Kim Trenbath: Hi everyone. Welcome to The Better Buildings Alliance Plug and Process Loads Webinar. We're going to get started at the top of the hour so hold tight and we'll be right there. Hi everyone. I'm Dr. Kim Trenbath from the National Renewable Energy Laboratory. Welcome to today's Better Buildings Alliance Plug and Process Loads Webinar. This webinar is called No Purchase Necessary: Low to No Cost Plug Load Management Strategies.

We have a great line-up for us today. We have got 3 speakers. I want to say that this webinar is going to be recorded. Next. And here's the agenda. Our speakers are from the Community College of Allegheny County, Cornell University, and NREL and all are building owners who have implemented low to no cost strategies in their buildings. We have a little bit of time at the end for questions and answers. For questions and answers please type your questions into the chat, identify which speaker you would like to direct the question to, and we will be organizing them on the back end. We will answer all questions at the end of the webinar. Next.

First on the agenda is the PPL Technology Research Team Update. Here is the PPL TRT from NREL, myself, Amy LeBar, Omkar Ghatpande, and Robin Tuttle. You can reach all of us at ppl@nrel.gov. I'm the lead for this technology research team. Next. I would like to take a minute to introduce our newest team member, Omkar Ghatpande. He joined NREL in 2019 and holds a Master's Degree in Electrical Engineering. His research focus is on electrical modeling and efficiency analysis of components in high-performance buildings. Omkar is a member of the team that developed the Building Electrical Efficiency Analysis Model or BEEAM, which is an open source Modelica library that simulates the efficiency of building electrical distribution systems on harmonic power flow. Prior to NREL Omkar worked as a senior electrical engineer at ABB and a solutions development engineer at Honeywell so welcome Omkar. Next slide.

Now we'll take a minute or 2 to go into the BBA PPL team update. Next. I want to direct your attention to our website. These slides will be mailed to all the participants on this call at the end of the call and you can get the link to our website here. Next. I want to feature some resources that we have for building owners and the first one is a toolkit on low carbon technology strategies. This is the newest toolkit that was released by DOE and it was an effort from DOE and all the national laboratories as well as the consultants to put it together. These documents help building owners and operators plan retrofit and operational strategies to achieve deep carbon retrofits. Next.

On the PPL website we have many on-demand webinars. In fact, this webinar is going to be on-demand after we record it and here's a couple that we've got already that I wanted to bring your attention to. The Houston Advanced Research Center presented on Getting to Net Zero Energy Through Strategic Building Operations and Plug Load Management and that's great because they worked on – they have a zero energy building and they talked about their plug load strategies. And the California Plug Load Research Center talked about how anyone's device usage patterns affect energy consumption so check these out on our website. Next.

We also have written resources for you on PPLs. The first one here is PPL reduction guidance and this is a fact sheet on assessing and reducing plug and process loads and we have these for retail and office buildings but they're relevant for many other building types as well. The middle is a blog that we wrote on utility incentives not only for PPLs but also for space conditioning so we have some HVAC utility incentives described as well. And the last is our most recent fact sheet on smart outlets and it talks about what they are and how you can use them to save energy as well as capture some non-energy benefits. Next.

I'll go over some recent accomplishments of the PPL team. We presented at the International Conference on Alternative Energy Sciences and Technologies and we talked about a plug load management system that uses IOT technologies to identify plug-in devices and their locations. This paper won best paper at the conference and we often refer to this technology at ATLIS and that stands for Automatic Type and Location Identification System. Another recent accomplishment is by the way of the Pacific Northwest National Lab. They host the Integrated Lighting Campaign and there were 2 winners this year for the plug load and lighting integration systems. These were Johnson Controls and The Minnesota Department of Transportation. Next.

And I wanted to highlight some of the projects that we're currently working on. We're working with automatic receptacle control manufacturers to increase market uptake and we're also working on a project for energy efficiency in medical imaging equipment. We're supporting DOE on that effort and focusing on MRI machines. Next. That's all that I have for the PPL update because we have a great line-up of presenters. You can contact us at the email above, our website is in the middle, and then my contact information is below. Next.

Now we'll get into our technical presentations. Next. Our first presentation is from The Community College of Allegheny County. I would like to ask Elaine and Tim to turn on their webcams and I will introduce them before I turn it over to them to give their presentation. Elaine Sadowski is the Director of Energy and Sustainability at The Community College of Allegheny County or CCAC. She has more than 40 years' experience in energy management and energy projects. She holds a Bachelor's Degree in Mechanical Engineering from Carnegie Melon University and a Master's Degree in Energy Resources from The University of Pittsburgh. She is an AEE Certified Energy Manager.

Tim Myers is a systems engineer at CCAC where he is an integral part of the team that takes part in the management and configurations of Windows desktops, laptops, and servers throughout the college. Tim has worked with CCAC for 9 years. He completed his Bachelor of Science in Management Information Systems. He also have a Master of Arts in Adult Education and Communications Technology from the Indiana University of Pennsylvania. I would like to turn it over now to Elaine and Tim and just so you know I don't see Elaine on video.

Elaine Sadowski: Elaine is here.

Kim Trenbath: Great, excellent.

