Rois Langner: Hello everyone. This is Rois Langner and welcome to the Better Buildings Alliance Plug and Process Load technical team biannual call. We're going to start in just a couple minutes here. I'm going to allow a couple more people to join the webinar. Okay, thanks.

Hi everyone. We will be starting in just one minute. Thank you.

Hey, hello everyone and welcome to today's biannual team call for the Better Buildings Alliance Plug and Process Load technical team. Again, this is Rois Langner from the National Renewable Energy Laboratory and I will be introducing today's call. Next slide.

The agenda will include an introduction to the team players for the Plug and Process Load technical team. We'll also provide a number of updates including upcoming events, publications and new research that the team is working on, and then we're excited to have a technical presentation that will be provided by Alicen Kandt of the National Renewable Energy Laboratory on a plug load management system field study looking at a wireless meter and control technology.

After that, we'll leave some room for questions and answers that additional member updates. Please note that this call is being recorded and we will be posting the recording to the Better Building Solution Center afterwards. We'll provide a link in an e-mail as well to all the members. And if you have any questions or comments during the call, please type your questions into the question input field. Thank you. Next slide.

And first, some news. We have a couple transitions happening. We have transitioned a couple of the technical team leads. I've been the technical team lead of the Plug and Process Load technical team for many years now and I'm transitioning over to lead the Better Buildings Alliance renewable integration team, which is focused on strategic integration of renewable energy sources into buildings and building portfolios as well as how buildings can be an asset to utilities as the utility landscape evolves to include more renewable energy sources. In particular, we will be investigating how buildings can provide load flexibility options for utilities and better grid coordination.

So the website is listed on, or there's a link to it on the slide and we haven't had a team call in a long time, but we are excited to announce our upcoming call on April 9th from 1:00 to 2:00 p.m. Eastern. During this call, we will have an exciting conversation on building load flexibility and grid coordination. Monica Newcomb, senior policy advisor in the office of energy efficiency and renewable energy at DOE will provide an introduction to the Department of Energy's research interests and stakeholder efforts with utilities and state policymakers in this area.

The Rocky Mountain Institute will also present new research conducted with the General Services Administration, GSA, to understand the value of commercial buildings to utilities in providing a resource for load flexibility and capacity to respond to demand requests.

Again the registration link is provided in the slide deck which Kim Trenbath will send out after the call, and we really hope that you can join us. Next slide.

So I'm excited to stay within the Better Buildings Alliance world and it's my absolute pleasure to announce that my colleague Dr. Kim Trenbath will be taking over as the technical lead for the Plug and Process Load team. I've worked closely with Kim for many years and I'm pleased to leave you in such good hands. And with that, I'd like to pass the baton over to her. So here's – I hand it over to you, Kim. Thanks.

Kim Trenbath: Thanks, Rois. Thank you very much. As Rois said, I've been working at NREL and I've actually been here for six years. I've been on the PPL technical team for a year, but prior to that I've been – I did some research on plug and process loads in commercial buildings.

Some of the research that I worked on is a publication called Energy Savings and Usability of Zero Client Computing and Office Settings, and that was also written by Amanda Farthing and Rois Langner.

The other work that I work on at NREL includes fault detection and diagnostics in commercial buildings, zero energy k-12 schools and student competitions for the building sciences. I'm also an adjunct professor for Cornerstone Design at the Colorado School of Mines.

We're excited to also welcome a new technical team member, Bennett Doherty. He is a research engineer at the National Renewable Energy Laboratory. He focuses on plug and process loads research in commercial buildings and residential research – residential building research with the Building America program.

His interest in building science began as a participant in the DOE Solar Decathlon Design competition, in which his collegiate team designed a zero energy elementary school. Bennett has a BA in physics from Middlebury College in Vermont. So, welcome Bennett.

Also new to the team is a member of our technical team support from Waypoint Energy. In the last call, we introduced Katie Vrabel and she is a director at Waypoint Energy and she began supporting the PPL team in July of 2018.

We're happy to welcome Carly Burke, an associate at Waypoint Energy. She began supporting the PPL team in November of 2018. Carly has six years of experience in energy efficiency standards and labeling programs, voluntary public private partnerships and market transformation initiatives. She has a broad understanding of the utility incentive programs. She has a BA from the University of Maryland College Park. So, welcome Carly.

Now I'm moving on to some upcoming events that I'd like you all to be aware of. We're excited for the 2019 Better Building Summit, which will be held July 10th through 11th in Arlington, Virginia. I would like to highlight a session that relates to Plug and Process Loads and this is the Beyond Widgets: Multi-Technology Integration and Connected Systems session that the plug and process load team will be hosting at the Better Buildings Summit.

