

Cedar Blazek: Good morning everyone and welcome to Day Three of the 2021 Better Buildings, Better Plant Summit.

Thank you all for joining us to learn about our Better Buildings Alliance Technologies campaigns.

My name is Cedar Blazek and I lead the technology campaign program here at Better Buildings. Our BBA technology campaigns lead by DOE's National Lab aim to accelerate the adoption of efficient building technologies by providing technical assistance, resources, and guidance on implementation best practices.

In 2019 participants reported savings of more than \$250 million from interior lighting improvements, HVAC rooftop unit replacements and retrofits, the use of energy management information systems.

Today you'll learn about our two current campaigns with our sessions split into two 45-minute halves. The first half of today's session will focus on the Building Envelope Campaign and the second half will focus on the Integrated Lighting Campaign.

Before we begin a few reminders. Today's session will be recorded and archived on the Better Building Solution Center. Attendees of this session will receive an email when the recording and slides are made available and accessible. All attendees are in listen only mode, meaning that your microphones are muted. If you experience any audio or video, visual issues any time throughout today's session please send a message in your Chat window located at the bottom of the Zoom panel and we will try and help you out.

And with that I'm happy to introduce our moderator for today's first half of the session, Hayley McLeod, who is a technical professional and project manager in the Integrated Building Performance group at Oakridge National Laboratory. Welcome Haley.

Hayley McLeod: Thank Cedar. It is great to be here to talk about the Building Envelope Campaign. But first can we advance the slides a couple? Yep, that's me. Then if we can advance it one more we can get an overview, yeah, of today's session.

So like Cedar said we're partway through our intros and session overview portion. The first part will be high impact envelope strategies brought to you by the Building Envelope Campaign, then we will hand it off to the great team of the ILC to talk about

integrated lighting strategies, and then we will wrap up with a final Q&A. Note that we are planning on having a short Q&A session after the envelope portions. If you have envelope questions you can ask halfway through and won't have to remember your question all the way at the end.

Next slide, yep, thank you.

So we are – you've probably been in other sessions this week so apologies, but we are excited to announce that we are using Slido for Q&A polling and feedback, so please go to [slido.com](https://www.slido.com) using your mobile device or using a new window in your browser. Today's event code is #DOE. Once you enter this event code please select today's session's title in the Dropdown menu at the top right. It starts with Driving Adoption. If you would like to ask the panelists any questions please submit them in Slido at any time throughout the presentation. We do encourage you to enter your name when asking questions, rather than remaining anonymous, so that we can better address the question and follow-up with you if necessary.

But I will give everyone just a moment to open up Slido and select our session. All right, so hopefully you guys are still going to Slido and getting setup, but I am going to go ahead and introduce our panelists for the Building Envelope Campaign half of the session.

So first up we will have Ginger Scoggins, who is a licensed mechanical engineer with 32 years of experience and is the president and co-owner of Engineered Designs, Inc., a full-service engineering firm which she founded 22 years ago. Ginger's focus is on designing high-performing buildings across a wide a variety of markets. In addition to running her firm, Ginger is heavily involved in ASHRAE and is the current chair of ASHRAE Building ad-hoc committee, overseeing the sale of existing ASHRAE headquarters to Children's Healthcare in Atlanta, as well as the search and purchase of the new ASHRAE headquarters, which is located Peachtree Corners.

Our second speaker, Chris Chmiel, is now starting his third four-year term as an Athens County, Ohio county commissioner. He has a self-designed bachelor's degree entitled, "Wholistic Transition to Sustainability," from Ohio University. And Chris and his wife built and live in a passive solar house, which has over 500 rammed earth tires in the foundation. Unfortunately, Chris will not be talking to us about his house, which I would love to hear more about, but will

be talking about a new construction EMS station in Athens County, Ohio.

So thank you both for being with us today.

With that we will jump right into our half of the session.

Next slide please.

Yeah, so we are going to go ahead and launch two poll questions to kick us off to learn a little bit more about the audience. So again if you haven't already please go to Slido, enter code DOE and select driving adoptions, the driving adoptions session. And yeah I just want to know what type of organization you represent. I like to know, I like to know who I'm chatting with.

So lots of government folks, no surprise there. No, no super clear second place, I like that, I like a diverse audience, you know always bring great questions and great perspectives.

And no matter what I do there's always an "other." I've never been able to figure out who the others are. Okay, give you guys another second looks like some answers are still coming in. Okay it looks like it has stabilized so we can move onto the next one in just a second.

Great and then my next questions is: Have you ever attended a Building Envelope Campaign webinar previously? I anticipate there will be lots of new folks today, I hope there will be lots of new folks today. Great, yep, I love that, I love new folks and I hope that you aren't all just here to hear about lighting, I hope that lots of you are excited about the building envelope too.

Okay, well welcome back to those who have, have heard us before. I'm excited to give a year one update. And I will, am excited to be presenting to some new folks.

So first things first. I have to say thank you to our wonderful organizers. We have worked really closely with AIA, IBEC, and IFMA over the past year and they have provided invaluable guidance, feedback, and communication support to help us spread the word about the campaign, so thank you to our organizers.

Next slide.

Okay so before I get into these next two slides, I have to give a disclaimer. I am not an engineer, but the Building Envelope Tech Team is at ORNL and Dr. Simon Pallin, whose been leading the work that I'm describing over the next few slides. Fortunately, he is on the call and available for Q&A. So if you have any technical questions or if I say something slightly incorrectly hopefully he will be able to clear it up later. His contact information will also be provided later.

So with that being said the first question leading up to the campaign and this work again has been going on for several years prior to launch of the campaign is: How can we assess the overall building envelope performance without accounting for how the building is used?

Next slide.

So the goal was to come up with an indicator to do just that. This is a very basic generalization, but the HVAC cooling and heating demand for a building is some of the building envelope energy load and the internal loads. We wanted to separate out that building envelope piece and so our metric is indeed specific to only the building envelope performance. We call it the "BEP value," building envelope performance value. You may notice it is in the same units as EUI, but it is actually spread across the building envelope area, as opposed to the square footage as EUI.

Next slide, please.

Okay, whew, that was the end of the two technical slides and back into my wheelhouse, which is the nuts and bolts of the campaign itself. So what is the Building Envelope Campaign? It is as Cedar said one of the current Better Buildings Technology Campaigns. Our goal is to help create more energy efficient buildings through higher-performing building envelopes. And in addition to introducing that new metric that I was talking about over the last two slides, we have also introduced a new assessment tool to help you determine that value and that is available on our website.

Next slide.

Okay so what are the primary goals of the campaign? Again, motivate action and increase awareness of the value of these high-performing building envelope technologies, recognize leaders in this field, and demonstrate and document energy and cost savings as a result of those building envelope improvement. So basically

that is recruit participants to the campaign, recognize successful participants in the campaign, and then work to spread the word of successful participants in the campaign, using you as examples to show the rest of the industry that it's doable.

Next slide.

So we have kind of two primary columns of engagement with the campaign. We have supporters and participants. To date we have about a 150 pretty evenly split between participants and supporters. Supporters are fully engaged with the campaign, but don't own or operate buildings themselves typically or don't have a building that's ready to be submitted in the campaign. Our participants are actually going to be those folks who own or operate a building or are contracted directly by an owner or operator and actually have buildings that they went to enter into our assessment tool, determine their BEP value and be recognized by the campaign.

Next slide.

