Holly Carr: Hello, I'm Holly Carr with the U.S. Department of Energy. I'd like to welcome you the December edition of the Better Buildings webinar series. In this series, we profile the best practices of Better Buildings Challenge and Alliance partners and other organizations working to improve energy efficiency in buildings. Next slide, please.

Today we'll focus on proven strategies for addressing plug load energy use in your buildings. Here is our plan for the next hour. We'll hear first from our friends at the National Renewable Energy Lab, or NREL, with a primer on plug and process loads, and also some new resources hot off the presses from our Alliance Plug and Process Loads technical team.

Then we will regale you with case studies from Stanford and General Services Administration, a.k.a. GSA, sharing successful projects to reduce plug and process loads in their building portfolios.

Finally, we will highlight some additional resources and have a time for question and answer from our audience. We have a lot of folks joining us today from the audience, so I'm looking for lots of great questions for that last Q&A period.

Let me go ahead and introduce our presenters. Next slide, please.

First off is Rois Langner. Rois has worked as a building scientist and engineer in the Commercial Buildings Research Group at NREL since the beginning of 2010. In this role, she has worked with organizations to develop, implement, and maintain energy management policies and systems for continual energy improvement, and has worked to support the small commercial building sector in overcoming barriers that inhibit the adoption of energy efficiency solutions. Rois leads the plug and process load Technical Solutions Team for the Better Buildings Alliance as well.

Second is Moira Hafer. I think we've maybe moved—there we go. Now we can see everybody's faces. So our second presenter day will be Moira Hafer. Moira serves as an analyst for the Assessments and Evaluations portfolio of the campus-wide Sustainable Stanford Initiative at Stanford University. Her work includes management of the Cardinal Green Office program, implementation of campus-wide plug load reduction programs, and compilation and analysis of metrics for sustainability reporting at

Stanford. Moira is also a graduate of Stanford University with a B.A. in Environmental Science.

And finally, Jason Sielcken is a Senior Project Manager with the U.S. General Services Administration, the GSA, joining GSA in 2009. Most recently, Jason served as the Project Manager responsible for overall delivery of the Wayne N. Aspinall Federal Building and U.S. Courthouse Modernization Project in Grand Junction, Colorado. This is the project that we will be hearing about today. The Aspinall project successfully balanced historic preservation with the use of innovative technology to become one of the most energy efficient multi-tenant office buildings in the country.

So, thank you very much to all three of you for being with us today.

Before we get started with our presentations, I want to remind our audience that we will hold questions until near the end of the hour. Please go ahead and send in your questions, though, through the chat box on your webinar screen throughout the session today, and we'll get to as many of those as we possibly can.

This session will be archived and posted to the Better Buildings Solution Center. Everyone who has registered for this session will receive an e-mail with a link to that archive as soon as it's available—it should be in the next few days to a week.

All right, so to start us off—next slide, please—let's go ahead and get a primer on plug and process load energy use and an overview of the new resources that our audience can download and use today, and that's coming to you from Rois at NREL. Rois?

Rois Langner: Great. Thanks so much, Holly, and hi, everyone. Thanks for joining our webinar today. If we can move to the next slide.

Again, my name is Rois Langner, and I'm a building scientist and engineer in the Commercial Buildings Research Group at the National Renewable Energy Laboratory, which is located in Golden, Colorado. I've worked in the Commercial Buildings Group for almost six years, and I've been the technical team lead of the Plug and Process Load Technical Solutions team for over a year. Next slide.

As I'm assuming most of you are aware, the Better Buildings Alliance is a platform where members in different market sectors can work with the Department of Energy's exceptional network of research and technical experts to develop and deploy innovative, cost effective, energy saving solutions that lead to better technologies, more profitable businesses, and of course, better buildings. The Better Buildings Alliance, or BBA, offers a number of technical and market solutions teams where members can share their successes in reducing energy and learn from their peers.

The Plug and Process Load Technical Solutions team is focused on solutions and processes to reduce energy consumption associated with plug loads in a building. As you can see in the graphic that I have on this slide, which uses data from 2010, plug loads can consume a third of a commercial building's energy use, and I think you'll see some examples in the upcoming presentations.

So the BDA Plug and Process Load team is really dedicated to providing a central location for plug load focused resources, which can be found on our website. We also have biannual team calls to discuss various plug load metering and control issues, and we provide technical support from the National Laboratories and technical experts to help address challenges that our membership faces around controlling plug load energy use. Next slide.

So, why are we putting so much emphasis on plug loads? Well, plug loads account for an increasingly large percentage of building energy use due to two main reasons. One, an increasing number of electric devices that we're plugging into our walls, and secondly because other building systems like lighting and heating and air conditioning—those equipment have just become more efficient over the past number of years. Especially in high performance and net zero energy buildings, plug loads play a much larger role in the energy consumption of the building, and it's become imperative to find solutions to reduce plug load energy consumption.

