CLEAN ENERGY SOLUTIONS CENTER
ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

The SmartSacramento Smart Grid Project

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For more information, see the clean energy policy trainings offered by the Solutions Center.

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Sean

Hello everyone. Hello, everyone. I'm Sean Esterly of the National Renewable Energy Laboratory, and welcome to today's webinar, which is hosted by the Clean Energy Solutions Center, in partnership with the International Smart Grid Action Network, also known as ISGAN. And today's webinar is focused on the SmartSacramento Smart Grid Project. And one important note of mention before we begin our presentations is that the Clean Energy Solutions Center does not endorse or recommend specific products or services. Information provided in this webinar is featured in the Solutions Center Resource Library, as one of many best practices resources, reviewed and selected by technical experts. And for your webinar features today, you have two options for audio. You may either listen through your computer or over the telephone, and if you do choose to listen through the computer, please select the mic and speakers option in the audio pane, and doing that will help eliminate the possibility of feedback and echo. And if you choose to dial in by phone, please select the telephone option, and the box on the right side will display the telephone number and audio pin that you should use to dial in. And panelists, just a reminder, please mute your audio devices while you are not presenting. And if anyone is having technical difficulties with the webinar, you may contact the GoToWebinar's help desk at the number displayed at the bottom of the slide. That number is 888-259-3826.

And so we encourage anyone in the audience to ask questions at any point during the webinar. To do that, simply type your question into the question pane and submit it through there. Those will be sent to me and I'll present those to Jim, our presenter, following the presentation. And if you're having difficulty viewing the webinar materials through the webinar portal, you will find pdf copies of the presentations at

cleanenergysolutions.org/training, and you may follow along as the speakers present. Also, an audio recording of the presentations will be posted to that Solutions Center training page within about a week of today's broadcast. And in addition, we are now adding the webinars to the Solutions Center YouTube channel, and you'll also find other informative webinars, as well as video interviews with thought leaders on clean energy policy topics.

So today's webinar agenda is centered around the presentation from our guest panelist, Mr. Jim Parks. And Jim has been kind enough to join us to provide an overview of the SmartSacramento Project and lessons learned through the project, as well as joining a question and answer session with the audience at the end. And before Jim begins his presentation, I'll provide a short, informative overview of the Clean Energy Solutions Center initiative, and the following the presentations we'll have the question and answer session, where you'll have the chance to ask Jim questions through the question pane, followed by some closing remarks and a brief survey.

And so this slide provides a bit of background in terms of how the Solutions Center came to be formed. And the Solutions Center is one of thirteen initiatives of the Clean Energy Ministerial that was launched in April of 2011, and it's primarily led by Australia, the United States, and other CEM partners. Some outcomes of this unique initiative include support of developing countries and emerging economies through enhancement of resources on policies relating to energy access, no cost expert policy assistance, and peer-to-peer learning and training tools, such as the webinar you're attending today.

And there's four primary goals for the Solutions Center. The first goal is to serve as a clearinghouse of clean energy policy resources. Second is to share policy best practices data and analysis tools specific to clean energy policies and programs. And third, the Solutions Center delivers dynamic services that enable expert assistance, learning and peer to peer sharing of experiences. And then lastly, the Center fosters dialog on emerging policy issues and innovation around the globe. And our primary audience is energy policy makers and analysts from governments and technical organizations in all countries, but then we also strive to engage with the private sector, NGO's and also civil society.

One of the marquee features that the Solutions Center provides is its no cost expert policy assistance, known as Ask-an-Expert. And the Ask-an-Expert program has established a broad team of over thirty experts from around the globe who are each available to provide remote policy advice and analysis to all countries at no cost. So for example, in the area of demand and policy evaluation, we're very pleased to have Bruno Lapillonne, the Vice President and co-founder of Enerdata, serving as one of our experts. So if you have a need for policy assistance in demand and policy evaluation, or any other clean energy sector, we do encourage you

to use this valuable service. And again, this service is provided to you free of charge. So to find out if the Ask-an-Expert service can benefit your work, please feel free to contact me directly at sean.esterly@nrel.gov. That's the email address displayed in the orange box on the slide, as well. Or you can call me at 303-384-7436. We also invite you to spread the word about this service to those in your networks and organizations.