Elaine Sadowski: Okay. May we have the next slide please? I just wanted to introduce you to our school. We were founded in 1966 in Pittsburgh, Pennsylvania. We're a rather large community college. We have an annual enrollment of 24,000 credit and 17,000 non-credit students and we offer a wide range of programs, everything from liberal arts and humanities to trades to being a dealer in our nearby casino to phone production and aviation. We're also 1 of the largest producers of healthcare workers in the area. We have 4 campuses and 4 centers and approximately 1.6 million square feet of buildings. Our annual energy and water bill is about $3.5 million. We do take saving energy and money seriously. We're a member of the Pittsburgh 2030 District and The Better Buildings Challenge. And I want to point out that community colleges generally do not have huge endowments so we live pretty much hand to mouth and doing things economically is a priority for us. Next please.

We have saved a number of – or quite a bit of energy and water. We're on track to meet our Better Buildings Challenge and 2030 District goals. We've saved over $4.25 million since we've been

keeping track. We're installing our 4th and largest solar installation at 1 of our campuses. We had a big project entirely paid from savings at our south campus that has cut our energy and water costs by 43 percent and our energy use by 51 percent. Our new building workforce center on our largest campus will be rated LEED Silver and we're doing incentive rehabilitation and renovation on an old mansion that we're turning into our Center for Teaching and Learning and that's going to be an interesting project because it is a historic building and we're trying to upgrade it, both the building envelope and the building systems inside to the degree possible. We're looking at a really big, deep retrofit. Next please.

One thing that I noticed was that we have approximately 4,000 computers scattered around our campuses and centers. I did some quick calculations and that's about 6 percent of our total electricity consumption. We also have a data center that's located in our administrative building and this accounts for 65 percent of our annual electric bill for the building. We estimate that computer-related energy is costing us about $240,000 every year. I'd walk into computer labs and offices and see computers on when there was nobody using them and I thought, "Well gee, this is a big waste. There's got to be a way to get better control of this," and I figured we could probably save about $75,000 a year if we could just manage the power consumption in these computers better. Next please.

We are doing other things. Our IT people are consolidating and virtualizing servers, we're improving the air management at the data center, we're switching to laptops wherever possible, but the 1 thorn in my side anyway was PC power management. We had no funds to spare for the purchase of specialized software, which costs about $50,000 to carry out reduction for the whole college. So we did the unthinkable and we talked with our IT people and right now we'll let you talk with our IT people. I'll switch this over to Tim and he can explain to you exactly what he did.

Timothy Myers: All right everybody. I'm happy to talk to you today about the actual steps that we took to accomplish the savings at the end of this project. So I'm going to start off with some past practices and then talk about our benchmark readings. So in the past we had sleep and hibernate disabled at the hardware level on the computers. Basically what this meant was that even if Windows was set to go to sleep after a certain amount of time it was not allowed to turn the computer off; the computer hardware kept itself on. So basically this left us with 3 different power options that we were able to have on our computers. They could be turned on, they

could be turned totally off, which required user action and a lot of people don't end up turning off their computers when they're finished, or the monitor might still be able to turn off after a certain amount of time so not a lot of opportunities for savings there because of the human interaction required.

So why was sleep disabled in the first place? Well there's a couple of things that I can point to at least. One of them is outdated negative experiences with some old hardware that we had. Back in the days of Microsoft transitioning from Windows XP to Windows Vista a lot of IT departments had problems with Windows Vista. Well 1 of the problems we saw was with how Microsoft was changing how sleep works on computers and it basically wasn't compatible with some of the older hardware that we kept using and we would see computers after they would go to sleep they had problems resuming and waking up. They would often crash and blue screen and when you're teaching classes that takes away a lot of time from the classroom environment.

Another thing that kept us from allowing sleep to happen was some outdated management strategies so at the time we felt that it would be best to leave computers on overnight to install updates so that we would interrupt them during the day. Now with both of these things we were able to revisit and revaluate do we still have these compatibility problems with the hardware when it comes to resuming from sleep? No, we don't. Computers have made leaps and bounds over just a handful of years and we just don't see those crashing problems like we used to. And then with our update strategies we were able to reevaluate those and now we've been able to queue updates during the day and we set them to install during maintenance windows or off-peak hours so it still should not interrupt people during their normal use.

And before we started implementing any of the changes, for our own benefit we wanted to see what impact we were having so we needed something that could monitor power consumption. We got lucky that we already had a program installed on all of our computers that was among many, many other things measuring power consumption so that program that we were using was called System-Centered Configuration Manager. There's also an online version of that called Endpoint Configuration Manager. Those are both Microsoft products and a lot of your IT departments are probably familiar with them already. Just to note those are paid programs and again for us it was just to measure the power consumption. We didn't use these to implement the changes. Next slide please.

And now onto the settings and how we actually applied them. So in a nutshell what we did was we enabled sleep, so the hardware was allowed to sleep now if Windows told it to, and then we delivered custom power plans to computers based on their use case. So to do all of this we used a system that we already use today to set various custom configurations on all of our computers in our environment and that's Microsoft Group Policy. Group Policy is something else that your IT department is probably already very familiar with and using today. We chose to use that, your IT department might end up using something like Endpoint Configuration Manager, and they basically are able to do a lot of the same things with applying configurations.