To help address this, the Plug Load Technical Solutions team provides access to numerous resources on our website that can help building owners assess their plug load energy consumption, select appropriate control strategies for their building type and application, explore and incorporate efficient plug load solutions into building designs, discover utility incentives, and lastly, which is pretty important, institutionalize policies and procedures for plug load energy reduction. Next slide.

So, I wanted to provide on this slide just my overview of the types of resources that we have available on our BBA plug load website.

We have a growing number of resources that include fact sheets, technical reports, case studies, how-to graphics, et cetera, and I've listed a couple key resources on the right side of this slide, which include two guides to help assess and reduce energy associated plug loads in both office and retail buildings—that’s the first bullet point there. We also have three new resources focused on advanced power strips, which are similar to regular power strips but come with built in controls to turn plug loads off when they're not in use. The resources include a technical specification that can be used to understand the different advanced power strip control options, and also how to procure the right advanced power strip for a particular application. We have a great one page how-to guide for using advanced power strips in an office setting; this is easy to print out and give to building occupants. And we also have a list of utility incentives for advanced power strips that were updating on a yearly basis.

Lastly, we are very, very soon to publish, probably in the next couple weeks, a set of decision guides that were created to help building owners find the right control strategies for plug loads in their buildings. These guides were developed for different building types, and they outline the cost, potential savings, complexity, and user-friendliness of various control strategies and their application to each building type, so stay tuned to our website and keep an eye out for that one. All right, next slide.

So, within all of these resources that I'm mentioning, we do go into much more depth about the following energy savings solutions for and these solutions do include messaging campaigns to the building occupants, advanced power strips, upgrading equipment with low energy or Energy Star equipment, using devices, built-in low power states which is pretty easy to do, design strategies for consolidating plug loads. This is particular important in new construction and major renovation projects where you have the opportunity, for instance, to use a central printer for a wing instead of having printers on everybody’s desks. Let’s see—integrating plug load controls with other building systems like lighting systems. This is becoming much more popular these days. And we also have information on additional submetering and control options. Next slide.

I just want to mention, we do have an exciting new project that we're going to be doing this fiscal year. This is a study that will look at the technology and behavioral aspects of using thin client or server-based computing systems compared to traditional computing systems. This work will extend into data centers as well, and we plan to pair up with some of our data center experts for that section of the study. The outcomes will include a technical report and also an outward-facing, easy to read case study. So these will all be public on our website.

Ongoing events for the Plug and Process Load Technical team include biannual technical team calls where members get together and share successes or challenges in reducing plug load energy use. Holly will mention this later in the webinar, but we have the 2016 Better Buildings Summit, which will be held in May in Washington, D.C., and then again we continually update resources on our Plug and Process Load website, so check in with us frequently. Next slide.

So that said, if you are not involved with the Better Buildings Alliance and would like to become either a member or an affiliate, you can join by clicking on the Join button on the BBA website. And I think, Kendall, if you advance one more slide, it should highlight the Join button—there you go. So we are always looking for more members and affiliates to join our team, so if you enjoyed the webinar today and would like to continue in these types of discussions, we really encourage you to sign up and join our team.

Through our team, we really encourage our members to share their stories about what they've been doing to reduce plug load energy use in their building and to promote best practices with the rest of the Better Buildings community. Next slide.

This is basically my last slide, here. I just wanted to list the current team members that we do have right now who are a part of the Plug and Process Load technical team. These team members might be involved in other tech teams as well, but we’d like to see this list grow, too, so please sign up.

And lastly—next slide—my contact information is here. If there’s any questions, feel free to reach out to me, I'm happy to answer them. All right, thank you.

Holly Carr: Great. Thanks very much, Rois. Super resources coming out of the Plug and Process Loads team. If we can send you links to those directly when we follow up with the webinar archive if they become available in the next couple of days as we get the archive together, we will certainly include direct links to those additional resources that are so hot that they're not quite off the presses yet, and otherwise, we will update the archive to include them.

All right. Now let's go ahead and hear from two organizations that have had success educing plug and process loads in their buildings. Stanford's approach was to first have a detailed understanding of what was plugged in on campus and then to implement targeted programs based on that knowledge. Moira, can you tell us more about what you've learned at Stanford?

Moira Hafer: Absolutely, thank you. My name is Moira Hafer and I am in the Office of Sustainability at Stanford University, and I'm gonna talk mostly today about a comprehensive equipment inventory that our office conducted throughout 220 buildings on Stanford's campus to evaluate and quantify plug load energy consumption and try and target reduction efforts. Next slide, please.