So these are our recognition tiers and categories for the campaign. For our retrofit projects we have Retro 30 and 50, so that's a 30 or 50 percent improvement between your existing building to the retrofit building. For new construction we have Novel 20 or 40 and so that's an improvement over relevant code and that's why those numbers are a little bit lower. Then we have Role Models, that's basically a gold star to put on top of one of those tiers I just discussed. Then we also have Honorable Mentions that are available. So if you don't hit one of those lower tiers, but feel like you know you have still gone above-and-beyond then and want to be recognized by the campaign you can potentially get an honorable mention.

So again, that's the campaign is open to retrofit and new construction. Buildings constructed since January 2019 and that is commercial and the multifamily residential, so not single-family residential at this time.

Next slide.

Also wanted to discuss the timeline of the campaign. So we launched at the summit last year, so we are wrapping up our first year and entering our second year. We are always looking for new participants and supporters to sign-up. We are only as strong our network and who we can work with. We are currently accepting and reviewing submittals from participants. There isn't a particular

submittal period in the spring. We'll take them whenever. If I'm talking and you're thinking of a building please head on over to the website and submit it. You wouldn't be eligible to be recognized until the end of year two, but you can certainly go ahead and submit now. Our submittal deadline was April 2nd this year and I imagine it will be similar next year.

Typically, we will also recognize our successful buildings at a summer or fall recognition event. This year it will be as a part of the Better Buildings Summer Webinar Series. I have a slide with that detail information later.

Then the last thing that I really wanted to emphasize here is that the campaign is totally free and obligation free to join. So if anything I've said has peaked your interest I encourage you to reach out. And it is easy to switch from a supporter to a participant. So if you don't have a building in mind yet, but think you might in the future all it takes is an email to me to switch from one category to another.

Next slide.

Okay and we are what we're here to do today is to talk about some of our successes from this year. So we are excited to recognize 14 buildings this year, 16 buildings were submitted, 14 ended up being eligible for recognition and that represent 1.5 million square feet of conditioned floor area and 9 million kBtu annual savings based on envelope technologies alone.

Personally, the thing that I found most exciting about this group is that it is really diverse. We have new construction and retrofit projects. We have multiple sectors represented. We have a lot of climate zones represented actually. We truly go from one coast to another with our submitted buildings. So I think this is a really good kind of first graduating class to show that building envelope technologies are applicable to everywhere.

Next slide.

So these are our retrofit projects that we are recognizing this year. Again, a lot more detail will come about these at our recognition event, but that lovely photo is of the new American Geophysical Union Headquarters in Washington, DC. If you follow our – if you receive our newsletter you've definitely seen a teaser article about this building, it's awesome.

Next slide.

Then these are our new construction projects. So we did get more new construction than retrofit this year, but that's, that's fine and I love this slide because it does show you know all the different building types that we got.

Next slide.

So I promised there would be a slide on our upcoming recognition event. So it is part of the Better Building Summer Webinar Series, it is called "Energy Saving Envelope Success Stories." It will be Wednesday afternoon in late July. I would love it if you guys would join and hear a lot more about all 14 of our recognized buildings.

Next slide.

With that I will pass it over to Ginger Scoggins, who is going to talk about the ASHRAE building. Thank you Ginger.

Ginger Scoggins:

Thank you Hayley and good day everybody. So we're going to start a little bit about our building and our goals, our execution, and then show some final pictures. I do want to do a shout-out to ASHRAE staff and especially Mike Vaughn for his efforts in, in getting us involved in the campaign. So we're excited to be showcased today.

Our goal was really to show what we could do with an office building that's past its prime and what's possible in terms of envelope, HVAC, and lighting.

So next slide please.

So why did we focus on an existing building? We spent a lot of time discussing this as an ad-hoc committee for ASHRAE in terms of whether we should build new construction or whether we should renovate. We felt like it would really show the market that you could take an older building and renovate it to an energy-efficient level. So we really wanted to focus on that and make that our mission for this project.

Next slide.

So this is the building that we purchased. As you can see it's, it's a typical 1970s vintage building, three stories. It's in Peachtree Corners, Georgia, about 66,000 square feet.

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So we have as you know as ASHRAE have standards that we have to meet or exceed. So we had a project OPR, which is Owner Project Requirement, on some of our requirements that we wanted for this project, but we also knew we had to meet or exceed our own standards. So this is just a list of some of the ASHRAE standards that we knew for this project we had to make sure that we met.

Next slide.

So our path to net zero. So we started with – our architect started with where are we and where do we want to be? Our target EUI, which is kBtu per square foot for the building, was 21.4, which was a pretty aggressive target in our OPR. You can see that blue line there with our target.

But we started with looking at our existing envelope with if we even had an ASHRAE 90.1 compliant HVAC system, was going to be somewhere in the 36.9 kBtu per square foot. If we could get our envelope in compliance with ASHRAE 90.1 2016, we could drop it to 31.6 kBtu per square foot. And then if we could reduce our window-to-wall ratio, which was over 78 percent of windows-to-wall, we could drop it another 5 or another 2 or so kBtu per square foot. Then if we could get a better envelope we could drop it even lower. So you could see the impact of an improved envelope on this building drops at least 10 kBtu per square foot for this project.

Next slide.

So looking at the existing building as you can see in this, in this slide the window-to-wall ratio as I said was over 78 percent, which, which is extremely high and it's on all sides of the building, so we knew we had to address that pretty quickly.

Next slide.

Again, the importance of window-to-wall ratio we wanted to define the optimum area related to achieving our daylighting goals, because we also had a daylighting goal in our OPR of at least 55

percent of occupants to achieve – daylighting at least 55 percent of the time, as well maximize the thermal efficiency of the wall.

We also knew we had an issue with air infiltration. When we did the blower door test before the renovations we were told we had the equivalent of a 10x10 opening in the building, which is big enough to drive a truck through, so we knew we had to address that and we also had to get our envelope R-value in compliance with ASHRAE point, 90.1, if not better.

Next slide.

So our architect did a really good job of looking at our existing window-to-wall ratio and figuring out how we could get it down and get it in compliance with ASHRAE 90.1. So they ended up recommending after several iterations, looking at cost and budget and options and also daylighting, with a window-to-wall ratio on the East and West of 33.5 and on the North and South at 41.9. And this met the requirements of ASHRAE 90.1, but it also achieved our daylighting goals inside the building.

Next slide.

So they did an envelope sensitivity analysis where they looked at cost versus performance, to reach a point where we could optimize our performance and get our costs within line for the project. So you can see here how the costs versus the performance works in this sensitivity analysis.

The final recommendations were that we would go with a wall assembly of R-17, we'd go with a roof assembly of R-35. You can see the window U-value, as well as the window-to-wall ratio average 40 percent. Then we had external shade depth that we added to the outside of the new windows and the infiltration goal of 0.11 cfm per square foot.

It's important to note that ASHRAE net 0 energy design guide recommends an R of 15.6 for the Climate Zone 3, which is where this building is located.

Next slide.

So this is what our envelope ended up with. We ended up adding a three-and-a-half inch continuous insulation on the outside of the building. We ended up obviously improving our window

performance. We like I said we had an R-17 on the walls, R-35 on the roof, replaced all the windows, and added the overhangs.

I think it's important to note that we did not anticipate such an impact from the envelope and you know as mostly mechanical engineers we focus a lot on the mechanical system and the electrical system in the building, not so much on the envelope, but the architect on this project did a really good job of getting this envelope right, rightly done so that we can right size the mechanical system and not oversize it for a bad performing envelope.

Next slide.

