know we have a lot of supporter types. I haven't gone over that. Please go to our website, learn about the difference between participant supporters, supporters are utilities, manufacturers and others that support our building owners and facility managers within products or services. But if you have a project that you know is coming up or if you have a project that you've already done, or if you know somebody that might be wanting to submit in that area, please select one of these categories to let us know that, you know, get a sense for what we might see in year two from at least the audience that we have here today.

And here, you can select as many as you feel you are aware of or as many as you implemented in your building. So you can choose more than one. And I should say, there are also – while you're filling that out, there are supporter recognitions that we do. For example utilities provide incentives for many of these advanced lighting projects. If you're a utility, please go to our website and check us out and join the campaign, share about your incentives so that we can recognize you. There's also diversity, equity, and inclusion champion in the supporter category. We're looking for

what organizations are doing out there to support those efforts. So that's a new recognition this year. We'd love to hear from you.

So let's go ahead and see the results from poll two and see where many of you might be leaning, the advanced sensor and controls, certainly, luminaire level lighting control, these network lighting controls, we're very interested in that, so please, if you do have a project already, come to the campaign. HVAC and plug loads, it looks like – I saw the earlier poll. I know that there were only a few of you that said you had it already.

So I look forward to hearing about new projects that are going to now implement that integration. And then horticultural, great, I look forward to hearing about that, hearing how we're saving water, how we're creating better crop yields. And then lighting and other integrations, we tend to see that the energy savings seems to be the main thrust for this, but don't lose sight of those other integrations and those other opportunities. And innovative maintenance facility management, unfortunately we didn't see anything, but hopefully many of you are leveraging the incentives that are out there, are looking at things like value as a service and using some of those models to help fund your project. Thank you for participating in that one. Next slide.

So I want to thank you for your time. There's our website link again. Feel free to contact us. That's our e-mail for our website and we will get back to you if you send us a message there. But I will now send it back over to Michael. I'd be happy to take a couple of questions about the campaign or the presentation before we move on.

Michael Myer:

Yes, thank you Felipe. I just wanted to grab you while you were still there. So a handful of questions, but I'm going to be conscious of time so we can move to our next section. The first question was, we reported numbers of energy savings and the question really is, were those total building energy, so maybe electricity or just lighting energy?

Felipe Leon:

Yes. So I did put the numbers there that we have in our presentations and I will say that we were primarily seeking that benefit of the integration. So what were the additional energy savings that were netted from the advanced controls more so than just a simple conversion from, let's say for example fluorescent lighting to LED lighting. However, many of our participants were not able to separate everything out, so if you go to our website, look at our presentation from the webinar. That provides a little bit

more information but the key one is going to be the case studies that we've published and we'll be able to share that. So, the answer being yes is that we did collect information for several projects. Some of them we have, for example, an aggregate of the energy savings, so that could include just the conversion from fluorescent to LED, but we also were able to obtain numbers that talk about that benefit of just integrating the lighting. How much did I save in HVAC from now having the lighting system integrated? So thank you, Michael.

Michael Myer: Great. We'll do two more then. Just conscious of time. Related to data gathered, we showed a number of energy stories and you just kind of discussed this, but did we get any non-energy data captured from these systems?

Filipe Leon: Yes. It was a lot harder to come by, those other integrations. You can see that we did recognize three participants for other integrations. And now the key thing that I'll say here is that many seem to be focused on that energy savings aspect, as are we, of course, Department of Energy, we're very interested in those energy savings, but we recognize that through those other integrations, there are other benefits and we think of the 3-3300 rule.

When you think about building costs for an organization, when you think about people costs, you know, increasing efficiencies in those areas can certainly help you or tip you towards the adoption of these LED systems, of these advanced systems. So, we are compiling that data. We are sharing the information that we have from those other integrations. And we know they are important in terms of helping buildings operate smarter, helping businesses operate smarter, but also, it's still an ongoing process and we are still capturing it this year.

So interactions with the grid, interactions with other buildings systems, anything that you're doing in terms of – we saw for example from Walgreens, we had that life safety pilot where you're getting information so you can do corrective actions before anybody even knows about them. So, that's something that we're very interested in is automated fault detection diagnostics.

Michael Myer: Great. That's helpful that now we've got other data and I like diagnostics as well. We'll take the rest of the questions offline. There are a couple more. I need to keep moving along for good information for our other colleague. So I'm moving to the next slide please, and thank you for both Gabe – I'm sorry Filipe and

Jay for presenting. So I'll be turning the next presentation over to my colleague Gabe Arnold. He's been with the lab just now two years. He comes to the lab with both utility experience and most recently from the DesignLights Consortium and while he does work for Pacific Northwest National Laboratory, he is actually located in Vermont. So, at this time, I'll turn over the presentation to Gabe for connected lighting system educational resources.