During this session, attendees will learn how efficiencies can be found in coordinating controls for different building end uses. We will highlight innovative approaches to controlling plug loads with other systems such as lighting and HVAC. And the session will include highlights from a field evaluation of LED systems equipped with advanced lighting controls that interface with HVAC systems and plug loads.

The registration is now open for the Better Buildings Summit and we look forward to – our team looks forward to seeing you there.

Another upcoming event that I want to put on everyone's radar is the US Department of Energy Building Technologies Office peer review. This is April 15th through 18th in Arlington, Virginia. This is open to all and it's free, but registration is required for admission to the presentations. The peer review is a review of selected projects across BTO's entire portfolio. So this not only includes commercial buildings integration, but it also includes the residential organization and emerging technologies.

During peer review, independent experts will assess the progress and contributions of each project toward BTO's mission and goals. Peer review is also a time to assess the management of existing efforts and collaborate on the design of future programs. This is a great opportunity for those in the buildings research community and industry to collaborate.

I also want to point out that related to the Better Buildings Alliance, there's going to be a portfolio review that focuses on the partnerships and potentially the Better Buildings campaigns. So this is where this project would align.

Moving on to some publications that I would like to highlight, one publication that just was released in February 2019 was a technical report on the Plug Load Management System Field Study. This report was written by Alicen Kandt and Rois Langner. I'm not going to talk more about this right now because Alicen Kandt is going to present on the findings of this report later in today's webcast.

I also want to highlight a publication that was released in Intelligent Buildings International, a peer-reviewed building science journal, in September 2018. This is a publication titled Energy Savings and Usability of Zero-Client Computing in Office Buildings. This was authored by Amanda Farthing, Rois Langner and Kim Trenbath.

We investigated the energy use of zero-client computing compared to traditional workstations from both a workstation approach in a whole building approach. And if you're not familiar with zero-clients, these are devices that act as a shell for a normal personal computer where all the computation and data storage is done on a server. We found that average power of zero-client workstations were 16.4 to 31.5 percent less than traditional workstations that used a laptop for computation during occupied hours, but when we factor in data center power use, which was estimated, the amount of energy used for zero-clients was higher than traditional workstations for this particular study location. But this is expected to change due to efficiencies in both laptops and servers.

A future publication that we have been working on for a long time is our landscaping study on Integrating Smart Plug and Process Load Controls into Energy Management Information System Platforms. This is in the final stages of publication. This research highlights the current state of the wireless plug load meter and control market, how PPL controls already integrate into BAF and EMIS platforms, where the market is heading, gaps to fill in order to push the market forward, and recommended research areas for the National Labs.

And finally, I want to highlight some new research that's in the pipeline. NREL is conducting research on OFCI plug load modeling and device level disaggregation. For this research, we're really trying to answer the question, how can a limited number of individual monitoring devices and building level sub meters be used to develop a disaggregated breakdown of plug loads in an office building.

So what we did so far here is we have looked at the load profiles metered by a few of these devices for an office building that also has a sub meter for the plug load. And we're trying to find – we're identifying that there's a lot of value in specific disaggregation, especially learning what products are being brought online and at what time and finding value and having these devices meter a handful of plug loads rather than the entire building's plug loads.

And then highlighting the latter two areas of new research. Both are informed by the guidance that came out of our landscaping study, and we are currently scoping the research for these. The first one is interoperability of plug load controls with other building systems and EMIS platforms. We're investigating where the market is going and what is needed to encourage greater interoperability. And for this research, we perhaps will reach out to some of our partners, so stay tuned for that.

The other area of research is looking at automatic and dynamic identification of connected devices and looking to see how this could reshape the way that plug loads are managed in a building, and also we might reach out further for that information, so stay tuned for an e-mail coming from us.

And that is all the updates that I have for the PPL technical team. Now we're going to move into our guest presentation.

Our guest presenter is Alicen Kandt. She is a senior mechanical engineer at the National Renewable Energy Laboratory. Alicen provides assistance in assessing technical and economic potential of renewable energy, energy efficiency and water efficiency opportunities, as well as providing technical support of projects. Alicen's research interests focus on the evaluation of emergent technologies, the water energy food nexus, particularly the quantification of energy uses of water infrastructure, and on the glint glare impacts associated with photovoltaic systems.

Alicen holds an MS in mechanical engineering from the University of Colorado at Boulder and a BS in mathematics from the University of the Puget Sound. And so now I will turn this over to Alicen.

Alicen Kandt: Thank you, Kim.