So this is what our final pictures look like. You can see the outside of the building. You can see the differential from the picture I showed you in the beginning that showed all the windows. So we got the window-to-wall ratio down, we added the fins on the outside of the, of the windows as you can see on the picture on the left side.

Go to the next slide.

And this is the final look of the building at the, at the end of the project from the entrance, which you can see the barrel vault that was there between the two halves has been removed and then the flat roof has been added there. We are now installing or photovoltaics system so that we will end up being a net-zero energy building at the end of the project.

And that is it for us Hayley.

Hayley McLeod: Thank you so much Ginger. I will pass it on over to Chris Chmiel then.

Chris Chmiel: All right, good morning everybody. I'm Chris Chmiel and I'm coming to you from Athens County in Southeast Ohio, so we're just a little bit south of Columbus and this is our new Athens County EMS Station. This is where our first responders are now located.

So next slide.

And just a little bit about Athens. We're a college town, so Ohio University is located here. We're in the Appalachian region of

Ohio, so we're a little bit more like West Virginia compared to the rest of Ohio, it's very beautiful and scenic here.

Next slide.

Athens County is also we have a high density of people that are sort of environmentally minded and socially conscious and we have the highest density of residential photovoltaic systems in the state of Ohio and even though we're one of the poorest counties in the state. We also have several solar installation companies, Third Sun Solar, they're, they're the largest installer in the state.

One of the things that I've been involved in as a commissioner is help start this Sustainable Ohio Public Energy Council, which is a council of governments which is based around community choice aggregation, which is a whole other topic. But basically through that mechanism we've been able to do some innovative things, including work with the City of Athens to create a voluntary carbon fee which passed by 76 percent at the ballot.

Next slide.

So yeah I made my own major at Ohio University in Wholistic Transition to Sustainability, so I guess I'm just really into trying to make the world a sustainable place. I started sort of just with myself, started a business and built a house. It's really great being in this role as a county commissioner you know because the, the ability to implement big projects it's just a great honor to be able to do that. With the SOPEC you know that's, that's a great tool. It's not every state can do community choice aggregation, but if you can it's, it's a good tool to use.

Next slide.

So a couple of years ago... Well for one thing there's three county commissioners and you have to get two of us to agree to get anything done and there's a diverse group of us right now. I'm definitely more on the sustainability end of, of things. You know we've got another commissioner that's very concerned about our budgets, you know what I mean, and so we try to blend all those concerns together to make things doable and achievable. So the budget is obviously always a concern.

You know originally we, we had bigger ideas and we had to kind of whittle it down to make it doable and I think that's really one of my key points I want to make is the art of the doable. So we had to

shrink it down, but it's, everybody is really happy with what we wound up with.

Next slide.

So a couple of years ago Athens County was part of the Georgetown University Energy Prize, which some of you may know about, which really helped educate the public and, and elected officials to the you know the impact our, our heating and cooling of buildings have. Luckily, in our community we have, we have some passive house – you know people that promote and you know build these kind of buildings. So we really partnered with, with the Passive House Alliance and we really think that their standards you know helped, helped us get where we, where we are today.

Next slide.

And so you know we built a little team of people, including our local consultants and our architects and you know we sat down with our EMS station staff and we, we just you know put everything down, up what we wanted. You know we went for, we went for the, for the moon I guess or the stars. We were able to you know really put into action with this new building what, what we knew would work. And you can see the R-value in the roof was 51.23 and you know the, the walls are 37.8, you know so you can see how much we went above-and-beyond what the code minimum was. The windows we, we did that, we went above-and-beyond as well and just you know the underslab insulation we just, we did as much as we could and I think it's really paying off for us.

Next slide.

We looked at a couple different options for the walls. The typical wall is on your left. We, we looked at this rain screen model, the second version and then we looked at the insulated concrete forms and then finally we, we settled with the double stud wall.

I was pretty excited about doing the insulated concrete forms, but that created a huge cost increase due to the additional foundational costs. The site that we had had, had some issues, so we were going to have to really spend a lot more on concrete, so we wound up going with the double, double stud wall.

Next slide.

And, ah, you know this was I think it's nothing, nothing fancy here, you just, you're just building that thicker, thicker double stud wall that you're going to fill up with cellulose insulation. You know again the, the insulation this is like not rocket science, this is very achievable.

Next slide.

The windows you know we, we shopped around and, and got you know a version that you know wasn't top-shelf, but it was definitely you know up there and it, it over-exceeded the, the code so that worked for us. We don't have as many windows as the you know the retrofit that we just heard about and that's really utilizing that, that passive house standards.

Next slide.

And yeah you know our, our old EMS station was a concrete block building that virtually had no windows and our, our EMS staff you know they really go through a lot dealing with you know the accidents that they show-up at and so to be able to provide them with this nice living quarters now feels really good. Our, our staff is very thankful for being able just to like have some sunlight in their, in their workspace.

Next slide.

And this is some thermal imaging that shows you know how where we were losing some heat maybe or you know just a, just a visual there of, of that.

Okay there's a question about the double wall system structure. Yeah those are 2x4 walls I'm pretty sure that's how that was created.

Next slide.

Yeah so one of the things that was really important for us was working with our local contractors, because this is not a topic that most of our local contractors are, are really sort of aware of. So we, you know we sat down with them and explained that we really wanted to make sure that you know we're going to get this place tight, we're going to be doing these blower door tests. You know there was a little bit of a learning curve as far as you know how the sill plate sat and, but bottom line you can see that tape around all of those intersections between the, the, the roof trusses and the, and

the ceiling and they just they went above-and-beyond to make sure that we got that really tight building.

Okay next slide.

So here we had our, our guys doing the blower door test and it's kind of hard to see, but it, it came out really well. I think it was really close to one, ah, but I mean I'm not even actually sure, I'm not an engineer either, all I knew is like we hit, we, we did well on our blower door test.

Next slide.

But yeah this was like actually one of the most exciting parts of this project was we used local contractors and just having these conversations with these guys about what we're doing, why we're doing it, and you know making them a part of this project just felt really good. It's good for the taxpayers. You know like this is mostly funded through local levies and for that money to go back into our local economy I think everybody feels good about that.

Next slide.

So bottom line is we were, we reduced our energy consumption by 80 percent by, by building it to this standard and pretty much it didn't cost any extra to, to do this envelope improvement. You can see we spent \$101,000.00 on this you know roof insulation and the wall construction and the under slab insulation, the windows, the passive solar, we did some shading. Automatically that was offset by the reduction in our HVAC size units. And so pretty much should be a no brainer.

We did put on a solar system and that cost us \$70,000.00, so you know we're going to be close to net-zero. We actually just got our first electric bill and I was just looking at it and we, we overproduced by 600 kilowatts or KWH this last month, so pretty excited about how that's looking, but we're going to be monitoring that as we move forward.

Next slide.

So yeah the reduction we used these air exchangers and we had a radiant slab in the, in the garage. We used two gas furnaces with AC units. And you know again this was not, this isn't new stuff, but it's not your typical HVAC stuff for like you know what the guys are used too. It was definitely something that you know was

achievable and it's just great that we're going to be able to show this to people.

Next slide.

And, ah, the way we had it oriented is you can see the bays there, because you know obviously the ambulance is leaving the facility, that we just kind of made it all work on our site. It's, it's, it's sort of in a rural setting where the, the outside is you know very – it's just like looking out like you're living in the country and there's nothing around.

So next slide.

And you can see we got the solar on the top.

And next slide.

Really excited that we've... You know I was on the Better Buildings list serve and I saw this Better Building Envelope. I was like, "Wow I've got to enter this stuff?" And luckily I got all the information in and we were able to get this Novel 40 level, pretty excited about that.