This slide just simply reviews our goals. One of the big drivers behind this is, Stanford is putting a lot of effort into better understanding the energy consumption of its heating and cooling systems, and also its lighting systems, and the way things had been shaping up, it really seemed that plug loads were kind of the missing piece of the puzzle, as I imagine is true in many of your organizations.

So, in order to address that, Stanford developed this comprehensive equipment inventory that allowed us to both quantify campus plug load energy consumption, and also to identify viable plug load energy reduction cost opportunities that were really data driven. Next slide.

To conduct the equipment inventory, Stanford used 12 student interns who collected data on 55 types of equipment that are plugged into wall outlets over the course of about 5 months. So, within those 55 types of equipment, we covered nearly all types of office equipment including gym equipment, equipment you would find in kitchen and break rooms, and we also included the most common types of lab equipment and IT equipment, but I do want to note here that we weren't able to capture all of the most specialized types of equipment, so there certainly are types of lab equipment especially that we didn't capture in this study. So we're not necessarily representing 100 percent of the equipment that's plugged in with this data.

I also want to note that, of course we weren't able to measure the actual electricity consumption of every piece of equipment that we recorded, and so instead, we collected what we called attributes for each type of equipment, which really helped us to, as accurately as possible, predict the electricity consumption of that equipment. So, for example, one equipment type was personal computers, and the attribute for that was desktop or laptop, and then another attribute was brand. So, for each personal computer that we recorded in our inventory, we were able to estimate the electricity consumption based on the type of computer and also the brand. Next slide.

Our interns used an internally developed smartphone application in order to collect this data, and the application combined electronic floor plans for each of Stanford's buildings with individual web forms for each room within those buildings so interns could access the web form for the room that they were in, enter the equipment based on what they saw in the room, and they used drop down lists on the web form in order to enter that, and then they could mark the room as complete which, in turn, would turn the room green and help the interns track which rooms had already been completed, and which hadn't. So I think this tool really helped Stanford to conduct this inventory in just a matter of months, and otherwise it may have taken us a good deal longer. Next slide.

Getting into the results a bit, the equipment inventory ultimately captured over 110,000 pieces of equipment within the 220 buildings that we inventoried. That equipment is estimated to consume nearly 50,000,000 kilowatt hours per year, which translate to about $6.7 million per year here at Stanford. That electricity consumption comprises about 22 percent of Stanford's total building energy consumption, and about 32 percent of the electricity consumption of those 220 buildings. So, you can see these numbers line up pretty well with the numbers that Rois was presenting earlier.

On the right hand slide here—and I apologize if the text is a bit small, but—we're just showing the most prevalent types of equipment on campus. So, as you may expect, personal computers and monitors were the two most prevalent types of equipment that we saw, followed then by desk lamps and phones, but there are also a couple types of lab equipment that are falling into this chart such as hot plates and centrifuges, so we do have quite a mix of equipment in terms of what's most prevalent here on campus. Next slide.

Of course, what we really want look at is the electricity consumption of this equipment. So this chart shows the total electricity consumption of all pieces of equipment within each of the 55 equipment types that we recorded in the inventory. So, even just looking at the top 10 highest energy consumers, we can really start to identify some trends, and the first thing I want to point out is, of course, most of you probably noticed how high server energy consumption is, and that’s followed also by network switches and other type of IT equipment and uninterruptible power supplies. So, all 3 of the types of IT equipment that we collected data on are falling into the top 10 highest energy consumers, and we really see this that there is an opportunity there to address IT load.

I also want to mention lab loads, because five of the highest energy consuming types of equipment are types of lab equipment, and those are displayed with the red bars in this chart. So, as a lot of lab sustainability folks might have predicted, lab freezers are definitely the highest energy consumer among that equipment, but we're also seeing equipment like incubators, water baths, and even lab refrigerators coming into the top 10 and actually even the top 5. So again, we're seeing that lab loads are really a driver of plug loads here on Stanford’s campus.

The last two types of equipment that fall into that top 10 are personal computers and space heaters, and these tell kind of an interesting story. Personal computers are falling into the top 10 mostly based on the sheer magnitude of those devices on campus, so in our inventory, we recorded about 20,000. But on the other hand, space heaters, we recorded about 1,000, which is a high number of electric space heaters, but those space heaters are so energy intensive that those are also falling into the top 10, even though their quantity is much lower. So feel free to refer back to this chart and kind of look at the energy consumption of other types of equipment, too, but I want to also look at energy consumption by building, so if we could go to the next slide.

So, our evaluation of plug load energy by building type showed very similar trends. This graph is showing plug load energy use intensity by building type, and again, we see that the two classifications of lab buildings here on Stanford’s campus have the highest plug load energy use intensity, which is then followed by offices. So I just—again, this really supports the idea that addressing office plug loads and especially lab loads will be one of the most effective strategies in reducing plug loads. Next slide.