Next slide, please. So thank you all for joining me and all of us today. Good morning or afternoon, wherever you are at. Here's just a quick overview of my presentation. I'm going to talk just kind of again quick snapshot of why we tested this technology with a little bit of background in the plug loads, an introduction into the technology, and an overview of the field study we conducted. And then I'll run through the quantitative and qualitative results from that study and then leave you with some lessons learned and we'll have some time for Q&A.

Next slide, Kim. So again, I think largely the bulk of you are familiar with plug and process loads, but if there's somebody new to this group or this topic, just one quick slide snapshot. Plug and process loads are those loads that are plugged into electrical outlets in buildings, so such as your computers, coffee makers, printers. And they also encompass hardwired clothes so those would be things like fire detectors, escalators. They're really any load that is not associated with a major building system, such as your heating and ventilation system, your lighting system. It's basically everything else.

So why do we care about these? They're very little, but a lot of these little loads add up to a lot. Plug and process loads consume about one third of primary energy in US commercial buildings and it's further important because as buildings become more efficient, then the plug and process load efficiency becomes more relevant to achieving aggressive targets. So as those large building systems that I mentioned our HVAC, our lighting systems, even building envelopes, become more sophisticated and efficient, we're seeing that PPLs make up a larger piece of the pie and so we're really needing to start to hone in on those and savings opportunities associated with them.

As the bottom table demonstrates, the savings potential associated with plug and process loads is quite large and commercial buildings, for the individual equipment or individual device, it's estimated between 10 and 50, about 50 percent savings potential. And then on a whole building level, that equates to between 6 and 10 percent savings potential. So there's a lot of opportunity out there. Next slide.

For this field study, we tested the Ibis InteliNetwork plug load management system. So it's comprised of intelligent socket devices. These are what you can see in the image. These are, you know, very straightforward. They plug directly into an existing electrical outlet, and then you plug your device into that, directly into that socket, and they collect energy usage information on that device.

The system also is comprised of a gateway which manages communication between that socket and the PLM cloud service. And then the system is also comprised of a PLM network. It's a cloud-based measurement and control network for the entire system, and it includes an online interface and dashboard where all of the data can be visualized, analyzed, and where the controls could be set for the plug load management system.

The vendor, Ibis, estimates a potential plug load of between 20 and 50 percent. Next Slide.

So for this field study, we tested this technology in two locations. One was in Chandler, Arizona. It's a pet-oriented retail store. And the top-left graphic is representative of that test location. We identified about 40 or exactly 46 devices for potential inclusion in this study.

I do want to, and I'll talk about this later in lessons learned, but kind of caveat it or explain that at the onset we identified 46 potential devices. After looking at that data in more detail, we had intended to control eleven of those and in reality, only five were controlled and had a full set of data. So I think that that's an important consideration and caveat to keep in mind as we start stepping through some of the findings. And when we do that, I'll talk through why those numbers were so different than what we had intended and hoped for.

For Test Location B, it was in Honolulu. It's an eyewear manufacturer and retail store. At that site, you can see we had many more devices intended or identified for the pilot, 130. That's the bottom left graphic. The bulk of those were office and retail equipment was the majority and then followed by optometry equipment in the grey. And just real fast, for that top graphic, the big yellow portion is pet care appointments, so this was a pet-oriented retail store for our test location A and the bulk of that equipment was associated with pet care.

And then just electric rates are on the bottom, so Arizona having a little bit lower rates at 12 cents and Honolulu, higher rates at 30 cents per kilowatt-hour, and you can also see when we look at the economic metrics, that those electric rates obviously drove the economics a little bit too, the economic results. Next slide, please.

So for testing protocol, there was an equipment inventory and PLM installation period when the technology was installed. Both of those were conducted by the vendor, Ibis. Following that period, we then did a baseline period. You can see at both locations, it was approximately four weeks. Following that baseline period, we, Rois and I at NREL, the vendor, Ibis, and then our partners at the retail stores collectively looked at the data, analyzed the data and identified devices for control.

We recommended ones that we would like to see controlled and then based on input from the store operators, you know, some of those fell out or, you know, they were excluded for certain reasons, potentially device type that just they didn't want controlled or for safety reasons wanted excluded. So that reduced the subset of devices that we were able to control. And then we implemented a controlled period. They were the same length as the baseline period, again, pretty close to at the four-week period. Next slide.