So with Microsoft Group Policy we were able to leverage kind of a structure of computers that we've already set up for the college. We have computers organized by campus and then within that we might have categories like classroom instructor computers, office computers, laptops, and then based on those organizational folders we were able to deliver custom power plans to each use case so for example classrooms had a need to remain on longer potentially during idle times when an instructor is standing away from the computer lecturing on a slide and they may not be actively moving the mouse or keyboard. And 1 of the most important things about these settings after applying them with Group Policy is that the users aren't able to change them so this kind of allowed us to put a bit of an iron fist down and dictating which settings that we were going to use.

Here you can see on the left side what it looks like from your IT person's perspective setting up some of these configurations, exactly when to turn off the display, whether it's on battery or plugged in, and then in the table on the right side these are some of the actual settings that we decided to use on the majority of computers taking some of those special use cases out of consideration. Next slide please.

So 1 of the really important things whenever you're changing how a computer acts in any organization is informing your user base so we wanted to gain acceptance and kind of manage the expectations of some of our users. Anytime something changes some people think something is wrong or people just tend to ask questions in general so it's good to keep them apprised and also really keep them filled in on what the mission is here is to save power and do better things for the environment and save us some money as well. So we expect some of those growing pains and to mitigate that we

threw together some communications plans. An example on the left side is something that we sent out to let people know what all of the general settings would be, why we were doing it, and some of the past communications explained when to expect that to start happening. And then the important thing with this was we accepted feedback from people. If instructors told us that they had different needs in their classrooms we were able to make those adjustments where necessary. Next slide.

Now we're getting into some of the nitty gritty data of what we were able to monitor with our monitoring software so this slide is the benchmark data prior to implementing any changes and also prior to a lot of hardware changes. There were a lot of computers that were physically updated during this time as well. So before we changed anything 1 single computer was averaging about 33 kilowatt hours per month so let's try to remember that, 1 computer, 33 kilowatt hours per month. All of our computers together were using over 120,000 kilowatt hours per month. And then on the right side if you break that down into a daily consumption by all computers you can see we're hovering at at least 4,000 kilowatt hours every day by all computers so try to make a snapshot in your head of this slide and let's go to the next one and see what the differences are.

So this represents a lot of the savings we were able to make considering the collection of all computers so we took that single computer average down from that 30-something kilowatt hours down to 9 kilowatt hours and all computers were using over 120,000 kilowatt hours; we brought that down to 31,000 kilowatt hours. And now when you look at our daily consumption graph you can see a much more drastic impact on the weekends when there's a whole lot less usage by the computers and you can also see that we never go anywhere near that 4,000 kilowatt hours per month. Go ahead and go to the next slide.

And maybe 1 of the more dramatic representations of this change, this is data all pulled from 1 particular model of computer that was not replaced during this time so this was the most accurate data we were able to get. So on the right side what we're looking at with the blue line is whether or not a computer is on and then the yellow and red lines are the monitor and the computer actually being active so those lines often don't change whether the monitor is on and computer is active but the blue line did. So in the left graph we can see that at any given time, even 3:00 in the morning, we had somewhere around 900 computers that were just turned on, not being used by anyone. And then in the results graph you can see

basically we were able to close that gap between the blue line and the activity lines to make it follow much more closely and you know you can see now that at 3:00 AM we no longer have 900 computers on not being used by anyone. Next slide. I'm going to get Elaine back for this one.

Elaine Sadowski: Yeah, we wanted to point out that saving money and energy doesn't have to be expensive. Another important point is I know that often facilities and IT don't talk to each other. It's a good idea to talk to each other.

Timothy Myers: It's always a really good idea to reevaluate relationships and past experiences with IT; even for the IT department it's a good idea to reevaluate.

Elaine Sadowski: Yeah and substantial savings can be hidden so look around, keep your eyes open, and 1 important thing is don't fixate on a specific solution. We were looking for a specific power management software package and it turned out we really didn't need that at all. We could accomplish this just using something that we already had. And be sure to keep people affected by change in the loop so they know what to expect and you can expect a little pushback, but with zero capital costs we managed to save $65,000 to $75,000 worth of electricity every year. Thank you.

Kim Trenbath: Thank you Elaine and Tim. That was an excellent presentation and it's very relevant. Some of you on the call might think that this does not apply to buildings; it does apply to buildings and I'm often in a building where the computers are always on so thank you very much for these best practices. We really appreciate it.

We're going to move onto our next presenter, Kimberly Anderson from Cornell University. Kimberly Anderson is the Sustainability Engagement Manager for Cornell University. She leads education and engagement initiatives to foster sustainable behavior and operationalize structural change across the areas of energy, waste, food, water, and climate. Prior to joining the Department of Energy and Sustainability Kim began her career in higher education as a Residence Hall Director on campus. Kim earned a BA from Cornell University in Psychology and is a Fellow in the Cornell Institute for Public Affairs focusing on environmental policy and justice. I'm pleased to turn it over to Kim.

Kimberly Anderson: Hi everyone. Thanks Kim. I'm happy to be here with you all today so I'm here to talk about some of the plug load strategies that we've done on campus, specifically focusing on engaging building

occupants. Next slide. A quick overview of what we're doing is I'm going to give you the quickest intro to something called community-based social marketing and how we use that to actually create our behavior change campaigns on campus and then talk briefly about our purchasing standards as well.