So I want to wrap up just by reviewing some of the solutions for the plug load reduction that we were able to develop out of this study. We first analyzed, of course, energy consumption by equipment type and by building type, and we also analyzed all of the potential savings opportunities that we identified, which was over 100. And based on a careful prioritization that was based on over a dozen factors, including cost of the opportunity, savings, and return on investment, we came up with about 33 viable plug load reduction opportunities that we could group into the following 5 categories that you see on this slide. And I don't quite have time to review every category at length, but do feel free to ask questions about these or contact me afterwards if you're curious about any of these categories.

Ultimately, the primary takeaway is that, with these very viable opportunities here on Stanford's campus, we noted that we could reduce plug loads by about 27 percent, which would save our campus about $1.8 million per year, if all of these opportunities were implemented. So, Stanford has gone about slowly starting to implement these opportunities, and just as one example, we began with the top category that you see here, which is basic equipment retrofit, and actually a number of the opportunities here had to do with installing programmable timers on certain types of equipment.

And after conducting field tests to really understand the energy consumption and savings potential of these opportunities, we just recently launched a program where we will systematically install timers on three types of equipment across Stanford's campus. And those types of equipment are coffee makers—large, industrial coffee makes—water colors and electric water heaters, and cable boxes. And we've conducted similar field tests in the space heating category and have also launched a Green Labs program within the last year that was very driven by this data, and have an ongoing sustainable IT program that addresses the opportunities within IT equipment which, as you can see from this chart, are fairly high.

And then lastly, under the procurement strategy, I just want to point out that one of the big takeaways from this study was to better understand how we can prevent bringing inefficient equipment onto the campus and help the community develop a better understanding there, so we've begun some work with our Procurement Department here on campus to look at strategies for that as well.

So, I think the big takeaway here from these programs is that we wouldn't really have been able to begin conducting these programs if we didn't have the data to back this up from the equipment inventory. So that inventory has really been an important driver for us in helping the community to understand why it's important to reduce plug loads at all. Thank you.

Holly Carr: Great. Thanks so much, Moira. I love how the inventory that you all conducted actually coincides perfectly with the data that NREL has in terms of the approximately 30 percent energy use from plug and process loads, so it's great to have that information to have such a large case study on hand to confirm that.

I'd like to remind folks quickly, we've had a number of questions come in, about wanting to access these resources and wanting to make sure where the hyperlinks are and so forth—please rest assured that we will be sending out all of the hyperlinks in this presentation, and they will all be in the archived version that will be linked from the e-mail you receive in a week or so, so all of these resources will be available to you.

Also, another quick reminder to go ahead and send any content related questions in through that Question function on your webinar screen. We're collecting all those questions and we will be able to answer them at the end of the session.

So let's move onto the next slide and head out to Colorado, where the Wayne N. Aspinall Federal Building and U.S. Courthouse stands as a testament to what is possible in an historic building retrofit. The Aspinall project is perhaps best known for being a zero energy historic building, but to get there, the team had to first reduce loads as much as possible in order to minimize the amount of on-site renewable power needed to run the building. As we'll hear, when you are pushing for zero energy, plug and process loads become increasingly important. Jason will tell us about GSA's efforts to set energy use targets and incentivize occupants to keep their plug in process load low.

Jason, how did it go? Let us know.

Jason Sielcken: All right. Well, thanks, Holly, and thank you all for joining us. Again, I'm Jason Sielcken, I was the project manager for GSA on the Wayne N. Aspinall modernization, and most recently I oversaw the pilot program which we just completed, and that pilot program was an effort to provide financial incentives to our tenant agencies in an effort to address plug load energy consumption. The results of that effort is what I'll be presenting on here today. Next slide. You can go to the next slide.

So, very briefly, the Wayne N. Aspinall Federal Building and U.S. Courthouse, the building itself is listed on the National Register of Historic Places, and it houses nine separate federal agencies. Next slide.

The modernization project, which we completed in 2014, targeted LEED Platinum, and as I was mentioning, it also targets net zero energy. And so, for anyone who’s ever sought to incorporate renewable energy sources, which is key for net zero energy, onto a historic property, you know the placement of the systems is quite challenging when trying to avoid any sort of adverse effect to the overall building’s image or prominent features.

In addition, federal buildings, especially of this era, tend to occupy almost all of their site with very little opportunity for renewable anywhere other than the building’s roof. And our original design, which you see in the upper left hand corner, incorporated a canopy, and atop that canopy would be a solar TV. That canopy protruded beyond our building’s footprint. It also was very important because it spanned a light well on the north side of the building, giving us a greater area for renewable resources, all of which would have produced our building’s energy needs quite easily.

When we took that concept for our Section 106 review process or historic review process, the successful outcome was, we were able to keep the canopy spanning the north light well. However, one of the challenges was, we had to reduce the sight line of that canopy itself, especially from the building’s edges.