Next slide.

So yeah we're just, we're hoping to use this building as an example for all of our new buildings that are going to be being built. We're – you know in my role as a county commissioner I get to talk to lots of different you know agencies, businesses, and we're really just trying to you know show people how, how easy this was to do this and you really should do that. It paid for itself automatically and pretty excited about helping this Building Envelope Campaign spread throughout Ohio and the region.

Next slide.

And that's it, thank you.

Hayley McLeod:

Thank you so much Ginger and Chris for talking to us all about your buildings.

I have one more poll for you guys and then we're going to head into the Q&A. I see all the questions coming in, I appreciate that. But yeah my poll question is now after hearing all that are you likely to join the Building Envelope Campaign? And so yeah if

you need more information that's great. I hope we answer those questions for you during the Q&A. I would also like know yeah you're splitting between supporters and participants. This is great, I appreciate everybody jumping in and answering. If you say "Yes" as a supporter or a participant I do hope that you reach out to me very shortly. And if you need more information again put those questions in the Q&A. I see a bunch of questions coming in so I'm not sure that we're going to have time to get to them all.

So I'm actually going to ask that we skip ahead one slide for the Q&A. Yeah, just so that everyone has ample time to take down our contact information. So again, that's me, that's Dr. Pallin, our technical lead, our website, and then the envelope campaign specific email address, but that also comes to me so it's, it's up to you which one you want to use.

And with that I am going to jump over to our Q&A. A reminder that we are looking for questions that have been entered into Slido and that Slido has a really neat voting functionality, so you can go in and review the questions that have already been answered and sums up them and they will hopefully bubble to the top and that's, that's primarily how I will be selecting our questions. We do have some, something for everybody so far, so I will also share the love.

So our first question is for Ginger. On the envelope sensitivity analysis slide was it conducted for one aspect at a time before other measures had been applied or was it an integrated analysis?

Ginger Scoggins: So our architect did that analysis and my understanding is it was a wholistic in its viewpoint. It was looking at all of the systems, the envelope together to come up with the most cost effective and best performing option for everything, right?

Hayley McLeod: Okay, thank you. The next question I've seen a couple versions of it come in, so I am going to pass it to Chris, but then actually back to Ginger. I think the audience would like for both of you to answer this. The question is about embodied carbons, so the question for Chris specifically was: Was embodied carbon assessed? Less concrete probably reduced embodied carbons and then the more general question was just: Was analysis done on embodied carbons? So I'll give it to Chris first and then to Ginger.

Chris Chmiel: No, we didn't look at anything related to carbon at this point.

Hayley McLeod: Okay, thanks Chris.

Ginger Scoggins: Yep for us so we started with project in 2018, which was a little bit before all of the discussion on carbon really hit mainstream, but we did discuss carbon in the fact that we got rid of our gas-fired generator that was on the building. And also simply by the use of an existing building you know we reduced our carbon footprint if you will by not building new. So that was our thought process at the time in terms of the carbon, decarbonization.

Hayley McLeod: Okay, thank you both for that. I do have a question here for Simon, because I, if I miss explained something I would like to clarify is the building envelope performance, it says, "EUI," but you probably mean BEP value, calculated as the total or net heat across the envelope, i.e. are cooling and heating loads added or subtracted?

Simon Pallin: Yeah I'm looking at the question right now and trying to – so, assuming the question is around BEP and not the EUI, it really matters to the questioning of let's say what we're doing here is not related to EUI. We talked about using EUI as a performance metric when we started planning for the campaign, but EUI includes everything and it makes it very complicated to focus on the envelope performance since it's very dependent on how the building is used and type of equipment and those kind of things.

So instead of sort of trying to interpret what if you, you referencing the EUI or BEP, the BEP then only focuses on – well I wouldn't say "only" really focuses on it a whole building envelope, windows, walls, roof, everything and combines sort of the overall thermal performance into one thing. Everything should be accounted for that involves the envelope and that also includes the thermal mass of the... So it includes both heating and cooling if we're trying to go back to that question.

Hayley McLeod: Okay, we did get a reply that said they were referencing the building envelope performance.

Simon Pallin: Okay. I wouldn't say you added or subtracted, they are, they are both included. So they are based on the first of all the, the – in our tool which we haven't demonstrated here today, the tool that we used to – it's sort of an online tool where all the uses centers they're information about the buildings and we offer DUE prototype buildings, which is 15, 16 buildings that, that with you know varying from warehouse to school, to hospital, to office, and so forth, they have some sort of the default features, which includes like thermostat temperatures and, and setbacks and so forth which we applied here. But other than that everything is just really purely envelope related.

Hayley McLeod: Thank you very much Simon. It looks like it was maybe a follow-up from Scott, but I didn't see it, so if you have additional questions for us again Simon's email is on that slide and, and feel free to follow-up.

We had a question about passive house so I think this is for Chris: In regards to passive house what do you say to folks who are concerned about sick-building syndrome or the fact that there aren't that many windows to open?

Chris Chmiel: Well I mean I think the key for us is our air exchangers and that was actually some technology that was I think developed at Ohio University utilizing Sterling engines. But basically those air exchangers are running all the time. They're I believe 95 percent efficient, so you know there is you know pressure air exchange happening all the time.

The reason some of the windows are not operable is because we didn't want the staff of the EMS people to like just open the windows all the time, but we do have some of them are opening, so I don't know hopefully that answers that question.

Hayley McLeod: Thanks very much Chris. I am keeping an eye on our time. I certainly don't want to run over into the IL, ILC section, so very quickly had a question that I think applies to both Chris and Ginger, so real quick: How did cost compare to typical construction and what was total payback on, on remodels, so I guess that half if for Ginger.

Ginger Scoggins: So total payback so we have not evaluated payback in terms of, of, of the project, that was not the focus for the project if you will. It was the cost I will tell you for the envelope portion of the project was more than anticipated, but we felt like we didn't really have an option there, because we wanted to get envelope as efficient as possible so that we could get our HVAC system down. So in terms of payback you could say obviously that there is payback because the HVAC system ended up being smaller. The original building had a large chiller and two large air handlers and we ended up going with a radiant panel system with a heat pump chiller. We are ASHRAE so most of that equipment was donated, so calculating that payback for us was not part of the project. I hope that answers the question.

Chris Chmiel: Yeah and for us really quick we felt like the payback of investing in the envelope like automatically paid for, oh more than paid for itself with the reduction in the, in the cost of our HVAC units.

Hayley McLeod: Okay, thank you very much for our really engaged Q&A. If there are other questions I hope you email them to us or maybe we'll have time at the very end, but I suspect that ILC will also have this many engaged questions and answers.

So we will now move onto the second half of the session. I would like to introduce Felipe Leon, who is an electrical engineer at Pacific Northwest National Lab and is the lead for the Integrated Lighting Campaign and welcome Felipe.

Felipe Leon: Thank you Hayley and congratulations to the Building Envelope Campaign's recognized organizations. And thanks everyone for joining us today. I hope you're having a wonderful summit.

Next slide.

Great, here, here's our agenda for this second half of the session. I will provide a brief overview of the Integrated Lighting Campaign and some of the first-year highlights. Then we'll have a presentation on an integrated controls pilot, covering installations with lighting, HVAC, and plug load systems were all integrated. In the second presentation will provide you that building owner's perspective from integrated controls at the University of Minnesota. And then I'll wrap up the session and we will a brief Q&A session like we just did.

Next slide.