So we, at onset of this project developed an NMV plan, which contained both quantitative and qualitative objectives that we were wanting to study and examine the outcomes for. So for the quantitative ones, those are identified here, they included measuring electricity savings. We were hoping to see the success criterion that we were hoping to see was electricity savings compared to the baseline of at least ten percent and measured plug loads. For cost effectiveness, we were examining both the simple payback and the savings to investment ratio, looking for a payback period of less than ten years and an SIR of greater than one.

And then for deployability, we were really wanting to see favorable payback and savings to investment ratios that were not only achieved just in this field study site but also in a broader rollout, you know, potential hypothetical rollout at other sites in that retailer's portfolio, so looking for broad deployability beyond just this study site. Next slide.

So the finding is associated with this field study at both sites, you can see the metered electric consumption met our success criterion at both sites with eleven percent savings at Test Location A, 18 percent at Test Location B. The economics, neither of them at our success criterion, and one big component of that was the fact that at neither location were we able to control the full number of devices that we had intended to control. And so there were some complicating factors that I'll talk about more in lessons learned, but it had to do with many devices we didn't get a full dataset for the control period, and so they had to be excluded. And so that was the biggest driver of the economics. Next slide.

And then deployability, so unfortunately due to that unfavorable payback and savings to investment ratio, it was unlikely that there would be broad deployability potential; however, again there's this caveat of there were some of these complications during the pilot that negatively affected those outcomes. So, you know, there is a potential that had those not happened, you know, there could be better economic return on investment in a different deployment or a different situation. Next slide.

So the qualitative objectives are defined here. The first one was ease of installation. So we were planning and we did interview the vendor and the retail representative with questions such as the time required to install and configure the system, the labor associated with the install, and the impact of install on the operation. So the success criteria were that it was less than a day to install, less than a week to provide online data access to both us and to the retailer. And then the operability component, this was understood with an interview with the retailer representative, this was looking at things like the usability of the Intellisockets, the usability of the network and then the time requirement for continual management.

So the metrics of success were that there was no impact to operations and maintenance efforts and less than four hours to understand the online data interface. And then the non-energy benefits, we were really hoping to see at least one non-energy benefit realized. So an example of that could be, for instance, that the vendor touts that this technology can help with device health management and monitoring. So by closely monitoring performance of the device, you could potentially see performance getting worse and, you know, preemptively realize that it's failing and change that out. So that's one example of a non-energy benefit. Next slide.

So the qualitative findings, for the time required to install the system it was less than a day at Test Location A and it was nine hours at Test Location B. So it was about, you know, they were both right around what we were hoping for, less than about a full day. For the vendor time to configure and provide online data access to the interface was about two to three days for both test locations, so that met what we were looking for. And then the impact of install and operation, it was really minimal. It was minimal to none, so that was great. Next slide.

So for operability, we were looking at the usability of Intellisockets at Test Location A. They informed us that it was very easy and intuitive. At Test Location B, they also said it was easy and intuitive; however, they did encounter some problems with devices not functioning as intended after the controls were deployed, and there were many, many sockets that the staff unplugged or deactivated as a result of that. And so, again, that was one of the factors that drove the economics, because a lot of the devices intended for control ended up not actually being controlled.

The usability of the online interface, this is another really important lesson learned and kind of an unfortunate outcome is that neither of our retail partners really were able to use the online interface enough to even be able to provide feedback. And so we did find that that was one of the limitations or potentially, you know, one of the barriers of the study is the fact that they weren't actively monitoring the devices, the device performance, and the data coming in, made it so that I think we missed some opportunities associated with savings and with troubleshooting when devices had been or sockets had been unplugged.

And then the time commitment for monitoring and management, you know, and this was tied to the previous note, but staff really felt, you know, they didn't have the one to two hours needed per week to manage or to actively monitor the online interface and the information coming in. And so I think that was a big barrier to success associated with some of those quantitative metrics for the economics. Next slide.

And then lastly non-energy benefits, so for Test Location A, there wasn't any realized. For B this was a site where some of the staff did kind of interact with the sockets and actually did, you know, try to override it and there was lots of good engagement with staff about plug load management and plug load energy use. So that in itself I think was a great non-energy benefit just to start that dialogue. Next slide.

So just some key takeaways, and this is where I'll go into a little bit of some of the nuances of the study and the real-world testing, but, you know, real-world testing resulted in real-world complications for us for this field study. At Test Location A, Mother Nature really threw us for a loop and the store was actually flooded. So, during the baseline period many, many pieces of their equipment were destroyed and lost. Some of the sockets were destroyed or lost or damaged, and so we actually had to go – we didn't but Ibis and the store together remapped some of those sockets onto different devices, and we had to start a new baseline period. So it resulted in a smaller subset and kind of a smaller opportunity base than we had initially envisioned for that site.