So Cornell has a variety of different building types. We have large, residential buildings, academic spaces and labs, offices, greenhouses, shops, and all of these spaces of course have unique plug load types. We have a campus of about 40,000 people and our plug loads really range from standard student residence hall spaces like micro fridges to office equipment to lasers and 3D printers so all of our spaces are really unique and it's useful to especially get to know the communities and the different types of plug load in all of our buildings. Next slide.

So our office is the Campus Sustainability Office on campus and our mission is really to engage the entire campus community, all the faculty, staff, and students to be a part of making a sustainable change on campus and our framework is really trying to bring people into this idea of how to think about the planet, people, prosperity, and purpose, the really academic and research purpose of Cornell as an institution when they're making decisions and so I'll show you a little bit more about this in a moment.

So our quick intro to community-based social marketing, there's a book by Dave McKenzie-Mohr called *Fostering Sustainable Behavior* and I'd highly recommend it. There's also a website, which I'll show you in a moment. Dave leads also workshops and so this is something that I attended and it's really core to a lot of the engagement work that we do on campus so as I'll show you next the idea behind community-based social marketing is that people are complicated and in order to actually get people to move from knowledge and awareness to engagement and behavior change it's important to know that people have their own unique habits, perceptions, willingness to change but they're also a product of their community. So when we're thinking about engaging people in behavior change around sustainability it's important to really get to understand the communities that are on campus and how to engage peers to motivate each other to actually participate in this change. We can move on.

So fundamentally community-based social marketing is really a research process. It's this idea of selecting behaviors that will have the highest impact within the area that you're looking for so if you're focused on reducing carbon emissions or reducing energy

consumption on campus thinking about what are the biggest users of energy on campus is really helpful, right, and then within that there's this multi-step process of getting to know the barriers and benefits for people to engage in a certain behavior change and then using those to inform the actual strategy. So oftentimes when people develop strategies for plug load for instance they might jump right into, "I think that this probably could work and would be useful," but it's important to realize that we all have limited amount of resources including time, money to able to actually implement strategies so it's really important to start with the first 2 steps to make sure that the strategies you're developing are grounded in the community that you're targeting so we can go to the next slide and I'll talk a little bit more.

So when you're selecting behaviors there's 4 areas to really consider. What's going to be the highest impact actions that people can take? What's the probability that people are likely to actually adopt these behaviors? Is the penetration rate low or high meaning how many people have actually already adopted this behavior? If people have already a high level of adoption then this is not necessarily a behavior you'd want to target because so many people are already doing it, right? So it's better to choose a behavior that very few people are already doing on campus and really put more energy behind promoting engagement in that behavior. And finally applicability would be what is the most widely applicable action that the audience can engage in so we have faculty, staff, and students on campus so we often have to think what audiences we're specifically targeting with different initiatives and how to make sure that actions that we're choosing for people to take are something that they can actually do and follow through on.

So as you'll see in this survey this is an example of a survey that we did as part of this first stage, the select behavior stage, where we're trying to get to better understand the community that we're targeting for these engagement efforts. So we had a survey that incoming students took that gave us a snapshot of what are these behaviors that they're already doing that they came to the university practicing, what are behaviors that they've started since, and that they plan to start soon, and then the red indicates that there's no interest or plans to do this action for now so this can really help inform the probability that somebody will take on an action as well as the penetration rate, how many people are actually already doing it so you can move on.

So this is an example of then how you can use a matrix to really

weigh out the impact of different actions so depending on what actions you're considering targeting in a community you can – this is like such a quick version of this so I'd definitely encourage reading the books, but essentially you can get a better sense through surveys with the community, conversations with experts, literature reviews, case studies, you can really get a sense of which actions rise to the top as being highest impact, most likely to happen that people are willing to actually follow through on and so for instance I'll just show the very bottom with showers.

We have run this actually as a course at Cornell where we teach students how to do community-based social marketing projects in their communities and showers consistently rise to the bottom of the probability of people actually changing their habits. So if we put a campaign together where we're really encouraging people to take colder showers or showers that are under 10 minutes the probability of that actually happening, and we've seen this in our own campus research, is really small so it's better for us to keep it in mind but consider which actions are more likely for people to take so we can move on.

So once you have a behavior selected then you really go through this process of uncovering what are the barriers and benefits to it so what's standing in the way of people actually engaging in a behavior and what are the benefits. So oftentimes benefits are shared within groups, there's sort of a common understanding that reducing plug load, retiring equipment for instance will save energy and replacing units for instance might make them more convenient or more reliable and more energy efficient at the same time where barriers can tend to be individual, like unique barriers where let's say we're trying to encourage people using power strips in their offices. If their power strips are really uniquely inconvenient underneath their desk it's going to be very unlikely that they actually switch it off in the evening and so it might be that in my office my power strip is very inconveniently placed where other people have power strips that are easier for them to just switch off before the end of the day. So it's important to really do research within the community to understand what are the barriers to actually act and for instance like do people even have power strips to begin with so it could be sort of really informative to really understand if you want to focus on a specific action what are the barriers and benefits to it.