Gabe Arnold:

Great. Thank you, Michael and thanks, Felipe and thanks, Jay. Hailing from Vermont here as Michael said. So our next topic is connected lighting system educational resources, and I'm going to start by giving you a little bit of background on this topic and what we're proposing to do and then we're looking for your input, actually, on which topics to address and how.

So let's start with this adoption curve. And this is showing us mainly the current adoption levels of LEDs and common lighting applications. And of course, all of us out there experienced this rapid technology change with LEDs. It really only started about a decade ago and it's just been astounding how quickly it happened. And, you know, if you were in this prior to LEDs, lighting was one of the kind of slowest and maybe stagnant industries and now it's one of the fastest changing and it's just been a massive energy saving success.

So if you look at this chart, obviously you've got some things on here that change really quickly. Traffic lights are on here and that's up near the top and nearly have completed that transition to 100 percent adoption. We've got street and roadway lights that are on here that are now at over 50 percent adoption of LED. Linear fixtures you might find in places like offices and schools. Still have a ways to go. They're at about 25 percent, but this change is happening really quickly to LEDs. A lot of people are converting. It just makes a lot of sense from a lot of different perspectives.

But here we are with connected lighting. And sometimes people will call this network lighting controls, advanced lighting controls, luminaire level lighting controls, these are all kind of the same class, the same type of product or system. And this is a technology that's been around for a while, even before LEDs came along, but it's way down this curve at about one percent adoption. Next slide, please.

So that's really too bad 'cause this technology can save a lot of energy and this is one estimate of savings of the technology from a recent report that was published by the DesignLights Consortium

and the Northwest Energy Efficiency Alliance. And it's showing a savings of connected lighting systems across about 190 buildings and one thing you'll see here is that the savings can vary widely from a couple of percent way over on the right to over 90 percent on the left, but on average, they found 49 percent savings and that number is sometimes referred to as a control factor. It's lighting energy savings and so it can reduce your lighting energy usage by about half, so while we recognize that LEDs are quite efficient and they're not using as much energy as they used to as a proportion of the total building load, even reducing that riding energy use by half is still a big number. Next slide, please.

And beyond the energy savings, connected lighting can provide benefits and capabilities, some that Filipe talked about. When we've got connected lighting sensors in all of our lights and beta connectivity between them and with other systems, we enable features like tracking assets in buildings. You can attach little wireless tags to devices. You can put wireless tags in badges and use that information to understand where objects are in your building and where people are in your building.

And so this is being deployed right now. One of the common use cases is in hospitals, all kinds of equipment there that they've got to track and they spend a lot of time trying to figure out where that equipment is. So this is a solution for that issue. One of our integrated lighting campaign recognitions that Filipe just talked about is Walgreens, and they're testing this approach, putting these tags on shopping carts that are actually kind of tracked by the lighting system and using that information to better understand how their customers are using their stores. And you can use this data for things like optimizing the use of spaces.

There's even COVID applications which I hope we won't need to use, but, you know, you can use this for things like contact tracing or social distancing management and that's just a few. The point here is that there's a whole lot of value in this technology beyond just energy and if we can support this additional value, we can support the greater use and greater adoption of the technology. Next slide, please.

The challenge we have and why the adoption's been so low is that you've got a lot of barriers to this technology adoption. And number one, the technology can be expensive and if you're only basing the value on energy savings and not the other benefits it can provide, it doesn't always pencil out with a quick payback. That's not always the case. There are some projects that would use

advanced lighting controls that do pay off quickly, but there's a number that don't. So that's been a real issue with the adoption.

The second one down here, there's been a lot of challenges with lack of standardization. There's a lot of proprietary systems that are on the market which means each system is different in how it's installed, how it communicates, the data it uses, the data it's able to share with other systems, and this lack of standardization, it really kind of exacerbates some of the other barriers on this list. Complexity, this is a complex technology.

You've got a lot of nodes of connected lighting, you know, with every light fixture and every sensor and you're trying to do some advanced things with it and controlling the lights and connecting to other systems. And that kind of feeds into this next barrier, which is lack of knowledge and experience and kind of wrapping this back to the standardization issue, it's harder to educate and train the workforce on how to use this technology, how to handle the complexity of it and really realize its potential if every system on the market is different.

So don't get me wrong here, there can be some benefits to proprietary in some areas, but there's a lot of opportunity to standardize aspects to make this technology easier for people to use and easier to educate people about it. Finally in these last two areas polland perhaps unfortunately, I think we've got some poor past experiences and some stigma we've got to overcome here because there has been a lot of users and starts or contractors who've really been on the leading edge of this technology over the past decade and sometimes that's called the bleeding edge and they've had some problems installing or operating this technology and they're hesitant to use it again. So that's something we'll need to overcome.