The second note, sockets gone missing, happened at both stores and, you know, I'm not sure the value – I don't think anybody is stealing these sockets. They don't necessarily have a value without the rest of the system components, so, you know, it leads us to believe that people either were a little leery of what that socket was doing, they maybe hadn't been educated on it, or they were, you know, legitimately experiencing some problems with those controls and, again, weren't informed or empowered on how to get answers and best, you know, override or best handle those. So that also at both stores led to a much smaller subset of controlled data to base those economics and savings calculations on than we had initially envisioned.

So again, just a quick snapshot of the numbers at Site Z, that's the pet oriented store in Arizona. From the baseline period, we baselined 46 devices. We identified eleven for control and then at the conclusion of the control period, we only had a full subset of data for five of those. So the other six had either been unplugged or experienced large portions of data loss that made it so that we could not include them in our calculations. At the Test Site B which was the one in the eyewear manufacturer and retail store in Hawaii, we had baselined 130 devices and then had into control 54. And then we ended up with only a full subset of data or a set of data for a subset of 19 of those devices.

So the balance of those, again, were either unplugged or experienced large data losses. So, again, I can't emphasize enough that you know, I think those economic numbers would largely be improved upon if we had better data sets that were more inclusive of all the devices that showed potential for savings that we had intended to control.

And then the last takeaway here is just staff engagement. I also can't emphasize that enough. I think that all the way from the top down of having a really vested champion on board for your deployment of this technology is key. They're going to be the person that's interfacing with the technology, that's monitoring it regularly to make sure that it's performing, that can flag devices that potentially have been unplugged or that data isn't coming through.

And they can also identify sockets or devices that the savings aren't what they had thought they would be and troubleshoot or move that socket to another device. And then all the way down to the staff, you know, working in the retail location, including the janitorial staff, and so we found at both of these locations, this was really complicated to reach out to everybody with messaging and educational background on this technology, on the intent of this project, on how to override and work with the technology if needed, and then who to contact. We found that both stores had multiple shifts.

They operate, you know, on weekends and holidays. And so, you know, even if the messaging was making it maybe to one manager down to the staff one day, it was missing, you know, a second and a third tier of the staff or a shift of the staff, and so – and also the janitorial staff were largely not included. So I think that that – part of that is indicative of you know, kind of it led to us seeing a bunch of these sockets becoming unplugged. Next slide.

And then other key takeaways, just, you know, honing in on and where we do see some successful deployment conditions would be areas with higher electricity rates. I think, you know, just even looking at the paybacks from these two pilots, the Hawaii site was 30 cents per kilowatt-hour and the payback was, you know, a little bit better at about 29 years and the Arizona site was at 12 cents a kilowatt-hour was, you know, in the 50 years. So that obviously has other factors included in it, but the higher electricity rates is going to help drive down the payback period and help improve the economics.

Look for a site with many controllable devices, so, you know, devices that will cause interruptions to business operations, reduction in sales, these are ones that you would not want to control, not want to include and so operations that have many of those are going to be ones that maybe aren't a great focus for a technology like this. Other devices that you may not want to consider are ones that would have health and safety concerns if unplugged or unactivated, ones that maybe have shutdown procedures or require reconfiguration on start. So that was something that we saw, you know, at the pet store or the pet retail location was there were some devices that, you know, had such a lengthy startup process that they couldn't be deactivated. And so really honing in on appropriate devices for control is really important.

And then looking for stores with multiple duplicate or similar stores or operations I think can really help you study one pilot store and then be able to identify, you know, extrapolate potential savings to those other stores. There's also the potential, like I mentioned, to, you know, if you have a great champion who is actively monitoring the information, you know, maybe you identify a subset of devices that are not able to be controlled at your first pilot store. You can take those sockets and move them on to a second location. And so, you know, if you have similar operations or some economies of scale and potential to move things around to keep gathering information and keep making informed decisions iteratively.

And then lastly you know the champion is just so important, having a staff member who can spend, we're estimating one to two hours per week, I think, you know, after maybe this is implemented and all the kinks are worked out, maybe it's not quite so laborious, but I do think continual interaction with the online interface and with the data really is important to keep track of where there's devices that have been unplugged or data that's not coming in or where there's additional opportunities for savings that maybe haven't been capitalized on is really going to help best optimize the economics associated with these type of systems.

And then beyond monitoring the data, furthermore just communicating with staff continually, you know, there's continual change outs of staff, new staff coming on board and so kind of an ongoing educational campaign from that champion down, you know, through the managers, through everybody really that's going to be interacting with these systems including signage about what the device is, who to contact, and how to override or operate the system if needed. Next slide.