So now, I'd like to provide the introduction for today's panelist, Mr. Jim Parks. Mr. Parks is a program manager in the energy research and development department at the Sacramento Municipal Utility District. His current focus is on completing the $308 million SmartSacramento initiative that has over fifty individual projects, including distribution automation, smart meters, demand response, customer initiatives, dynamic pricing, electric vehicle infrastructure, hardware and software upgrades, and more. And so with that, I would now like to welcome Jim to the webinar.

Jim

Thank you, and I will say that I'm excited to be able to present this project. I think if you're involved in a smart grid project or you're thinking about doing a smart grid project, or you're just interested in smart grid, I think you'll find this presentation interesting and informative. We have been involved in this project now for, you know what? There we go, thank you. Sorry. By way of background, SMUD is a publicly owned utility, which means in essence we're owned by the customers we serve. And so we've been in business for over 65 years, and we serve largely Sacramento County, with about 604,000 customers and a population of 1.4 million. We are really governed by an elected Board of Directors, so we have seven directors who each represent about 200,000 of our customers.

Back in 2009, October, so it's been five years now, we received notification from the Department of Energy that we received a Smart Grid Investment grant, and this was part of the RRA funding, the Recovery and Reinvestment Act. And it was going towards a $308 million project. And it was interesting to me that we received about 63 percent of the SGIG money that went to California. So it's a very large project, and we're excited about it. And it's just wrapping up now finally after five years. Just by way of notice, the DOE makes no warranty, expressed nor implied, about the content of this presentation.

OK, so here's what we've done. What I plan to do is talk about the projects, and it's kind of nice, because I've talked about these projects for five years. Early on, I talked about here's what we're planning to do, we're thinking about this. Then in the middle of it, I started, well, we've done some of these things, and you know, we don't have any results yet, but we're moving forward. And now I'm at a point where I can say we have finished almost every single project, and we have some results and some lessons learned. So I keep adding to this slide deck as time goes on.

But the first thing we did was a smart meter installation. This was really the biggest part of the project. We did a consumer behavior study, which is looking at like time of use and critical peak pricing rates and the impacts on the customers. We've done a significant amount of demand response. We did, I think, the second largest project was distribution automation, and I'll talk a little bit about that. And then we had several customer applications, technology infrastructure, cyber security. Those first seven items on this list were part of the Smart Grid Investment grant. Then in addition to that, we did a lot of different research and development projects.

By way of budget, you can see here that we had the $308 million Smart Grid Investment grant project, and then we had an additional $43.3 million in R&D projects. And once again, you can see that the advanced metering infrastructure, the smart meters, plus communications infrastructure, came in at $145 million, which was definitely the biggest piece of the project. And then distribution automation coming in at almost $59 million was the second largest piece.

So this is kind of a pictorial of our smart grid vision here at SMUD. So what this is supposed to imply is control over a lot of different elements throughout our service territory, so that we can have a variety of distributed energy resources, such as wind, photovoltaic, or electric vehicles, or energy storage. You'll see down in the lower right we have, actually have dairy digesters, we call that "poop to power," where we basically take the cattle waste and then it degrades into methane and then use the methane to run a generator. And then on the lower left hand corner, you'll see the chart showing kind of the time of use rates. So all these things working together under kind of central control, that the utility control and optimize the grid to improve the energy efficiency, the reliability, and those sorts of things.

So going into the projects, we installed 620,000 meters and all the communications infrastructure. And as part of the project, if you watch smart meter implementations, really throughout the world, you'll see varying impacts from the customers, in terms of how they respond to the smart meters. Some places, the meters go in very smoothly and people don't complain, and other places you'll see almost customer rebellion over the smart meters. And we were starting to install our meters and we saw this happening. We saw, not in our service territory, but surrounding us, customers were upset, and city councils were banning smart meters. And we thought, we need to stop what we're doing and make sure we communicate what we're doing with the people around us. And so we basically set up a communications plan, and we trained several SMUD employees to go out into our service territory and provide presentations to really anyone that would listen. So we went to Kiwanis clubs, Lions clubs, Boy Scouts, Girl Scouts, churches. And we made it a point to go to all the city councils and the County Board of Supervisors and tell them what we were doing, tell them why we were doing it, tell them what the benefits

were to them, what the benefits were to their constituents, what the benefits were to the community, what the benefits were to SMUD. And in doing that, I think we really lessened the impact of any negative outcry. We didn't have any negative articles in the newspaper, and we were able to implement the meters very smoothly and efficiently.