So once you figure this out and you really have a good sense of what's either motivating people to engage in this or standing in their way then it's a matter of developing strategies. So as you'll

see on the next slide 1 great part about CBSM is that it really shows the social psychology behind implementing change, implementing behavior change in someone's life. So if you realize that some of the barriers standing in the way of people taking action are forgetting to act then tools that would be useful are prompts. If it's a lack of knowledge then communication would be useful like Tim had mentioned. If it's a lack of experience or low confidence then this idea of social diffusion and modeling by peers for instance or by leaders can be really effective so this also helps to make sure – the first 2 steps help to make sure that the strategy you're creating really will drive the behavior change you're looking for.

So once you've figured this out, you can go to the next slide, once you've developed your strategy then you go to actually pilot it and then finally on the next slide you implement it broadly and evaluate, so piloting is really this process of seeing what works about it, what maybe was unexpected or unintended, and then if you realize that it does seem to have the impact you're looking for that's when you actually invest in implementing it more broadly and evaluating broader success. So to wrap up this quick intro to CBSM this is their website, Fostering Sustainable Behavior, and you can learn more about it there. The book is I'd say very user-friendly and informative and so I encourage you to check that out.

So what I'll do next is just show you some of our behavior change campaigns that we've used CBSM for. The first will be communication from leadership so we have a number of opportunities to really engage senior leaders in messaging around energy use so on the left for instance similar to what Tim showed with his communication is we – every winter the university shuts down for a week so we have our Vice-President for Facilities and Campus Services send a message to the community and this really is an opportunity to reinforce university commitments like that we as an institution have a commitment of being carbon neutral by 2035 and then also what are the actions that people can take to really support that commitment.

So we really focus on providing clear expectations for people to follow through on like what are certain key actions that they should take before they leave their office or their residential rooms for the semester and whenever possible it's really important to provide feedback to the community so at the bottom of the message we tend to include what the impact of it was in previous years and the small chart to the right shows real-time energy metering and so that happened during 1 of our events where you

could actually see the dip in energy that happened when people unplugged their devices for the day and what is important in a community where people are not necessarily the direct recipients of the benefits of reducing energy, so in a residence hall for instance the students aren't actually going to receive any discounts in utilities, so what then can be very motivating is to let them know that the actions that they're taking are making a difference.

And finally here modeling behaviors from senior leaders is really important so this is a picture of our VP who participated in that event and modeling by and communications from people that are well-known and well-respected really helps to reinforce that this is something that's important as part of our culture. So moving on 1 thing that we have at the university are sustainability teams and so we've partnered with colleges and departments around the university to create teams of people that will really drive change in their specific areas so often they have support from senior leadership, there's members at every level of the organization that are participating in it, and they're really the experts in knowing what will work and what won't work in their area.

So we focused on developing peer-to-peer education and engagement with them, we have programs like Green Office and Green Lab certifications and we're working on Green Shop certification right now. Oftentimes these teams have very small budgets but they focus on things like with a Green Office certification for instance 1 of our points is what are objects in your space that are ready to be retired? Do you have 3 printers right now and 1 of them is just ready to go but they're still plugged in, which happens quite often? So these teams can really be creating a culture within their space to pay attention to these items so you can move on.

So these teams help to communicate with their peers. When we as a staff create communications for instance they are often using social diffusion to really engage people in their area so rather than it all coming from us it's coming from people that they know, that they trust and respect that can help create more of a culture in their space. They also help to host workshops and events and participate in recognizing their peers for engaging this behavior too. You can move on; thank you.

So 1 other thing that we have is a module, it's an orientation module for all incoming students so we run this through Canvas and it's an opportunity for us to communicate both expectations for students as they arrive to the university, but it also encourages

them to really envision how they play to live in their space so before they even come onto campus they're thinking about things like what should I be bringing into my room, how can I manage my plug load. It's a small – you'll see on the right-hand side it's a small part of the course at the moment but it really helps to encourage them to imagine and make commitments for how they intend to act once they actually get here and the survey that's part of this course helps to inform some of our social norm campaigns that we use with students as well.

So on the next slide you'll see some of our engagement efforts that we have run with students and with staff and faculty. One is the Sustainability Goose Chase Scavenger Hunt and it's an opportunity for employees and students to sort of compete amongst each other to take sustainable actions. So what's cool about this is you can actually have things like unplug your devices and there's a fee so as people are actually doing the actions you can see the videos and photos so it's both a good feedback system to see that people are actually following through but it helps to again create more of a norm, more modeling for people when they can see that other people are doing these things as well.

One other tool that you'll see on the next slide is Eco Challenge and this is a free site and you can actually customize it too for your areas and what we have done this year is we've chosen actions that are considered highest impact by our experts on campus, our energy management team, and the highest impact actions that people can take as building occupants and we encourage daily action and for people to compete with each other and as part of a team to engage in these behaviors regularly.

And next, so incentives is oftentimes 1 of the ways that people think behavior can be motivated but you have to be very careful with incentives because sometimes they can be sort of counterproductive so we often like to think of incentives that will really help to support the behavior change we're looking for. So 1 thing that we've done is create mini-grants that really encourage teams to think creatively about how to reduce energy use in their space and we have a modest budget for that program, about $500 per grant. And then similarly with prizes and giveaways we try to find items that connect to the desired behavior like remote controlled power strips or solar charges and lights that will continue to provide tools for people to reduce their energy rather than it being something like a water bottle that would be a little disconnected from the action.