So one piece of the solution here, and I'm kind of getting to the punchline, that I think has a role in addressing all these barriers is education and what we're proposing to do for the department of energy is to develop a suite of educational resources on connected lighting. Next slide, please.

So these resources would be targeted to specific knowledge gaps, barriers, or opportunities and we're really looking to tailor them to specific audiences and especially the building owners and managers and the practitioners, the people who are making the decisions of whether and how a connected lighting system is installed on a project. Some of you may recall the really massive

DOE educational effort on LEDs from about a decade ago, and there were all kinds of materials that were developed and disseminated by DOE and lots of partners out there. There were lots of fact sheets, training and we're aiming to replicate and do some of the same things here with connected lighting. We think there's a real need for it. And these researches are not intended to be long technical reports that few people will read, rather we're aiming to make them very accessible, easy to understand and use, and we're looking for your input on which topics should we address, which ones are the highest priorities to address for these resources and then what is the best format to deliver on them? Is it a fact sheet? Is it a short tutorial video? Should we focus on getting together some content that can be kind of built in to some of the workforce training programs that are out there?

Maybe we're working to try to build this into training programs for technical licensing, things like that. So there's a lot of ideas here and we're going to be reaching out over the coming months to a lot of people to get input on this, but we wanted to get this started today with a couple of poll questions and the first one is on the topics to address and the second is how to deliver on the resources. So, next slide.

And we can go ahead and launch this poll and we're interested in what topics do you see the greatest need to address with educational resources? Is it some resources to help you choose the right system for your project? A resource that really lays out the technology benefits in terms of energy and non-energy? Is there resources that would help you understand kind of the differences between proprietary system and maybe open systems and how that should play into your decision making process? Resources on integrating with other systems. I'm going to stop reading through all of these because I think we're actually quite a bit short on time. Why don't we go ahead and close that poll and see how it turned out.

So this was a ranking poll, which I have not actually used before and seen the results of. Okay, so most people chose for their number one resource, a resource on system selection and I would not say there's any more clear winners except integrating with other s systems. All right, well, it's going to take us a little bit to digest these results, so thank you so much for that input there. Why don't we go ahead and move on to the next poll and that's a question of how – what's the most useful way to deliver on these resources? Is it one to two page fact sheets? Is it detailed technical reports? Is it short tutorial videos? Detailed webinars? Content to

be used by others in workforce training? And again, you're ranking here, but we're just giving you three choices to rank.

All right, why don't we close that one down and show that real quick. And looks like a lot of interest in the one to two big fact sheets and the short tutorial videos. Great. Thank you so much for that input and you'll be hearing more about this effort in the coming months. So why don't we go ahead and move on to the next slide.

And I'm going to have to rush through this. I wasn't left with a whole lot of time for it. So our last topic is the DOE L-Prize and next slide please. And so this is a new Department of Energy competition. We are really excited about – I imagine some of you were in this space about ten years ago when DOE awarded the first L-Prize which was ten million dollars to a manufacturer that was able to develop a first of its kind high quality LED lighting replacement for a 60 watt incandescent bulb. And Philips Lighting was the winner of that one and look at how far we've come now with this technology.

And now DOE has launched a new L-Prize and this one is targeting commercial lighting systems, not bulbs, but commercial systems. And DOE's really looking for some groundbreaking innovation in this space. This new prize has \$12 million awards. It has three phases that are stretched across three and a half years, a concept phase, a prototype phase, and then a manufacturing and installation phase.

The concept phase actually just closed. We're right now as we speak evaluating those entries and there's going to be a lot of opportunities for you to participate in this prize, not just for the competitors, the people that are entering, but for all of you out there. So what I'd like to do is tell you more about it and let you know how you'll be able to participate. Next slide, please.

So this new L-Prize is again focused on LEDs like the first one, but specifically it targets, as I said, commercial systems, commercial and institutional sector applications. And it's a competition, it's not just a bulb here. This is a full lighting system, which includes the luminaire as well as the lighting control system that goes with it. Next slide.

It's got five focus areas. We're looking to drive innovation, efficacy, quality of light, connectivity, product life cycle, and innovation and inclusion. From the efficacy perspective, we're looking for

lighting that is at least 150 lumens per watt and at the same time is going to deliver exceptional quality light in terms of glare control, distribution, color rendering quality and flicker .

Connectivity, we're looking for innovation in connectivity and controls and in the lighting systems themselves as well how they connect to other systems and the fourth one down here, the one thing I'm really excited about is this new competition incorporates some new aspects of sustainability under this product life cycle area to support a circular economy.