I'd like to welcome our panelists for this session. Scott Hackel is the director of research and innovation at Slipstream, a supporter of the ILC. He conducts applied research tests and deploys innovative new technologies and approaches saving energy and reducing its carbon impacts. One major research focus area being complex commercial building systems and controls. His presentation will describe the outcomes and best practices found during a small pilot in which network lighting controls were connected to plug loads and HVAC for additional energy savings.

And Jay Amundson, is a district engineering manager for energy management, a division of facilities management at the University of Minnesota, also is a participant of the ILC. He manages the district engineering teams supporting demand site management and

energy efficiencies for the five zones at the University of Minnesota. Jay has been practicing energy management for 12 years, following a 25-year career in architecture. He is a certified energy manager and leverages his previous career in architecture to incorporate energy efficiency into design and operating practices as part of the life cycle buildings. Jay will describe that building owner's experience again from executing it in integrated controls project at one of the classroom office campus buildings.

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If you're just joining us for this part of the session, please go to [slido.com](https://www.slido.com) using your mobile device or by opening a new window in your internet browser. Today's even code is DOE. Once you enter this event code, select today's session title in the dropdown Menu at the top of the screen, Driving adoption of impact, high impact envelope and integrated lighting strategies.

If you would like to ask the panelists any questions please submit them via Slido any time throughout the presentation so that everybody can see them and vote on.

Next slide.

The Integrated Lighting Campaign is a resource of the US Department of Energy Building Technology's Office and is funded by DOE. It launched last year during this summit and it is designed to help building owners to take advantage of advanced lighting controls and the integration of lighting with other building systems. This can help increase their whole building energy savings and it can also enable nonenergy benefits.

Some of the possibilities are shown in the puzzle pieces on the left side of the slide. Those with energy saving potentials are there, they include HVAC and plug loads, but there's also nonenergy benefits that can help you decide on going with the more efficient and newer lighting system. You can see as the tracking there is space utilization and several other possibilities.

We support building owners by providing relevant resources, documenting, and recognizing exemplary projects and partners, and delivering technical assistance. The goal is to promote the use of innovative solutions in lighting and the integration of lighting with other building systems.

Speaking of innovative solutions we are also excited that during the summit the lighting prize or the L-Prize was announced. With over \$12 million in cash prizes the industry has been challenged to develop breakthrough LED lighting systems, including requirements for integration and interoperability. Learn more about that americanmadechallenges.org/lprize.

Next slide.

Just like with the Building Envelope Campaign we are very thankful for our wonderful organizers. They provide guidance, support, and, and their efforts are well aligned with the Integrated Lighting Campaign and its efforts.

Better Buildings is an initiative of the US Department of Energy designed to improve the lives of the American people by driving leadership and energy innovation and is the host for this summit.

Design Lights Consortium is a nonprofit organization dedicated to accelerating widespread adoption of high-performing commercial lighting solutions. The United States General Service Administration or GSA mission is to deliver the best value in real estate acquisitions, technology services to government and to the American people.

The IES or Illuminating Engineering Society they're objective has been to communicate information on all aspects of quality lighting practice through various programs, publications, and services. Now the International Association of Lighting Management Companies was, was an organization that was setup in the lighting industry to create nationally recognized professional lighting management certifications. IFMA is the International Facility Management Association and they are an association for professional facility managers supporting over 22,000 members in 78 countries. And the Lighting Control Association is a council of the national electrical manufacturers association and they have educated the professional building design, construction, and management communities about lighting control technology, applications, and benefits.

Next slide.

The ILC is also composed of supporters and participants. On this slide you will see just a few of our campaign partners to provide you a sense of where your organization may be. Hopefully you'll choose to join the ILC and if you do in general building owners

and facility managers are what comprise our participants. Those are on the right-hand side of this slide, while others such as utilities, solution providers, consultants, and more are supporters of the campaign.

Next slide.

Although we are still analyzing the project data received during the first year of the ILC we'd like to share some of the data we are seeing as it relates to our recognition categories. The advanced use of sensors and controls for lighting seeks to recognize projects that use sensors, controls, and other capabilities in lighting to go beyond the normal approaches of occupancy, daylighting, dimming, and scheduling.

Seventy-one percent of buildings submitting project this year provided a narrative in this category and included things like human-centric lighting, task tuning, lighting scenes, personal controls, among others. With LEDs the ability to not just dim your lighting, but to also adjust its white point is an ongoing topic of research where health and other benefits are being explored. Also, we are taking control of our own lighting through personal controls that go beyond just your wall switches.

The integrated controls for plug loads and lighting systems seeks to recognize novel integration of lighting and plug load control systems, with a focus on energy savings. This is done by leveraging the occupancy sensor and lighting, for example, shutoff equipment when it's, when this space isn't occupied. With some system even capable of monitoring plug load energy use. Eleven percent of the buildings that submitted projects this year provided a narrative in that category.

The integrated controls for HVAC and lighting systems seeks to recognize approaches that saved energy by managing lighting and HVAC loads together when spaces are not in use. Setting back temperatures, adjusting ventilation, doing CO2 monitoring with air volume changes based on occupancy are just some of the highlights of what we saw in, in the entries and that was 39 percent of the buildings submitting projects this year submitted in that category.

Lastly, the other integrated systems in lighting seeks to identify other ways that lighting is enabling deep or whole building energy savings or enabling businesses to operate their buildings or their business better. Integrated with automated shades for example,

enabling visual guidance via geofencing and leveraging a wireless mesh network in lighting are among the narratives provided in this category by 29 percent of buildings submitting projects this year.

Next slide.

For those building owners, for those that are building owners on this session we tried to collect a mix of projects in the ILC from different building sectors. Seeing projects from your peer buildings can better help communicate the potential in your own buildings. So who submitted projects this year?

It was a great mix of organizations as you can see here, in retail, food service, grocery, we received projects from two unknown retailers and a distribution center. In federal and state municipal government we received, we received projects from a VA medical center, judicial and service centers, and air-based schools and many more. In healthcare we saw projects from a long-term care unit and a hospital. In higher education we received projects from two pilots at universities and a college of physicians and surgeons. Lastly, in commercial real estate and hospitality we saw four manufacturer headquarters, bank and escrow headquarters, and an architecture office.

Next slide.

So where do we go from here? Our recognition event is planned to be held during the 2021 IES Annual Conference in August. Some of the validation work that has been conducted and the projects being recognized through the ILC will be considered for case studies and those will be available through our website.

Next slide. Next slide please.

Oh, no go back one. Lastly, joining the ILC is easy and free. Back up one slide. Hopefully you can join the campaign, it's easy and free. Stay up-to-date on our newsletters, events, submit your project for recognition. Simply go to integratedlightingcampaign.energy.gov to learn more and to register today.

Next slide.

I would now like to turn it over to our first speaker, Scott Hackel, at Slipstream. Scott take it away.

Scott Hackel:

Thanks Felipe and thanks for inviting me to be a part of this panel and thanks to all of the audience for giving me a few minutes of your day.

Felipe already discussed why integration is important to consider. I want to start by putting some numbers to that and you can go to the next slide.

So much of the energy efficiency industries, especially you know that driven by utility programs is, is built on a backbone of lighting savings. And a lot of our projects are simple lamp replacements or fixture swap outs where we're achieving 50 percent lighting savings, which is fantastic, that's great energy savings for our buildings. But as we start to think about the you know the needs to reach other building systems and go deeper we recognize that these lighting retrofits are only, only 3 to 8 percent savings at the total building level.

Next slide.