And so, long story short, right off the bat, our production capabilities were drastically reduced on this project. Next slide.

And so in our case, again, we knew what our maximum production potential was relatively early on, and so our approach to net zero energy on it was that we needed to design a building which could operate within that limit or those tolerances. Next slide.

As we began to shrink our energy needs by incorporating more efficient systems into our overall project scope, the largest variable, plug loads, represented here on this graph as Miscellaneous, tends to become a larger part of the building’s overall energy profile, similar to what Rois and Moira had shown. And so we as a project team really needed to pay special attention as to how we managed plug load, and we did that in a couple of ways. Next slide.

So, from a design and construction standpoint, we incorporated systems similar to what Rois had talked about—load shedding plug strips, we added load shedding circuits. As part of our messaging effort, we incorporated an energy dashboard in the lobby—all of the building occupants have access to that dashboard from their desks and can access real time information about the building's energy consumption, or in fact their own agencies consumption.

But the most important thing we did in my opinion was submeter all the way down to the circuit level. That submetering provided us with this incredible amount of data and information as to how the building operates, both at the system level, but very, very importantly at the occupant level. Next slide.

And so, knowing that plug loads can kind of make or break our energy bill on net zero, and we have the ability to dis-aggregate plug load consumption for each individual agency, we thought to implement a financial incentive in an effort to drive good behavior. So again, this is a multi-tenant building in which GSA occupies a very small room within it. It's something, in a lot of ways, helped us kind of shed the potential of GSA becoming the energy police, for lack of a better term, and it helps place some responsibility on the agency in order to realize the reward by driving the behavior.

And so in the federal government, incentive are a really tricky thing. GSA can't just go out and write a check to another agency, so we had to get creative in our approach. So what we proposed was, if an agency met an aggressive energy target in fiscal year 2014, they would receive a reduction in their 2015 rent rate equal to that of the incentive amount. So this aligns very well with an executive order which came out not too long before we started this, mandating federal agencies reduce their rent expense. We saw this as an opportunity to, as another tool to do just that.

So we pitched this to our agencies as a pilot program. If it was successful, it could be rolled out to more buildings in the future, and although the incentive was relatively modest for this particular building just based on its size. If you extrapolated that over a portfolio of buildings, it could be quite substantial.

And so we created very aggressive energy targets for each individual agency, and those targets were based on rentable square footage, full time employees. We included factors such as emission, and we also included factors such as equipment that we knew about when we started this effort. Next slide.

And so, yeah, I'm not gonna dive too deep into the equation we need to develop the incentive, but long story short, if an agency met their target, they received a lump sum deduction off their next year’s rent. If an agency improved upon their target, they received an additional, in this case, 25 cents per kilowatt hour, again, taken out of their next year’s rent. Now, 25 cents in Colorado is more than double what we were getting back as a rebate from the utility when we sent energy back to the grid.

The period of the incentive was one calendar year. We did things like develop green teams in the building that was made up of a representative of each agency. In theory, they’d meet monthly with the building manager to review their progress. We also tried to engage agencies at the national level and at the regional level and try to coerce them to try to help incentivize or recognize those employees in this building who were actually making those changes to reduce energy consumption. Next slide.

And so the results after about a year—well not about, but after a year—they aligned pretty straight down the middle. Agencies who were able to meet their very aggressive energy target or, in fact, improve upon their target were agencies who, for the most part, had a very typical office setup—Corps of Engineers, IRS, Senate—these are all groups that are very 9 to 5, very desk-based organizations.

Again, agencies who struggle to kind of meet their aggressive energy requirements were also agencies who have a very unique mission, and they also have very unique and constantly evolving technology which supports that mission. And so again, this kind of aligns in what we struggled with early on, which was estimating plug load consumption, especially for specialized office types and agencies. It’s very difficult, and there wasn’t a lot of good information out there to do just that. And so one of the biggest takeaways from this is that, really up until this point—again, we don’t have a lot of data out there to help us estimate plug load energy consumption, especially by agency or by organizational mission, and this information that we've been able to collect out of this is gonna be critical in helping us plan for future projects and enhance this program moving forward.

For this building in particular, with the goal of net zero energy, one of the other things we found very, very important was how critical it is to have the program incentivize and reward groups for improving upon their energy target. We have the ability to lean on agencies who have more flexibility in what they can do with their equipment to offset those agencies who truly need to utilize and keep that equipment running 24/7. It really kind of embodies this collective effort of net zero energy. Next slide.

And so, what were the takeaways? I think that there's a lot of things that we can do to improve this moving forward, but I think we were pretty successful in what we accomplished this year. Kind of first and foremost, IT support and involvement in a lot of design construction projects, that can get overlooked, but IT involvement early on in the net zero project planning strategy, design delivery phases, post construction phases—it's really, really important to keep them engaged, because really that's our low-hanging fruit in terms of what we can do to reduce plug and process loads.