Having said that, there is a small group of customers, right now I think it's about 380 or so, so less than one tenth of one percent of our residential customers, that have chosen to opt out of their smart meters. And usually people will opt out for two reasons. One is they feel that there's health impacts from the radio frequencies that we use to read the meters, or electromagnetic fields or something along that line, or they feel that Big Brother is watching. And because we get hourly data now on residential meters, we might monitor when they come and when they go and what they're using and when they're using it. And so those are usually the reasons they opt out. We set up a fee for those that opt out. They have to pay a $127 up-front fee, and $14 a month. And that may sound heavy handed at some level, but if you look at our cost to actually send someone out to read their meter, it's a money loser for us. We're not making money on that. And so we're glad to have so few customers that have signed up for that project.

But in terms of benefits of the smart meters, too, we have a remote connect/disconnect switch, so now if someone is a late payer or they start a new service or they stop their service, we can connect and disconnect them from the office here. We don't have to send out a truck. And that feature alone has reduced the truck rolls by over 400,000 per year, which I think is significant.

So as I mentioned earlier, we had started deploying meters. And so when we stopped, we had deployed 80,000 meters. And our approach was to figure out what were the hard to read areas? And we installed meters in those areas first, because we figured if it works in the hard to read areas, which tends to be dense urban, so you might have meters that are in basements or in rooms or the homes and the buildings are packed close together, so there might be difficulty in receiving the meter reads, and then rural areas, where the meters are really far apart. And so we installed 80,000 meters in those two areas, and it worked great. And so we knew that the rest of the implementation would be smooth from the perspective of insuring that we got the reads accurately and on time.

Some of the other functions that we get, we now provide to our customers, instead of once a month reads, and by the time you get the bill it's too late to do anything about it, they get yesterday's data today. So I can log in this morning and I can see 24 bars of energy use across each of the hours from yesterday. In addition, there's other features you can do on line, where you can have warnings and so forth if you have a limit on your bill, and you say I'm going to spend $100 a month. Well, if you're at $50 the first week

into it, you know you're going over and you can get warnings. There's just several things like that that the smart meters enable for us.

It also enables us to provide dynamic rates, like time of use or critical peak pricing. You couldn't do that before with the electro-mechanical meters. They're great for once a month reads, but you're not going to really do dynamic pricing with those. They allow some communication with home area networks and so forth. It sends signals with a meter tamper detection. I mentioned the automatic connect/disconnect. It also allows us to ping the meter, so if we have an outage we can ping them. I think I have some slides on that. So the green dots here represent meters throughout our service territory. Well, for one reason or another, we might have an outage, now represented by the red dots there. And we send a crew out there to fix that outage, they fix the outage, and they go on to other things. But what we may not realize is there was an imbedded outage within that bigger outage, and prior to the smart meters, we wouldn't know that until customers called in again. Now they've already called in once, so they think we're working on it. We think we fixed it. We left. And so now, when an outage is fixed, we basically ping the meters, and if there's a certain subset of meters that are not responding, we leave the crew in the field and direct them to the new outage. And so this has helped us improve reliability quite a bit, by reducing the length of outages.

The other project we did, this is what the DOE calls the consumer behavior study. We called it smart pricing options. And this is a very innovative study, and I would highly recommend you go to the DOE website and look up our Smart Pricing Options final report, and you can get all the results. There's two reports there, a Preliminary Report that's about 380 pages, I think, and then the Final Report, which is actually much shorter, because the first report covered a lot of the information. But we offered a combination of time of use, critical peak pricing and a combination of time of use and critical peak pricing to a variety of customers. And we had a couple approaches on this. One, was we allowed customers to opt in. So we sent them a notice and said, would you like to sign up for this rate? And we made them an offer. Either you go on a critical peak pricing rate, or you could go on a time of use rate. And the customers that felt they could benefit from that rate signed up.

So in a certain sense, when you have these opt in type programs, what you have, I don't think is representative of the community. You have people that look at that rate and go wow, I'm not home during that peak period, so boy, yeah, I could definitely benefit from this. Or, I have the ability to shift my loads during those peak periods, so I think this will improve my monthly bills. And so I don't see that as really indicative of the entire community.

Now the other set we did was default. We basically sent out a notice that said, hello dear customer, you are now on this rate. And if you'd like to get off, you can call us. And we had planned for a 50 percent drop rate.