A couple things have happened that enable us to integrate and go deeper than that 3 to 8 percent. So one of those is luminaire level lighting controls. So there's an image of just one example of those on the right. There's actually two sensors within that device, those little circles, one is an occupancy sensor and one is photosensor. In addition to that this fixture has onboard controls and communication capability, so it can communicate with other fixtures and other systems. This enables a really granular network of sensing and control that enable integration.

Next slide.

So what our pilot, the pilot that I'm going to tell you about today, attempted was to use that type of approach to integrate with both plug loads and HVAC. So you can see here in the image now we're controlling most of the systems in the room. And our early, some of the early results are suggesting in buildings where this is a fit we can achieve 25- to 35-percent total building energy savings, so a significant increase over just the lighting project alone, but as you'll see not, not proportionally additional effort in time.

Next slide.

So in, in this pilot, this was a pilot was funded by the Department of Energy and in a partnership with Excel Energy in their Minnesota territory, we implemented that type of integration,

integrating luminaire level lighting controls with plug loads and HVAC in five buildings. Those five buildings made up a pretty diverse set of building types, two are shown here, so we, we implemented in a clinic, which included a pharmacy and some other areas, outpatient and we implemented in a couple of offices, one of them a shot shown here. Jay is going to tell you about another one of the buildings next, so I'll let him discuss that, the one at the University of Minnesota. Then we also did a public works facility. So there's a variety of facilities that you can do this type of integration in.

Next slide.

Once you integrate those three systems especially due to the occupancy sensor network that you now have available and again that occupancy sensor network is not simply you know one occ sensor in each conference room or major room or the corner of the room, it's a sensor in every single fixture. So we can begin to have confidently take steps to control these other systems.

The first two sections of this table describe the lighting savings that we can get. So in addition to of course just more efficient LED lighting by swapping out the fixtures for luminaire level lighting controls, we also get these other advanced lighting controls, occupancy sensing of course, but also daylight sensing, task tuning, and personal tuning, so we're really able to drop the energy needs, consumption of our lighting.

In addition to that we add plug load control and this includes – we did this at the individual outlet level, so we used wireless control to the outlets and were able to control individual work stations, as well as some common area equipment like workrooms, some kitchen equipment, and even some fitness equipment in the clinic.

On the HVAC side this also made use of this wireless mesh network of occupancy sensors, although I need to add that in order to make the connection to the HVAC system we did utilize, we did need to utilize one wire that connects a gateway on the lighting system to a gateway on the HVAC system and that wire uses a BACnet protocol to communicate between the two systems. That enables the HVAC building automation system to control anything that it might, that might benefit from building occupancy.

The sort of classic example and this was hinted at one of Felipe's slides is thermostat setback. So when people aren't in a room let's setback the thermostat. But that actually only scratches the surface.

I think a significant amount of the additional savings you can get come from other measures as well, like if you have a VAV system turning significantly down or even completely off the minimum airflow through the VAV box. Because even when thermostat set point is met you still often have airflow through those boxes.

We also implemented aggressive resets on pressure and temperature in the ductwork. Then in some situations we're also able to control ventilation. Now that depends on the makeup of the HVAC system. Our approach here was meant to be entirely controls based, so we did not install new HVAC equipment. So in some cases we were able to control ventilation and in some cases not, depending on the existing equipment.

So there's a lot of measures that we get with implementing this controls-only package.

Next slide.

We have savings information back on three of the sites and initial indications on a fourth. So let me talk through those. You can see sort of right off the bat visually the savings here range between you know \$0.50 to over \$1.00 a square foot. We want to make sure to point out that, that one site that saved over \$1.00 a square foot was a 24-hour building. So this building, this was the public works facility, a lot of people coming-and-going, large number of hours where spaces are not being used, but the building is open 24-hours just do to the nature of the agency's work. So this was a huge saver for that type of building.

Another thing to point out is that lighting savings here you know maybe \$0.20 a square foot, those are going to be conservative. Network lighting control programs are generally going to see more lighting savings than that and that's because we had to – we were implementing in sites that were already pretty progressive and had energy goals and were taking energy steps, so they already had some occupancy sensing and some controls on their lighting. We would expect more controls if this was broadly applied in the mainstream, sorry more savings on the lighting side.

Then finally, there's a fourth site. These three sites all used VAV systems, there's a fourth site that used signals on RTU and the results are not conclusive there yet, but they do suggest substantially lower savings for singles on RTUs, just due to the way those systems end up needing to respond to individual zones, they're just not as sophisticated or granular.

Next slide.

So let's talk a little bit about payback. So first the cost. Across our five systems the average cost for the full package was \$6.73 a square foot.

Now, oh one item I, I forgot to mention on the previous slide you probably saw the plug load savings were pretty small. We just weren't able to squeeze a lot of kilowatt hours from the plug loads. There's some savings there, but it's not huge.

So if we look at a system that's just lighting plus HVAC, because that's where a lot of the savings were, the cost is \$6.47, which is a payback of about 8 years.

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We also look at benchmark costs in areas where there are more mature luminaire level lighting controls market. So a good example would be the Pacific Northwest where they've been working on luminaire level lighting controls for several years to sort of transform the market to use those and there's a lot of projects going in. There the costs are a little lower and we would expect for this package to see for the full package to see a little over \$5.00 and a little bit less with lighting plus HVAC. That gets us to a pack back of 6 years. If we add in incentives from the utility which Excel does provide, it gets us to a cost of about \$4.00 a square foot and a payback of 5 years. So it starts to become a very reasonable mainstream project.

And I would add that – oh actually I have – go to the next slide please.

I forgot I had added this one in. What's important to, to consider is that most of that cost is the retrofit of the lighting for the luminaire level lighting controls. In addition to that there is some cost for the plug loads and then of course some cost for integrating the HVAC. We were able to keep that to only about \$0.60 a square foot by utilizing the controls contractor or service contract or staff, internal staff that were already managing the building automation system, so we kept those costs down and, and the payback for just integrating the HVAC if you're already do the lighting piece is very low, probably in the ballpark of a year.

Next slide.

So to finish up here I just want to cover a few lessons learned on this project and then I'm going to kick it over to Jay to give you the more specifics on one of the projects.

So first of all we recommend having a control matrix for each zone type, outline exactly what you're going to do, how you're going to control the system, because there's a lot of control parameters and we set one of these up in advance at each site.

Next slide.

We also recommend using as a starting point a standard set of sequences. ASHRAE has a great guideline out now called, "Guideline 36," that is a standard set of highly efficient control sequences and those sequences often make use of occupancy. So we already had a set of controls sequences and we're going to see this becoming more and more popular and easy to use as different controls contractors get comfortable with it, but this was, this is what we used, again, with whoever was already managing the building on a Mason system.

Next slide.

It's also important to, to do some pre, some zoning ahead of time. You have to overlay our HVAC zones, plug load zones, and lighting zones. And the lighting, these lighting systems are highly flexible, so this is not a problem, you can easily setup the lighting systems to these zones similar to HVAC.

Next slide.

Then finally, just a few sort of miscellaneous lessons learned. Make sure you label very clearly the outlets that are being controlled. That was something in some spaces that we ran into some trouble with. What I would have like to see is some really bright colored outlets for control, which, which we did not happen to have.

Avoid the inter-not of things. I, I like this phrase, borrowing it, borrowing it from PN&L actually. In some situations it's tempting to try to not connect these systems to the internet for cyber security reasons. But we found that where we tried to do that it was very difficult to maintain the system to push firmware, to see what was going on in the system. So try to work with IT in advance to get connected to the internet.