And finally I wanted to just mention that whenever possible we look for opportunities to create – to make sustainability the default and 1 of the ways we do this is with purchasing standards. So on our procurement site we have preferred suppliers for computer hardware, which are Energy Star compliant and meet different standards and we also integrate sustainability into the procurement process so you'll see on the next image that we have e-SHOP filters that actually will help filter for Energy Star appliances and that can assist people across the university in choosing items that are more energy efficient.

And similarly the last slide there is around as part of e-SHOP we have Amazon Prime, the Business Prime, and they have now a climate-pledge friendly filter as well that we encourage people to take and we train people on campus, our employees especially, to use a quadruple bottom line framework, and I'll put that in the chat, which really has them thinking whether it's multi-million dollar projects or small decisions for offices how they can make sustainable purchasing decisions more frequently. And if procurement is a new concept or sustainable purchasing standards, New York State has some on their website there that are useful so thank you so much.

Kim Trenbath: Thanks Kim. This was an excellent presentation. I really loved the behavioral aspects that you went through and I loved how you talked about the community-based social marketing. That is a strategy that I probably haven't dug into but I think it's a very effective strategy to reach building owners within communities, within your building to increase energy efficiency for plug loads and other build end uses. Next we have our final presentation from Dr. Paul Torcellini from the National Renewable Energy Laboratory. Dr. Paul Torcellini is a Principle Engineer for Commercial Buildings Research at NREL. He's a key contributor in the development of the Advanced Energy Design Guides, or AEDGs, including chairing the technical committees that produce the zero energy AEDGs. Dr. Torcellini has been at NREL for 27 years. He is a Registered Professional Engineer and holds a PhD from Purdue University. He is an ASHRAE Fellow and an ASHRAE Distinguished Lecturer. I'll turn it over to Paul.

Paul Torcellini: Thanks Kim. You can go to the next slide. I want to talk a little bit about NREL's story. You know NREL has about 2,500 employees so like the other 2 speakers a lot of infrastructure and things with that and we needed to build a new office building and the first space as 360,000 square feet. The object of this building was to show that we could build a building that used half the energy

without increasing the cost. Go to the next slide.

But 1 of the challenges with doing that was our plug loads and we did a survey of our plug loads in our existing facilities and found out that our plug loads alone were more than the energy budget that we wanted to allow for the new building and so plug loads had to come front and center in what we were going to do in the planning process. This is a graphic showing where the building ended up and so you have to remember that the building is very energy efficient with this and even with the energy efficiency the plug loads and the data center, which is really supporting a lot of our IT equipment is a substantial part of the load; in fact, it's more than half of the load. And so as we think about attacking plug loads and anything that's not heating, cooling, ventilating, or lighting it's a significant portion of the load and to ignore it really doesn't get us to the end point of our energy performance. Next slide.

So you know what did we do to do that? Our target was a 50-percent reduction. The first step was that we really needed an inventory of anything that was using electricity so you know Tim and Elaine talked about the IT piece of it. That was very high on our inventory list but it was everything else that was there and really asking the question how much of that equipment is still needed. When we did our inventory we had more printers than we had people and so right off the bat it was like well how many printers do we really need and where do we put those printers and how do we operate those printers? How do we make sure that we have the most efficient Energy Star printers and then excess the rest of that equipment? Do we really need equipment operating when the space is not occupied? What is the level of service we need out of all those plug loads or asking a question like is there a more efficient way to perform whatever service that plug load was doing? So an example might be moving to all-in-one document processing stations that do printing, faxing, scanning, everything else that they might do and so you have 1 piece of equipment that you have to manage and take care of rather than lots of equipment that needs to be part of that. Next slide.

So you know answering the question of when do we really need plug loads and I really like the example that Tim had that showed the difference by controlling the computers and getting the weekends off. And if you think about it nights, weekends, and holidays are 66 percent of the year for any typical office building. But even during the typical workday, and this is kind of a pre-COVID discussion, it probably might even be more than that today, building occupants are only at their desk a third of that time

and so if you put all those pieces together workstations only need to be powered about 7 percent of the year and perhaps a bunch of the peripheral plug loads to go with it and just getting things turned off or turned down when people aren't there, when they don't need them is a significant savings. Next slide.

So you know as an example we also looked at the computers and when they were using and how we were using screensavers and it was interesting being at a lab we did measure a lot of this equipment, not only being a user but being on the research side as well and what we found is that our screensavers, when they were running on this particular set of computers, actually used more energy than just the computer when it was being used as a regular computer. And so we started very aggressively doing energy management on our computers, getting the Energy Star settings involved, getting the monitors turned off, removing the particular set of screensavers that we had, and moving those computers into a standby mode.

What is interesting is that we were committed to making a zero energy building, that is looking at our consumption and then matching that consumption with on-site renewables. At the end of the day this 1 move in turning off the screensavers saved $500,000 of PV that we didn't have to buy and already get that balance. And some of it is you say, "Oh, it's just 1 computer," but at the time it was 800 computers, it very quickly became 1,200 computers as we started moving into the space and realizing what we needed to do with that space, and anything multiplied by everybody is a big number. Next slide.