So like Kim mentioned, Rois and I are excited to point you to this study. It was just recently published in February. The link is here and I encourage you to go take a look at it and then of course reach out to Rois and I if you have any questions.

At this time that wraps up my presentation today and I believe we're going to open up for a Q&A. Thank you.

Kim Trenbath: Thanks Alicen. And yes, we are going to move on to questions and specifically about this presentation first and then move on to member updates. So we did have one question come in for Alicen and that question is, oh, we have a couple coming in. So yes. Please, please put those into your chat boxes and we are collecting them.

The first one is, "I am curious about how did you get the baseline energy conception?

Alicen Kandt: So, we used the sockets, which gather data for the plugged in devices. It collects baseline data. So, the system, the Ibis PLM system that we tested is great for even just baselining data because I know doing, you know, having access to baseline data or usage data for plug loads is something that's often really hard to procure. Mostly those systems aren't sub metered. And so this serves as a great system just for baselining and quantifying the loads associated with plug loads.

So, we just used the sockets and plugged in devices that we had thought could have high potential for savings and then measured that data, just kind of in a business as usual standard operating environment. For those, it was about approximately four weeks for each of those sites. And then that data goes into the online interface and then we were able to analyze that data.

The Ibis system does do some analytics where it analyzes the baseline data and generates potential savings and suggestions of which devices to control and how to control them. And then Rois and I also independently did some analysis on that data and then we resolved, you know, our findings with Ibis's suggestions and again, then vetted that with the retailers to get their buy-in on which devices to actually control.

Rois Langner: And hi, everyone, this is Rois. Just to add to that too, the sockets themselves collect data down to the minute level. So that's the data that we were able to use for that. Additionally, the sockets are wireless and they communicate using a ZigBee communication protocol so that's how they communicate via a mesh network back to the gateway and then the gateway is connected via Ethernet to the cloud services there. And that connection allows you to collect the data wirelessly and also implement the controls through the online dashboard. So I'll just add that to what Alicen just said.

Alicen Kandt: Thanks, Rois. Those are both important – those are important implications.

Kim Trenbath: And we have a second question and I'm going to modify this a little bit. What is the main cost impacting the poor economics?

Alicen Kandt: So, this was largely driven by the fact that the bulk of the devices we identified as showing promise for having good economics based if we activated controls, didn't actually end up being able to be controlled and included in our study. So again, it was five of eleven and then nineteen of fifty-four that we intended to control, ended up having _____ controls activated for the entirety of our control period. So, the savings realized was therefore drastically reduced and not impacted the savings.

There's also associated with these devices, you know, there's equipment costs associated with them and there's a software as a service fee, a monthly fee that is paid per device or per socket, and so that also obviously impacts the economics. I do think that if you were to deploy these in an application where you know, you were actively controlling the devices, and realizing savings associated with that investment and with that SaaS fee, that would really improve the economics associated with the investment of the system.

Kim Trenbath: Okay, great. And I have a third question. How did you decide which devices to monitor and how many smart plugs did you use for each location?

Alicen Kandt: So, for the devices to monitor, again, and this is another kind of key takeaway I think Rois and I were _____, or if we could do this again, would love to go and be a part of the initial equipment inventory and visiting the site and installing this. I think that there was a little bit of us not having a full snapshot of the loads and the plug loads in these applications and then we also further had problems at the store that flooded because Ibis kind of remotely supported the store in remapping those sockets and I think that complicated it a little bit.

But, so Ibis visited the store and did a walk through with our kind of main retailer point of contact or the champion, and based on the knowledge and expertise of that retailer contact, started identifying devices just for the baseline period. And so the baseline period is very kind of low risk from an operational perspective in that we're not controlling anything. We're not changing operations of any of those devices and so the retailer felt, you know, fairly confident, hopefully really confident, in doing baselining and installing these sockets on many, many, many different device types. And so we just installed them on kind of a plethora of representative devices for those different applications.

So for the pet retailer, we obviously differed greatly from the eyewear manufacturer and retail store, but we were trying to get a good sampling of devices that were representative of most of the plug load devices in the store. If the retailer knew at the onset that a certain device was not going to be able to be allowable as a controlled device, then we likely excluded it from the baseline, although, again, it can be just informative to really quantify the energy that's associated with those different devices.

So then, based on the data we got in that baseline period, we just examined it for high energy use periods that were happening during non-usage times of those certain devices. And so a great example at the pet retail store that we saw, you know, that was really high and kind of an outlier was the grooming tables. And so it was happening, you know, there was high energy usage happening overnight, where, you know, no grooming was happening, and so we immediately honed in on that, had some dialogue with our point of contact at the retail store about, you know, what are the operations associated with these grooming tables, why are there these high loads at night? Is this something that we could deactivate?