Commissioning the HVAC controls is very important. You have to know that they are in fact working based on occupancy, visually verify that.

And then finally even setup alarming on that occupancy data point in the building on a Mason system. Because we had one site where the occupancy control from the lighting system did go offline for a period of time and we didn't know it until we happened to look at the system later on, so set that up as an alarm.

And I think that's all my material.

Next slide.

Yeah, um, feel free to email with questions, otherwise I'll certainly stick around for the Q&A at the end. Thanks again for our time.

Felipe Leon:

Great, thank you Scott. Thank you for that presentation and for sharing those lessons.

So let's, let's exercise our Slido poll capability here and having learned about some of the benefits that today's lighting system is going to enable. We'd like to ask: What drives you to consider going above-and-beyond in your lighting projects, right? So take a look at the selections here. Let us know what you're thinking and we'll give everybody a second or two to get those answers in.

All right, I see and, and almost expected we see that energy savings benefit. We, we know that that's very easy to quantify, it's the real quick, "Hey let's connect these systems and save something." But we can see here too that there, there's, there are things to consider too if you're looking at a healthy building environment, if you want to future proof your building for, for other capabilities, GEB, or, or anything else that's going on or if you do want to do tunable white lighting now or in the future. These, these are things that you could, you could consider, but energy savings does seem to be the, the, the one that is most on people's minds. It could be for many reasons, among them that the fact that it's easy to quantify and make a case for it.

So great, thank you. So let's go ahead and close that poll. And let's move onto the next part of our presentation here. I'd now like to know turn it over to Jay Amundson of the University of Minnesota. Scott the floor is yours.

Jay Amundson: Thank you, Felipe.

Felipe Leon: I'm sorry Jay the floor is yours.

Jay Amundson: You got it. Well thank you Felipe and good morning to everybody. I want to start off by saying when Scott Hackel their approach we are really excited to participate in this program.

If you wouldn't mind go to the next slide here.

Yeah, we were excited when, when he asked us to join the pilot primarily because we at the University embrace research and we also were very interested in the true savings from integrating building lighting control and building HVAC control. And in the end you know we saw this project really successful. We realized most of our anticipated savings and also as important is we were on budget. So there's a lot of planning that went in the beginning and we're able to create the successful just by staying on budget.

One of the things that we thought about was not whether or not we wanted to be, ah, participate in the program, but really which building? So we quickly thought about the best fit and, and we chose Jones Hall primarily because it's got an emissions department on the second floor and that gave us you know some potential to share with students, potential students and their families our you know good stewardship towards sustainability.

This building also had 27,000 square feet, which seems to be about the right size for a pilot building and it also had a good mix of administrative office workers, classrooms, and an auditorium space. We also thought this is a good candidate because even though it's a historic building and 1901 was when it was originally built, we had remodeled it about 15 years ago, so it had a pretty decent control system and HVAC ductwork, VAV system with supply, two supply units, one on the north and one on the south.

So the design process went really smooth. You know we had luminaire selection by a pilot program. They scheduled all the equipment and all the lights. One thing I found interesting is that doing footcandle calculations really helped us out a lot, because normally and this project included, we, we tend to replace light fixture for light fixture and you're a little limited when you replace lamp for lamp. So with this project we were able to do light fixture for light fixture in all the same locations, but tune or adjust the lumen output to match was necessary or what was designed as the

best footcandle and illumination for all the spaces. So we had some tunability there.

We did some integration with the HVAC like Scott was showing with zoning, the lighting spaces with the HVAC zones and that was part of the plan. And then also the design included a commissioning plan that, that thought ahead about what we were going to commission.

So with the equipment we had a variety of equipment and a lot of it was new to us. The Cree LN fixture, which is the light fixture just directly to the right, wish I had a laser pointer, but anyway just to the right, my first impression was because it looked a little space age like, but once installed and you'll see a picture of this later in my slides, once installed those wings are out of glass and they're fairly transparent and they look really fitting for, even for a historical building.

We also installed some linear fixtures and some Troffers and downlights. You know a lot of that is turning a pilot into reality with the spaces and, and getting everything to align up with the existing functionality of the building. But some of the light fixtures like the linear and the downlights had to have additional hawk style occupancy sensors and photosensors, so we added those in.

The real smart in the brains of the system came from what's on the lower lights right on the slide, the blue colored SmartCast Link. This had a connection to our fiber optic data and then we connected through an Ethernet 5e, category 5e cable to the different gateways hardwired and then from the gateways we probably had a half-a-dozen of those. They went out and distributed a wireless signal to all the lights. And then we had wireless dimmers and switches and those were essentially replacing all the manual switches.

What I found after doing the project is most people after they get familiar with the system were not using the manual overrides on the, on the wireless dimmers switches, they were just letting the lights turn on-and-off according to the occupancy and to the photocell.

The last thing here on the lower left of the page is our configuration tools. So with the commission process we used the commissioning, I mean a configuration tool that really connected the lights and all of the devices to the network. When we were initially installed the lights they all worked independently with

their onboard occupancy control and photocell control and when we connected it though to the network then we were able to program the lights and tune a lot of things and then managed and modify our occupancy groups.

Next slide please.

I'll say a little bit about the plug load controllers. We tested an early plug load design. We, ah, we put a number of these components into a junction box that were basically under the desks. The cost to do the plug load control was pretty low and the technology is advancing real quick and it's really become more plug-and-play now. So the integration was pretty simple, but the, the interesting thing was it required some occupants' behavior change.

What was super interesting to us is that the, the people in the spaces they, they found or we found that, that the best use of these occupancy plug load controllers was for desktop lights and desk fans and under-desk heaters and that turned out to be where the savings were at. Mostly you know turning – using things like personal computers or the like was not the best use of it, we just found that desk, desktop lights and accessories were the best use.

So the installation it went really, really simple. We bid the installation separate, the materials, the pricing was about, about half-and-half, half labor, half materials. The installation went well and there were no construction issues. The commissioning was a little more complicated. Our contractor came and went quickly and then CREE and the commissioning we took a little more time figuring out things and getting everything to, to work. We integrated the HVAC to the University's network. And then once everything was setup and once commissioning was complete the operating portion was straightforward and really no issues after, after setting up.

This photograph I know it's hard to see, but on the upper right-hand corner of the photograph you can see that's the LM fixture which we installed in multiple spaces and then on the left side you can see one of those linear fixtures that we used as well.

So with HVAC we integrated with jobs and controls. This building was a Metasys building with Johnson controls and we just happened to have a, a programming team on campus and we worked with them to get everything setup. Our occupant experience was generally positive. We didn't have really any

comfort issues at all. We essentially through BACnet we imported all of the points from the occupancy sensors into our Metasys and, and laid it out on a table and then just connected everything.

And Scott mentioned this earlier in his slides, you know we employed a, a position called "Standby," so occupied, the building is occupied from 6:00 in the morning until 10:00 at night and then unoccupied in the evenings, where we really take our temperatures set points and we drill them down let's say in the winter unoccupied we go down to 64 degrees and in the summer we go up to 80 degrees to save energy. The standby is an important piece, because when somebody leaves let's say an office or classroom for 15 minutes or an hour, standby allows that temperature to drift just a 2 or 3 degrees instead of you know more and so the recovery makes, makes for a much quicker return.

So savings, you know we are all interested in savings. As Scott mentioned the lighting savings was 50 percent and that was really wonderful to see. We, we did see that the plug load savings were very small. I think the, the word is still out on that. I believe that as people do change their behavior they'll start thinking of new things to plug into those outlets. The cost is \$6.00 a square foot approximately. You know that's very high and we expected that with the pilot and I'm really hopeful that in the future you know as the industry matures that we will drive that down and see a return on investments get, get lower.