If we go to the next slide—again, as Rois and Moira had pointed out, IT is our largest contributor to plug loads for offices. What this slide shows is kind of what our building energy makeup looks like over the years. The blue represents our net energy consumption, gray shows our minimum energy consumption—so max is, like, middle of the day on a Wednesday when everybody's plugging away at their computers, and minimum is like the weekend or at night.

And so lighting, heating, cooling—all of those have relatively large discrepancies between the max and the min. Where we don't so that is at the plug load level. And some of those are issues, kind of, or hurdles that were created with some of our IT groups on this project. You know, in some cases, we ran into IT policies for some of our agencies, restricting them from powering down laptops at night, requiring offices to keep equipment on 24/7 like fax machines, even when the agency admitted they hadn't used the fax machine in five years. And so again, all of that kind of inhibits our ability to make major strides in terms of PPL energy reductions. And then if we, engaging those IT groups early on could've helped us maybe to deploy quicker, more efficient IT equipment to these agencies in this particular building. Next slide.

Other ways we can prove this moving forward—incentivizing more than just plug load. This was a really big one for us. When agencies did all they could to curb energy consumption at the plug level, where we fell short was not incentivizing other energy reduction measures like lighting or temperature settings—things that the agencies have control over in their suites.

Another thing we could've done is improve on the duration of the incentive program overall. So ours focused on one year. Again, that aligned very well with our energy tracking for net zero, but one year is too long. People get busy, organizational changes occur, and so something more aligned with quarterly, potentially even monthly incentives may be more productive in keeping folks more engaged and motivated throughout the year.

Our incentive was through the rent line, which was a great incentive for an organization, but it didn't always necessarily result in the recognition and reward getting passed down to the offices who achieved or are working toward those goals. And so, again, getting our agencies or helping them to find a program which does that recognizing and reward for those folks is, I think, the key to the success of this.

And the last thing I'll leave you with on this is setting both aggressive but yet realistic energy goals is really, really important. When we began this, again, there wasn't a lot of good information out there to help us kind of estimate what our plug load energy consumption was gonna be to set those aggressive targets for our agencies. And so after this first year, we have this just great understanding of what plug load consumption is by agency, what it is by person, and all of this information is gonna be key in driving our success on this project and future projects moving forward. So, thank you.

Holly Carr: Great. Thanks so much, Jason. This is really a beautiful example of an historic retrofit that is very high performance—lots of great lessons learned and best practices that we can all implement in our buildings.

I'd like to go ahead now if we can move to the next slide and just point out links to specific resources that I know a lot of folks have been asking for throughout the presentation. So these are links to resources that have been mentioned during the panelists' presentations, first from NREL, a link to the Plug and Process Load team page of the Better Buildings Alliance, and from there, access to all of the plug and process load resources that Rois mentioned, and more. And then, from Stanford, the publication of their plug load inventory results as well as a couple of guides for installing timers on various kinds of equipment, and a link to the Sustainable Stanford annual report, and the inventory results summary as well. And finally, a case study from GSA on the Wayne Aspinall Federal Building and U.S. Courthouse, all accessible from this page. Next slide, please.

Okay, so this is gonna be the challenging part of our webinar because we have so many great questions that have come in from folks, so we'll try to get to as many of the question as we can. First off, we had a number of questions for Moira about the Stanford work that was done on plug and process loads. First off, a number questions about how you made the assumptions for energy use per equipment type. Moira, if you could speak to that a little bit, whether or not you actually measured usage at the outlet or if you used published data for manufacturers, or how you made those assumptions.

Moira Hafer: Yeah, absolutely. That’s a great question. In most cases, we were not using the actual measurements from the equipment here on campus. We were primarily using published data from other plug load studies that had been done in the past as well as some manufacturer specifications and kind of other industry research. In some cases, we did, where there wasn’t a lot of data already out there, we did go out and measure the electricity consumption of certain types of equipment, or we worked with other Stanford studies that had been done previously that had collected those types of values. So it was certainly a mix of methods, but pretty much all of it is estimated. None of it was really measured at the time of the inventory.

Holly Carr: Okay, and we had questions from folks about just about every single solution on that table of solutions. Folks want to know, can you tell us more about the exact strategies that you're using for your Green Labs program at Stanford and why the Green Lab project payback was so long at 11 years. Can you speak a little bit more to your work in labs?

Moira Hafer: Yeah, that’s a really great question, thank you. Stanford didn't previously have a Green Labs program that really kind of comprehensively addressed sustainability in laboratories. We, as a university, were doing work in certain areas like wire efficiency or recycling, but the launch of the Green Labs program was really driven by the plug load equipment inventory results, but certainly looked to include all aspects of sustainability as we work with each lab.