This is a topic that maybe the lighting industry is a little bit behind on relative to some other industries and there's a lot of I'd say discussion and momentum around it and really excited that it's part of this competition. And then finally, the last part here, this new L-Prize incorporates some incentives for innovations that support greater diversity, equity and inclusion and how lighting systems are designed, how they're produced, how they're deployed or how they're installed. And this is really trying to get at how can we get these innovations and advanced technology deployed, not just into the class A office space and those with big pocketbooks or sophisticated staff to operate the systems, but how do we really get them deployed to everybody out there? Next slide, please.

You can break down these topics into subtopics where the L-Prize, we've set some minimum mandatory requirements that every – any winner must meet and then optional points where we're looking to really incent some new groundbreaking innovation. And I don't have time to go into these, but there's some ones of interest in here, I think. I'm really looking forward to see what industry can bring forward about them. Next slide, please.

So as I said, there's three phases. We're in the concept phase right now and entries were due just before Thanksgiving and we're reviewing those. And this phase is really just about concepts on paper, ideas and the prize amounts or 20,000 each, but as you move along with this to the prototype phase and then the manufacturing and installation, the stakes increase significantly to millions of dollars and just a small handful of winners. Next slide.

And then the last phase, the manufacturing and installation phase is where we're really looking to drive not just creating these innovations, but the deployment of them into the market, the competitors don't just need to show they can make it, but they have to sell and install it to win this. There's points that they can earn for the number of US installations and one piece that I'm proud of here

is that we're actually awarding US content and assembly. This is – the lighting industry is a global industry and many of the components of lighting, especially LEDs and the electronics, they are manufactured internationally. And we're definitely not going to change that with this prize, but what a lot of people don't realize is that we've got a multibillion dollar luminaire assembly business here in the United States, and that's something that we really want to support.

And so, we've got kind of a multiplier here built into the scoring of this competition, based on the amount of US content of the submissions and we actually require US assembly as part of it. Next slide.

So the last part, how can you support and participate in this effort? Well, that opportunity is coming up soon. We will be issuing a request for information or an RFI with the launch of the next phase, which is currently scheduled for February or March of 2022 and this RFI is where you will be able to respond to express your interest to partner and or support this L-Prize. It's an RFI that will be continually open. You'll be able to sign up at any time and it's going to lay out a few ways that you can consider participating. You'll be able to express your interest in being a host site for one of the competitor's installations. You'll be able to express your interest to partner with DOE after we've awarded the winners to evaluate or demonstrate some of the innovations.

We'll be looking to work with utility partners to develop incentives from the innovations. So look for this RFI coming in March of 2022, maybe February. My money's on March and I hope that we'll have the opportunity to talk again with you all around that time. I think we do these calls quarterly or so. So I think that's all I've got on the L-Prize. We've got a couple of minutes left. Any questions, Michael, that came out on any of these topics?

Michael Myer:

Two general feedback about the ranked choices. They were needing a little more time to properly rank and that's one of the feedbacks. Those were the two high level questions. I think the thing to think about or to think we can do is how can we share some better resources. It sounds like fact sheets and limited duration tutorials were the highest ways of sharing information.

Gabe Arnold:

Okay. Thank you for that. I do apologize for the time constraints there.

Michael Myer:

Yes. And there's one other question that I'm reconciling and I know you're tight on time. Sorry, I'm pulling it up right now. But I would echo your request for – we will be having another one of these in 2022, but we are also honestly, we as a national laboratory work for the Department of Energy, which is funded by tax funded money. We want to help you and your organizations get better and more efficient lighting technology, as well as other lighting technologies into the marketplace.

If you have a need, we can help work on that, whether or not it's a resource, we may already have generated it. If you need a novel one and there's enough interest, such as specifically how to integrate lighting with plug loads or maybe a short kind of flow diagram with integration with mechanical systems, we'd like to hear that. We'd like to know how we can help get resources for you. You can find all of us through – at PNL – PNNL.gov. You can find us directly or you can reach out to me since I'm speaking, I'll mention it, and I know Gabe has to go. The L-prize team is calling him. They have a big meeting today to evaluate.

My e-mail address is Michael.myer@pnnl.gov and if you reach out to us, we'd love to hear any of your needs. Really, we are here to help you. We have been given a direction to try to help get more efficient technologies out into the market, really looking at that market barriers and anything we can do maybe sample guidance or language on financing models, things that we can help, we'd love to do them for you.

So please reach out and if there's enough of a need or we can show that this would be really critical, it's definitely something we can take over. At this point, I'm supposed to say next slide because we're coming up on the final minutes and there are all of our e-mail addresses, so you can reach out to any of us on any of the topics that we've presented. So that is where we are. Thank you for attending this meeting.

We will be having another one in 2022, actually more than one in 2022, but we'll have one in the first calendar quarter then and we'll be following up with any of the questions and feedback we received. Thank you for your time.

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