You know with, with project we were helped out a lot. We did a cost-share between what I call "facilities management," we have, had a very motivating incentives from the DOE and from Slipstream and from Excel Energy, our local utility and then Energy Management, my group, we paid for the lion share of the project basically running on a return on investment.

But you know also with savings we haven't been able to measure the savings extremely detailed yet, because a few months before the pandemic we finished the project and the building has essentially been empty for a year for the most part and so we're looking forward to seeing more data as we return to work hopefully in the fall.

So communicating success you know we, we're excited to see the savings and draft reports. I think another layer of success was with occupants. They learned a lot about lighting control. You know most of the office workers didn't know the difference between occupancy sensor and a photocell sensor, whether lights could dim

or not. So there's a lot of learning in that way and we had some handouts that was all really useful. I think from facilities management we all recognize that there are deeper savings beyond just changing out lamps, to include the HVAC and, and lighting control.

And my last slide just really a summary of some of the things Scott said and, and some of the lessons learned with, with this program. Most of this I've already mentioned, but you know installation went really well. It was pretty straightforward with installing the equipment.

We did have one little hiccup where we recognized early in the project, but the, the wireless sensors or I'm sorry the wireless switches need a neutral wire. You know most or old-fashioned wiring has a leg, a black, a switch-leg which is basically two black wires and to do wireless we really needed neutral. We had to add a neutral, we didn't add a whole lot of expense to the building, but just one of those lessons learned.

The most important lesson learned, one of the most important lessons learned I think was the one-button setup with the CREE configuration tool was really an unknown skill. I watched several YouTube videos and did a few of them, but it's a skill that you know unless you do it every day it's going to take a little time to, to figure things out.

And then you know Scott mentioned this too, our integration with the IT department and the controls engineers and, and the SmartLink took a little time, maybe a couple of conference calls to figure all that out and get through our security level and that was a lesson learned.

Mapping the controls points between lighting and HVAC took a little time, it was pretty straightforward, but that's, that's a piece that was done at the end that we had to take the time and go through the right steps.

Then training occupants, you know that's, that's a lesson learned. It's essential that they are involved and understand what our mission was and they, they did and learning how occupancy control works and how it's integrated with HVAC was also an important lesson.

So with that said you know I would, would emphasize that we thought turning this pilot into a real-life situation was good and we

were successful. I'll let Filipe now manage the questions, but thank you all for listening.

Felipe Leon:

Great, thank you so much Jay for that presentation and the building owners' perspective it's really important.

So to everyone a quick poll again. Having learned about the building owner's perspective we'd like to ask: What barrier most needs to be broken in order to make a better case for a more advanced integrated lighting system? What is that's holding you up? So thinking of this our organization would consider these if a – which one of these? So...

I see that oh we got a good, good contest going here. You're, you're looking for people that are trained to maintain and operate these, so that's a very good one. We need to have somebody to take care of these more advanced systems. Cost of course is, is a well-known barrier and managing the various systems, having a single unified dashboard rather than several is something that we've heard before too. So great, thank you so much for this perspective, it really helps us understand what you're facing and what's holding you back from this and that helps inform the campaign, so thank you very much for that.

Next slide. There, it's already there.

Key takeaways from today. Today's lighting is not your parent's lighting. You can do so much more with it. I hope you've seen that in these presentations and I hope you'll join the integrated campaigns and learn about them.

Putting together multiple systems is feasible. A system integrator can help you do that. Some, some utilities and others are creating incentives to help you pay for some of that labor cost that's going to be required. For example we know Efficiency Vermont if you're in that part of the world look into their program. They just launched recently, we featured them in our newsletter. You can learn more about it there too.

The benefits are real. Maybe they're not documented everywhere that you can easily pinpoint, "Hey, we can save 10-, 15-percent in HVAC" or X-amount in plug load, like you can do with the energy savings, but if you assume zero then you're not helping yourself, right? If you want to future proof your building and think about, "What's the potential impact on my business when I do these

things," right? Don't just assume zero, there is a benefit there if, if – whether you need it now or later.

So to learn more and tell us about your successes and to be recognized for some of that work that you're already doing in terms of integrated lighting with other systems go to the campaign website or send us an email, I'll be happy to answer any questions you have.

Next slide.

So now we're going to transition to just I'm going to hit up the key questions here that came in. We have about four minutes so let's, let's look at the top vote getter and I'll pitch this one to both Scott and I'll ask Scott to kick us off here. How much of the HVAC savings are uniquely possible due to the lighting integration? Are some of these savings possible through HVAC controls without the need to integrate systems?

Scott Hackel: Yeah, great question. So the, the resets of pressure and temperature on the VAV system those you actually can implement whether you have the occupancy sensor network from the lighting or not. It is important to also implement those so that we were taking maximum advantage of the VAV boxes shutting, turning off when the occupancy – so we, we save a lot more with the occupancy sensors, but you can get some savings from those without the sensors. But DCV, VAV shutoff, and temperature setback we could have not have gotten any of those savings without the lighting network.

Felipe Leon: Great, thank you so much Scott. Jay?

Jay Amundson: I would, I would add too.

Felipe Leon: Oh yeah go ahead Jay.

Jay Amundson: Yeah if I could I would add that yeah we had a lot of that stuff already in, in the program, but where we saw some deeper savings was like for instance we have a, a all the classrooms and building which might be 20 percent had occupancy sensors that turned off our VAV boxes and the lights at the same time already, but the big difference was getting to every single light in the building, the other 80 percent is where we saw a big impact.

Felipe Leon: Great, thank you so much Jay. And I did have one question for you if you could in 30 seconds let us know if you performed any post-

occupancy surveys and how did occupants feel about the, the controls?

Jay Amundson:

That's really a good question and that was an ongoing conversation with the occupants. We did not do a formal post-occupancy survey, but we particularly toward the end I was in the building quite a bit and so was, ah, CREE their, ah, their, their commissioning person and so we got to know the building people and we heard all the time about their, their controls and what was going on.

And, and it's interesting we had very little negative feedback on comfort and, and on the HVAC side, but we had some, ah, fairly strong feedback on lights that would dim or lights that would turn on or off unexpectedly and we had to answer those questions and even tune up the system on occasion to take care of that.

Felipe Leon:

Thank you so much Jay. And I will, I will go ahead and we're going to archive these questions. We'll try to get these answered in one way or another to, to those who participated today. But I want to move on and, and let you know that there are additional resources from Better Buildings that you might want to consider. There are several links that will be posted, along with this presentation. So please take a look at these links here and especially when the presentation posts online.

Next slide.

We'd like to invite you to attend our Better Buildings: Summer Webinar Series starting in June. Partners will discuss some of the most pressing topics they're facing and will share best practices and innovative new approaches to sustainability and energy performance. To register go to the Better Building Solution Center and click on Events and Webinars.

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With that I'd like to thank all our panelists so much for taking the time to be with us today. We have launched a short feedback survey in Slido and I ask that you please take a couple of minutes to give us feedback on this session. Your answers will not be visible to other attendees. We rely on your feedback to design webinars, future summits, and more. The poll will be open until tomorrow morning.

Driving Adoption of High-Impact Envelope and Integrated Lighting Strategies

If you'd like to learn more about the resources discussed today please check out the Better Buildings Solution Center or feel free to contact any of us at the email shown here.

All right, thank you very much and thanks everyone for joining us.

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