And so that's just one example where we were really looking for energy usage that was in off periods or kind of an outlier and then started some dialogue with the champion about whether or not that would be something that we could control.

Kim Trenbath: Okay great. Thanks. I think that's the questions that we have, but now I'd like to turn it back towards the team members that are on the call. So I appreciate all of you guys being here. So, Kim –

Alicen Kandt: Kim, there's one more that was typed in that I see.

Kim Trenbath: Oh, okay.

Alicen Kandt: Yeah, it ways it was mentioned that the time requirement for monitoring and management through the web interface was one to two hours per week. Is it assumed that this task falls to a building manager or is there a specialist that is or can be contracted to monitor and manage the system? If so, did the economics take into account these labor hours as an O&M cost?

So, your assumption that this task falls on a building manager is a good one. I think that it could fall on a building manager, an energy manager. It could also fall on if there's like a sustainability director or somebody at kind of a headquarter level that oversees all the stores. For one of these, that was initially our main contact, but we do find that whoever is doing this really does need to have good, really good familiarity with the building, with the operations, great contact and knowledge of the staff on site and so somebody, you know, managing this remotely is definitely doable, but they just need to have that really good knowledge of the site and contact with people on site.

So, I think that's probably the most common kind of situation where it's somebody within that entity. I would imagine that Ibis could be contracted to monitor and manage. I mean, their online data interface, like I said, does some analytics. They're very knowledgeable about plug loads and so I would think that they could largely take on that role, those costs associated with them serving as more of the champion is not included in the cost, the equipment costs and O&M costs that we did for this study. But I really think that you do need somebody that's intimately familiar with that site, the operations and the staff.

Okay, that's all I see, Kim.

Rois Langner: I actually see quite a few more questions here. Another one _____ can you explain some of the challenges that you encountered with controlling equipment that you noted? Was this due to the PLM technology or the equipment that was being controlled?

Alicen Kandt: I think it was the latter and I think that, so in Test Site A, which was the pet related retail store in Arizona, that store had sockets that went missing and kind of faulty or inconsistent data sets. In that store, we did not – we were not made aware of staff that were having problems with the sockets and with the controls of devices. So, in that store there were, you know, again, no complaints or no questions, or no issues that we were made aware of or that Ibis was made aware of associated with the operations and the control of those devices.

The second site, which we called Test B, which was the Hawaii eyewear site, that one we were made aware of staff reporting that maybe a device wasn't turning on when it was supposed to be turning on, according to the control schedule and reporting that they weren't able to override that and then removing the socket. And so that store had numerous problems associated with that. And so, I'm not – I think that's it's a multitude of problems of maybe a schedule was set incorrectly, maybe they were working at a time outside of the normal, you know, time we had assumed when we set the schedule.

Also they didn't have the proper education and awareness of how to properly override it and who to contact for more information on the system. And so it resulted in them just removing those sockets. The Ibis system does have an ability to set up alerts, where if a device or if a socket is no longer collecting data, or is unplugged, or if data isn't transmitted for a certain amount of time, and so both Rois and I set those up and were receiving those as was our partner with Ibis.

But she informed us accurately and we discovered that it is like an overabundance of alerts that you get because even if the system just stops transmitting data for a little blip of five seconds, you'll get an alert that it's off and it's back on. And so, you know, when it's dozens or hundreds of devices, it becomes overwhelming to identify the true alerts or the true, you know, problematic alerts that need an action versus ones that are just, "Oh, this this tripped off and it's back on a few seconds later."

And so I think that that was one limitation of the alerts and of the system and again kind of drives that, what we're estimating as one to two hours of somebody to really look at the data and realize, "Oh this system, you know, this device had been on, you know, not actually being measured for a week," or, you know, "This socket's gone." So, that's, you know, that drives some of that _____ our recommendation that we came up with for management.

Rois Langner: And let me just add, actually in the pet retail store that we worked with, there was one device where the equipment was an issue at working with the controls and we found out that the pet tag, like the dog tags that you have for your animals, that piece of equipment that makes those tags used a ton of energy, but it was problematic to turn that machine off and back on again. A lot of times, the piece of equipment would just fail. So we couldn't actually control it. It had to be left on 24/7, but it brought to the attention of the owners of that retail store that that equipment used so much energy and that it was problematic for turning it off so that gives them some power to say, "Okay, maybe there's a different piece of equipment that we could invest in that we can control and that uses less energy." So that was kind of an interesting outcome from that store too.