We figured that of the people that got it, for every hundred, fifty of them would call in and drop. Well, as it turned out, only 10 percent dropped. So we had 90 of 100 that stayed on the rates as a default rate. And so you can see the numbers here in the boxes show how many customers were on each of the categories. And then we had some various offers of in-home displays and so forth, or no in-home displays, which muddied the waters, made it more difficult to evaluate, but we did it, did a great job on this one.

The one thing I really wanted to point out here, there's are the different rates, the time of use and the critical peak. But if you look at the ones I highlighted in red, during the critical peak period, which was 4 to 7 p.m. on weekdays, during a called event, so in other words, we said we would call events up to twelve times per year. And so we set boundaries on it. We couldn't just call events whenever we felt like it, willy-nilly, so during the hottest days we would give the customers a day ahead notice saying tomorrow, between 4 and 7, it's going to be critical peak. So they knew it was coming. And we charged them 75 cents a KWH. And if you look at the critical peak line, the second line up there, you'll see that the off peak price was only 7 cents. So there was a 10 to 1 differential between the off peak price and the peak price.

So the question that comes up is, if you have rates like that, does it drive behavior one way or another? Well, it does drive behavior. If you look at this chart, just for the time of use rate, this doesn't include the critical peak pricing, you can see the yellow line shows the base case, and then the orange line shows what really happened. So you can see that during the peak periods, when the electricity rates were higher, people did reduce their peak load. Now looking at the time of use rate, comparing the default customers to the opt-in customers, you can see the opt-in customers saved roughly double what the default customers did. So the opt-in customers who chose and selected the rate, they saved between 10 and 13 percent off during the peak periods. And then those that were on the default rates still reduced their usage between 6 and 8 percent, which is really quite significant. Because you consider these customers, they were given the rate, and they figured out what to do with it.

Now those that were on the critical peak pricing rate, the reduction during the peak period is really just about doubled. And you can see for the opt-in customers, they saved between 22 and 26 percent, which is huge. They reduced their peak load during that 4 to 7 window one-fourth. And then those that were on the default rate were still about 12 to 13 percent, which once again is about half of the opt-ins, but is still a significant reduction during those peak periods.

On the demand response side, we did a variety of things. The first thing we did was to procure a demand response management system, and we got the Lockheed Martin, they call is SeeLoad, so you can see the load, I guess. And then we developed a couple of residential pilots, and on the

commercial side we developed an RDR program. The first year we ran a residential pilot with a pre-cooling strategy, so what we did was basically sub-cooled the homes prior to peak events by 2 to 6 degrees, and then saw how they responded during the peak event if we called an event. And the next year, we didn't do the pre-cooling strategy, we just had controllable thermostats that we could manage from SMUD and reduce their temperatures, set back the temperature a little bit before a peak event. And then the AutoDR program.

So during the PowerStat 2012 where we did the pre-cooling, you can see here that we had a two-hour pre-cool and a six-hour pre-cool. So some customers we started cooling way before the event, and we pre-cooled by 2 degrees. And then other customers, we just two hours before the event, we pre-cooled by 4 degrees. And you can see what happens is you end up using more energy before going into the event, so you can see the blue line and the red line where the energy use goes up. And you can see the base line, with no pre-cool, which just kind of follows the base load. Then during the event, everyone drops off and you can see that they reduce their energy use during that event. And then every single one of them rebounds afterwards to bring their house back up to temperature, or down to temperature, I guess, in this case.

And so in essence, you're using more energy before and after the event, and reducing your energy in the middle. When you levelize it, it looks like this. So you can see that those that are on the, this is based on temperature, sorry, so this one you can see the higher the temperature, the more energy you use to pre-cool, but the more you save during the event, and then the more energy you use on the rebound afterwards. And that was consistent across all the temperatures, you'll see the 110 is the highest use but the biggest savings, and then on down the line to the lower temperatures.

So the question then came up of how much are people saving money? And it looks like those that were on the no pre-cool reduced their bill by about 1.2 percent, and the two-hour pre-cool, they actually increased their bill slightly, by about 55 cents per month. And on the 6-hour pre-cool, they actually saved a little bit. So it just depends, the 2-hour pre-cool used so much energy in the pre-cooling that it caused people to use more energy overall. And you can see the kind of scatter plot on the bottom shows whether people saved money or lost money. And people basically, the range was from saving $10 to spending $10 more on their bill.