And so the other thing that we did was we started with what we wanted our profile to look like so you can see 1 of the measurements of that is how many watts per square foot of all of this stuff plugged in do you have and sometimes, especially if you're thinking about commercial real estate or you know looking at office requirements a lot of the times the requirements on the plug load side can be 2, 3 watts a square foot reserved for plug loads, sometimes even more than that. We started off with a goal that we didn't want to exceed 0.6 watts per square foot during the day and we really wanted to get this equipment off at nighttime down to 0.15. And as we measured our total set of plug loads, and you can see this is represented month-by-month data, at nighttime we were a little bit higher than we wanted to, we didn't do quite as good a job at getting things turned off, but during the daytime we were like half of what we projected and that was just very successful and it was, it was some of the social aspects, it was

training aspects, and it was also procuring the right equipment that went along.

You know 1 of the things to think about is computers, we went through an era of time for many years where the faster the computer the better and today that's not necessarily the case. You really want to match the computer and its speed and its power to what those users need from that and some people at the lab need very high-powered computers, do a lot of analysis; some just need to do basic word processing or even web surfing and you don't need a lot of computing horsepower and you can save energy by kind of right-sizing the computer for what those uses are. Next slide.

So I just put a bunch of ideas on here, I won't go through all of these, several of these have been mentioned by others really around Energy Star everything whether it's computers or office equipment, appliances, getting things unplugged when they're not being used whether that's using smart plug strips or conventional plug strips, moving towards laptops, laptops tend to be more efficient than desktops, even thinking about things like using task lights or minimizing or turning down some of the overhead lights. Things like when people bring in space heaters really that's an issue kind of in fixing the HVAC issues. Next slide. And here's just some other ideas and I'll let you – we're going to distribute these slides and you can kind of look at those at your leisure so I will wrap up there I think Kim.

Kim Trenbath: Thank you so much Paul. Excellent presentation. All right, so we have 5 minutes left and I do want the panelists to answer some of the questions. If you have some questions still type them in. If we don't get to all of your questions we can send out a document with the answers to the ones that we don't answer. The first question that I would like to ask is for Elaine. As a community college what is more important, actual energy savings or reducing carbon emissions?

Elaine Sadowski: Actually the most important thing for us is cost effectiveness. We're dealing with trying to do things in as environmentally responsible a way as we can in a cost effective manner. Unfortunately we don't have funds to go out and buy carbon offsets and do things like that. We have to be very careful in managing our resources so our priority tends to be on things that also save money and fortunately a lot of environmentally sound and energy saving actions also save money so we are able to accomplish everything

that we set out to do but according to my board of trustees saving money is the priority.

Kim Trenbath: Excellent. Thanks Elaine. The next question is for Kim Anderson from Cornell. It's a long question but I'll read it all. Looking at this list of what to do the actions are weighted towards the person doing something instead of smart technology automatically doing something such as reducing thermostat without turning off heat, turning off lights, et cetera. What is the thinking behind requiring a person to do this instead of automating?

Kimberly Anderson: Yeah, that's a great question. So I would say this is complementary so I'm sharing 1 component of what we do. We certainly work on a systems and structural level as well and a lot of times our engagement efforts make sure that students, employees, and staff also understand what we're doing on those large scales so we have an energy management team that does a lot of that work but oftentimes people want to participate too. We have a campus that's very engaged, they want to feel that there's something tangible that they can do as well, and as an educational institution it also – we realize we're also graduating students and sending them out into the world and so giving them sort of an insight into actions that can happen on campus and beyond is really important.

Kim Trenbath: Thanks Kim. The next question is for Tim. Are these computers desktop with a monitor, laptop, or combination? We're trying to understand the source impact such as age, combination, set-up, et cetera.

Timothy Myers: So that's a really great and really relevant question. So during this project where we were implementing the power settings we also had other things going on that always go on like the standard replacement of old computers so during this time we absolutely had a lot of computers that were upgraded from the old, large tower with spinning disc hard drive, lots of fans, and we've changed over to a lot of smaller, micro-form factor computers with solid state hard drives. And so kind of the natural progression of technology as it goes has also helped us save money with this. Great question.

Kim Trenbath: Thank you. I have a question for Paul. How scalable are the strategies discussed?

Paul Torcellini: Well kind of going with what Tim just said there are some things that through purchasing becomes very scalable because that's just what the accepted is. Our IT folks make sure that all the Energy

Star settings are in place and locked so those kinds of things are pretty easy to implement and are very scalable. It's certainly scalable to do education of our occupants and employees and kind of refresh around those pieces. So I would say it's very scalable to larger campuses or even scalable to small companies and other places. It's really how engaged are you with your employees or students or faculty and can you work through some of the purchasing discussions.

Kim Trenbath: Excellent, thanks Paul. Well we're at time. Thank you all for being here today. If you have any other questions please send them to ppl@nrel.gov and thank you all. We'll try to answer all the other questions in an email or document. This recorded webinar will be available in the next couple of days so you can share it with your colleagues. Have a great holiday season.