Kim Trenbath: All right everyone, this is Kim again, and we're – I now have a plethora of questions, so I think I'll ask one more to see if we have any time for that. So the one is, "Any control algorithms that have been embedded into these socket devices, such as to automatically shut down the plug-in devices or have the time automatically scheduled," a control algorithm question.

Rois Langner: And Alicen, if you don't mind, I'd like to answer that one. At this point in time, the Ibis PLM system does not have embedded automatic controls, but I know that that's something that in this filed they're working on developing and understanding, you know, how do we classify devices together or how do we look at different areas of a building, for instance, in an office space. Can you look at devices that are commonly used like a multifunction printer and turn that off automatically? Okay, I know that there is research happening in that space to understand how do you classify devices and how would you implement automatic shutoff controls with that? So, but it's not available at this time.

Kim Trenbath: Okay, great. Thanks, Rois. So, I think we have about five minutes left and I have a ton of other questions, but I would like to give some people on the call the opportunity to talk about any projects that they are working on that are related to this project and if we need kind of a discussion question, I think the question is, "What are some of the best practices that you know of for plug load metering with these plug load metering and control devices?" So, if anybody has anything to contribute to those thoughts, I think we should allow people to talk and feel free to chime in.

Male: Hey Kim, everyone's muted. But I think if folks have something to contribute, why don't you let us know via the question portal and then I think I can add you as a presenter where you can speak. So if you have something to contribute, let us know and then we'll add you to the presenter role and unmute you and then you can talk.

Kim Trenbath: Okay, so I'm not seeing anybody else ask. I'll ask one more question, and this one is, "Are you familiar with any product technologies out there that incorporate lighting, HVAC, and plug load receptacles into one control system? I understand designers are having a hard time finding products that integrate together into a space which then requires more zone-by-zone calculations." Rois, would you like to take that one or would you like me to take that one?

Rois Langner: Sure, I can talk to it a little bit, but maybe you can elaborate on some of these. As Kim mentioned earlier in the presentation, we're starting to look more at research to truly integrate systems. I know I've seen a couple of products that I'm not sure if they're fully on the market right now but looking at integrating some lighting controls with plug load controls and actually through the Better Buildings Alliance interior lighting campaign, they are offering a new category for innovative controls, and that's really to look at whether there are examples of people combining both lighting and plug load controls, or even lighting and HVAC controls, or combining all three together.

So we're right now trying to reach out and find some examples and case studies of people doing this together and how they're actually controlling that, and in addition, the plug load team, so Kim and Bennett will be leading some research efforts that's focused on, you know, where are the true opportunities in integrating these systems together, how can it be done, and how can we push the market to make this happen in real buildings?

Kim Trenbath: Yes, thanks Rois, so right now, the lighting manufacturers have jumped on board and they are focusing on integrating plug load controls with lighting controls. So the market is moving in that direction right now. At the Better Building summit, the session that I highlighted earlier is going to focus on a couple pilot studies that have investigated technologies that integrate these controls. And so basically the bottom line there is that these things are being piloted right now and collecting data on these pilots. So it's an emerging area, and we're looking forward to finding more about this in July.

Rois Langner: All right.

Kim Trenbath: Yes, yes.

Steve Schmidt: Hi, this is Steve Schmidt from Home Energy Analytics. And regarding the report, I thought the report was great. We do something similar in the residential space, so we focus on residential energy efficiency out here in California. And we've seen that there's a huge opportunity mitigating plug loads to get overall savings.

We've been working with a similar product from a company called Kiwi, and we've kind of adopted a three-pronged approach or a three-phased approach. We use meter data to identify buildings that have high plug load problems, mainly it's high standby loads that seems to be mostly caused by plug loads.

So, we first used the smart meter data, which is very cheap to analyze, and find the buildings or the homes that have very high plug loads. Then we will install a bunch of these Kiwi devices for as many of their devices as they can, as many of the home devices as possible, to identify what we call high idle load. Then we will move most of the monitors out and then focus on mitigating the worst loads. So, we rent the devices from Kiwi, so it keeps the costs very low because we can move them from building to building.

So, that's the approach we came up with to try to reduce the economics or improve the economics of doing the site monitoring. Thanks very much.

Kim Trenbath: Great, thanks Steve. Thanks for that contribution. And we are at the top of the hour, so I'm going to close the conference call now, but if anybody has any follow-up questions, please reach out to me and we'll get back to you soon. Yes, so thanks everyone and have a wonderful day.

[End of Audio]