So the chart that I had shown on my last slide did show an 11 year payback or so for the measures involved in the Green Labs program, but those—it's important to consider first if these are just addressing the energy efficiency measures, and that these do include a number of measures that involve just simply replacing existing equipment with new, energy efficient equipment.

So, some of those measures that we deemed as viable were associated with longer paybacks just because of the high expense of lab equipment and the idea that we were looking to essentially kind of, the opportunity was looking at immediately replacing that equipment. A better strategy, of course, is—and this is what we've really been implementing as we work with labs—is that, as labs are ready to purchase a new energy efficient, or a new ULT freezer, for example, we would work with them to procure the energy efficient model rather than a more standard mode or a more inefficient model. So that's ultimately what's driving kind of the higher payback.

Holly Carr: And along those lines, Moira, we had a question about procurement strategy and how that yields plug load savings. So clearly, you're working with PIs and researchers to encourage them to purchase more sustainable equipment. Do you have any policies in place for procurement, generally, either with labs or in other areas that kind of mandate plug and process load reductions?

Moira Hafer: The quick answer is no, not really. It's very tricky on a large university campus to really implement a campus wide policy like that. And so, in general, we try to kind of stay away from central mandates, although those would be helpful in situations like this one.

So really what we've been doing is working with our procurement department to incentivize the purchase of energy efficient equipment, and that applies to lab equipment and also type of office equipment like printers, personal—like, mini refrigerators is another good example. And so there are certain types of equipment that, if we can really incentivize the purchaser to just quickly make the energy efficient choice rather than the inefficient choice, we'd save a lot of energy. So it's not necessarily leading to immediate savings, that standard, but it's preventing unnecessary energy from being used in the future.

And then, to address the first part of that question, which was how are we seeing savings here in this category, the strategies here within this category are actually phasing out certain types of equipment completely, so they address the potential to make a campus wide policy, for example, that would prohibit mini-refrigerators in offices and instead encourage common refrigerators. And so, while we don't have those policies in place yet, if we could move forward with those policies and slowly start to eliminate mini-fridges on campus, that's where the energy savings within that category would come from.

And we haven't necessarily pursued any of those options yet, since our conversations with the Procurement Department are really erring on the side of really trying to incentivize people to make the right choice as opposed to mandate it.

Holly Carr: Okay, thanks. We did have a comment from one of our audience members just pointing out the Sustainable Purchasing Leadership Council as a good resource for folks who are looking for guidance on sustainable purchasing, so the Sustainable Purchasing Leadership Council—you might want to check that out.

I'm gonna send a question over to Rois. We had a question from one of our audience members on the potential of thin client computing in various types of office spaces. We may not know the answer to this, since you're gonna be doing research on this forthcoming in 2016, but do you have a sense of the kinds of office spaces that are most—for which this is most applicable? Could a small office with five employees use thin client computing, or is it more for a larger office?

Rois Langner: Yeah, thanks for the question. It is a really good question, and I don't know if I have a clear answer for it yet, and hopefully I will get one after I conduct this study. But I think it depends on how the office is set up. I could see thin clients being used if your employees are just working in the office and need to come in there, or maybe—I guess they could take it home as well. I think it could be relevant to a small office. If it's an individual working for themselves, they might want their own computer; that might be easier.

So for this study, what we're looking at are, looking at both the savings and the behavioral aspect of using thin client, so we'll look at, on the behavioral side, the operability, the interface, what it takes to open up your computer and shut it down, signing in at home, the speed, usability performance, accessibility, et cetera.

So I think when we do this study we'll get a much better understanding of its application and who would really benefit from it. The reason why we're doing this right now is, the Department of Energy's Golden Field office is actually housed in the same building that NREL occupies as well, and the Golden Field office uses thin clients, whereas the rest of NREL uses traditional computing systems, and we're fortunate that in our building we have our plug load submetered at this point. So we're going to collect some really good data there and get some feedback from the Golden Field office employees that use the thin clients on how they like that system for working on.

So stay tuned for that. Sorry my answer is not very specific to your question, but I hope that explains a little bit more about what we're doing for that study.

Holly Carr: Great. Thanks, Rois. A couple of questions for you, Jason, coming from the audience regarding submetering and what the cost was for submetering at the plug load level. Can you give us an estimate?

Jason Sielcken: Sure. Yeah, so each panel is associated with its own individual meter. On the BAS, each circuit showed up as an individual component. I don't have the actual costs, the physical number. I can tell you that the meters themselves were not that expensive. The bulk of that cost was at the programming level of the BAS where we were trying to identify what those particular circuits were and label those within the BAS, so determining what's common lighting, what's associated with a plug, what's associated with another component of the building system.