[End of Audio]

Additional Speaker Q&A:

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Additional Questions

Audience member: @Tim: How did you first learn about these strategies? Was this communicated by Microsoft, an outside vendor, webinar or educational program to learn about these energy saving strategies?

Tim Myers: Assuming that by "strategies," this means 'ways in which we could manage power settings on computers now and going forward.' This is a lot of personal experience in working with computers over years. The settings we changed are the same settings that a consumer can adjust in Windows on their own computers within the Settings app. When Windows computers are joined to business networks, administrators are able to dictate these types of settings centrally, including locking them down from users being able to change them. A lot of this is just baked into how Windows has worked in enterprise over many years. The rest, I try to keep up with by following tech news, watching out for Microsoft keynotes, following trends etc…

Audience member: re CCAC; IF sleep/hibernate settings were not disabled, and you had another starting baseline, would the energy savings have been less?

Elaine Sadowski: Probably, but people were in the habit of leaving their computers on. In fact, some had been instructed to. The computers in labs were always on on purpose. Unless the settings were enabled on all machines and could not be changed by users, there would have been some savings.

Audience member: I was interested to hear that the Endpoint Configuration Manager natively monitors and reports energy use for computers in a way that makes it easy for IT departments to see. Can other (non-PC) connected/IoT devices on the network be monitored this way?

Tim Myers: Endpoint Configuration Manager and Group Policy are limited to Windows computers. We found out that having the Endpoint Configuration Manager agent installed on computers without doing anything else enabled us to gather energy consumption data from the built-in reports included with the software. These reports are in the Monitoring > Reporting area of Endpoint Configuration

Manager. It is worth noting that we cannot necessarily determine where mobile devices are residing in order to exclude consumption data from when they are off-site. Our most accurate data now only comes from queries on desktops still in use within the College as most employees now use laptops. Depending on the report, different subscriptions could be set up that email excel or pdf files with the data to certain users on a scheduled basis.

Audience member: Changing behavior at the student/user level to reduce energy consumption and implementing carbon reduction / sustainability programs. What about from the university level where budgets are allocated to buy technology and equipment to facilitate the reduction and enable end users to do these things?

Kimberly Anderson: Cornell's Energy Conservation Initiative (ECI) studies and identifies high-impact energy-saving projects across the Ithaca campus. ECI is managed by a dedicated team in the Energy Management Department who identify and implement three types of upgrades: building automation & controls, heat recovery, and lighting systems. The program launched in 2000, and as of the early 2020s, the ECI program at Cornell has saved the University over $52 million dollars and avoided over 231,000 $MTCO_2e$.

Audience member: What software did Cornell use for the Goose Chase?

Kimberly Anderson: We worked with the online platform called GooseChase: https://www.goosechase.com/

Audience member: Are there any energy reduction solutions for plug load when cube farms are hoteling?

Paul Torcellini: This depends somewhat on the strategy to put "amenities" into the space and how the spaces are assigned. If there are no amenities in the space, then the plug loads are zero, except for what people bring into the space when they arrive. If the spaces are assigned daily, then the plug loads go away with the occupant. If more amenities are provided, such as monitors, then these should go into sleep mode when a video signal is not detected. An alternative is to have an 8-hour timer–the plugs for that cube will turn on in the morning and it will time out at the end of the day. For assignments, if you assign cubes from one end of the space to the other, blocks of power can be turned off (including lights and HVAC) in areas of the "farm" that is not being used, until it is actually needed.

Audience member: I see that the energy savings were from 2010-2011. Have you looked at the persistence of those savings? In particular, any instances of people misusing or misunderstanding control devices or settings in the meantime?

Paul Torcellini: The sleep settings on the computers are very persistent as they are required in the configurations of our system/networks. We have good persistence with easy things–such as manual on/auto off plug strips. More complex systems (like occupancy based plug strips) require more training. AV equipment in conference rooms has increased with more tele-presence and is currently an area that needs work to keep it from running 24/7. We have a cyber policy on printers and thus the multi-function document devices work well and are centrally managed. There are several USB powered devices such as task desktop fans that if run on the computer will shut down–or in general, people are good about turning these sorts of devices off. Same goes for task lights. As more cloud computing is done, our central datacenter power has gone down and have fine tuned our hot aisle containment over the years. IT closets are an area that can always be improved, especially when the building is not occupied. We do have a small coffee shop and by contract they have to manage plug loads and turn things off at nighttime. Same for vending machines–by contract they have to be energy star. In the break rooms, not much equipment has been added. We required coffee pots to auto shut off for safety reasons and that has persisted well. We have not done a formal follow on study.

Audience member: What opportunities are there for machine learning?

Paul Torcellini: At the first level, I like to keep it simple. It tends to give better savings over a broad market reach. One of the things is that if the controls you create are not effective, the occupants will figure out how to override and you get zero savings. If you have a strategy to figure out how to turn off the power based on machine learning and can show that occupants will accept, great–this is an opportunity. In general, most of the plug loads are tied to computer equipment. Having a sleep function on the computer which also controls the monitors is very effective as mentioned in the presentation. It is easy to deploy. You may have opportunities for machine learning at the IT switch level, server level to ramp up/down to meet the current/projected loads with limited loss of apparent service.