So, it wasn't that substantial of a cost, but I can say that the submetering has offered so much information to us on this project and helped kind of present a lot of opportunities for us, and it continues to do so. So for us, that was one of the key parts of our ability to pursue net zero energy in addition to everything else.

Holly Carr: Well, we have two questions that tie into your response. One was, where is the building, now that it's been in operation for a while, where is the building in terms of being net zero? Are you there or getting close? And then the other question was related to staff overhead, or staffing needed to monitor the performance and the incentive program—so I'll keep both of those in mind if you want to answer the zero energy question first.

Jason Sielcken: Sure. So we're still working toward a site net zero energy. When we started this project, there has obviously been a lot of definitions and a lot of definition changes over the course of the last five years. Based on NREL’s old classification, we were a Class D net zero energy building in 2014, and we're continuing to work at the plug and process level to get a site net zero energy in the near future.

How much savings were observed before and after PPL measures—you know, we incorporated a lot of things. To try to determine which was the most effective out of that is a little bit difficult as we had no true baseline on it. We did do things like the load shedding circuits and the load shedding plug strips. Those were obviously a big factor in compacting plug and process loads in the suites.

Again, sometimes those things can be circumvented if somebody actually wants to, but information and being able to present information to the folks in the building is always something that continues to be incredibly valuable.

Holly Carr: And Jason, what do you think are some of the key measures that you implemented at Aspinall that GSA is looking to implement at other existing building retrofit sites moving forward?

Jason Sielcken: Again, everything we did on this project was really sort of site specific, and it was done in an effort to balance both our goals for energy in this building as well as our goals for preservation. I think there’s been, a lot of the technology that’s come out of this has been incredibly valuable and will probably be, maybe be replicated on other projects, I'm not sure, but I think one of the big takeaways on this is just how we can utilize buildings like this to pursue very deep energy retrofit goals and do so without necessarily disturbing or disrupting the historic fabric of these very important structures and we were able to do this particular project at a concept very comparable with similar LEED Platinum net zero energy new construction projects from a cost perspective, and in some cases much, much lower in terms of overall investment.

Holly Carr: Okay. Great, thank you. I have one more question, quick questions for Rois and Moira. Moira, audience members want access to that inventory app. Is there any possibility that Stanford might be willing to share that with folks?

Moira Hafer: Yeah, we're more than happy to share kind of the methodology of how it was created. Really the key component is having access to electronic floor plans for your building that can be georeferenced, and then the ability to just create the web forms, which our IT Department did for us. And so yes, we're more than happy to have our IT folks share some of that methodology with you and help you understand whether that's something that is feasible for your organization.

Holly Carr: Great, and one last quick question, Rois—can we use advanced power strips on slot machines? I love this question. *[Laughter]*

Rois Langner: Maybe it warrants a trip to Vegas for this.

Holly Carr: I know, yeah. *[Laughter]*

Rois Langner: That's a great question. I haven't worked directly with slot machines. I would assume that you could use like a timer control with slot machines to turn them off if the casino closes at night—so, for those hours, to turn it off.

So I think advanced power strips would work if you have a couple that you're trying to control. If you have a lot that you're trying to control, I would look at controls through the building management system; that might be a little bit better. And then another option, I guess, that I'm thinking of off the top of my head is potentially working with the manufacturer to figure out other options to reduce a slot machine's energy use, like being able to turn just the lights off during unoccupied hours. So those are kind of three options. Advanced power strips, maybe using a building management system to control it with a timer control or working with the manufacturer directly to see if you can turn portions of the machine off at night, if not the whole thing.

Holly Carr: Awesome. To our casino owners, you can certainly touch base with Rois offline to get more details on that. And let's move to the next slide. It's 4:00, so we'll wind it down here and let you know the next month, actually in January, in the new year, we will have our presentation on cutting edge building technologies. We'll be talking about our high impact technologies list and the technology demonstration projects that are underway. So if you're interested in what is coming down the pike, what some of the new and up and coming technologies are that you might be thinking about for your buildings, this is the webinar to join. We'll have a presenter from the Department of Energy as well as some of our tech demonstration partners, New York Presbyterian Hospital and QM Power on the line for that one. Next slide, please.

We mentioned the Better Buildings Summit May 9th through the 11th. This is the only big, in person event for the Better Buildings Program this spring, so registration will be opening in the new year for that, and we encourage you to come and join us. Next slide, please.

And these are your contacts for our panelists today who are happy to answer questions, anything that didn't make it into the webinar today, they're happy to follow up with you via e-mail. So thanks again so very much to our presenters for taking time to be with us on the panel today and you can expect to see an e-mail with an archive to this presentation and links to all the resources within the next week or so. Please follow the Better Buildings Initiative on Twitter for all the latest information about our program, and thanks again for joining. Have a great afternoon.

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