I didn't put in any AutoDR slide, sorry about that. We have an AutoDR program for our commercial customers, and we signed up several customers and it worked like a charm. We basically had base cases, they signed up to reduce their loads, and what we thought we would get is really about exactly what we got. It really worked wonderfully. And right now we have a fairly small number of customers and about three and a half megawatts, but both of these programs, both the residential and the commercial, have moved into regular programs. So they went from

basically pilot stage during our Smart Grid implementation, and they've now moved into regular programs, and we'll be soliciting additional customers and growing those programs over time.

On the distribution automation side, we had never done feeder automation. So if you think of a feeder, you can probably go outside your house or your business and you can look up and you'll see a distribution line there, and it's thousands of volts, and one feeder, think of it as between about 1,000 and 1,200 customers. So distribution line going from a substation serving about a thousand customers. We had never automated any of our feeders. So meaning, we couldn't really pull down any useful information from feeders. We had monitors at the substation where you could see what's going on, but at the actual feeder level we can't tell what's going on. You get an outage and the customer calls you to tell you that there's a problem. And so we installed equipment on these lines so that we could actually control them better and understand what's going on them. So we called it feeder automation.

So we automated 118 feeders. We implemented SCADA, which is, basically think of that as a way to really see what's going on at your substations, having two-way communication and control of your substation, on 40 existing substations. Now it's fair to point out that we've been installing SCADA on any new substation for probably the last 25 or 30 years. But we have legacy substations out there that they haven't been automated. And so through this project we hit another 40 substations, and I think we're up over 75 percent of our substations are automated now. And we usually automate them at a rate of about two to four per year.

We implemented what is called Volt Var Optimization and Conservation Voltage Reduction at a couple substations in 2011, and we're wrapping up a project now where we did this on 14 subs. And I'll show you a little bit about that. And we did some other things that are quite interesting, and I'll give you a few details. Volt Var Optimization and Conservation Voltage Reduction, if you look at a transmission line, or a distribution line as shown on the top, they come from the substation and as you get further from the substation, typically the voltage goes down. And so we're required to delivery voltage generally in a plus or minus 5 percent range. So in this example, we're looking at a residential example, we need to deliver voltage to homes between 120 and 114 volts, considering that our nominal voltage is 120. And so we go between 126 and 114. So what happens is, we went out, we do this Volt Var Optimization and circuit optimization, we install devices on the line, and one of the significant devices we install is line capacitors. And what that does is that boosts the voltage further down the line. So you can have a more consistent, flatter voltage profile across the entire feeder. And that's represented by the green line here. What that allows you to do, then, is to at the substation, you can reduce the voltage across that entire feeder. So you drop the voltage down and you're still within the limits that you need to provide to the customer, but yet you're saving energy also.

A minor engineering lesson. Ohm's law, where the power equals current times voltage. Well, if you reduce the voltage, the power goes down, so you actually save energy. And that's what happens in this case. This is an instance where customers are actually saving energy, but it's entirely invisible to them, they don't even know it. And so it's one way to get energy efficiency, if you will, from the distribution system. It's also interesting to note that depending on what is on the system, you'll save more or less energy. So as an example, you can see incandescent lights, if you reduce the voltage 3 percent, you'll get about a 5 percent energy savings. I found it interesting to look at the LCD TVs and the plasma TVs, it's zero. So you reduce the voltage and you get zero energy savings. The only thing, I'm assuming this, I'm assuming that they have voltage management built into the TV, so if the voltage goes up or down, it just automatically bumps or boosts the voltage to meet the requirements that they need, and so if you do conservation voltage reduction you won't save anything on that. Kind of interesting.

And we did find that in our studies. We went through the, well, we're on the 14 substations now, it ranges pretty dramatically. You do a 2 percent reduction, you might save .1 percent, and some other line you're saving 2.5 percent. And so there's pretty wide variation. So I'm trying to do some analysis now on those circuits to see why did some reduce more than others. And is it, is there some characteristic that we can look at where we can in the future say, we know this type of circuit has the biggest benefits, so that's where we need to focus our resources and our efforts when we expand this in the future.

Here's an example of one of the substations we did in our early tests. We did two substations, and we did 2 percent voltage reduction. So if you look at the very top squiggly lines, the red line shows the pre-voltage, and then when we reduced the voltage you can see that it did go down. And then you can see the load curve below that, where you can see that the space in between the two curves essentially represents energy savings. So we definitely saved energy on this project.

Of the two subs that we did initially, you can see that the one that Madison Kenneth was approximately 1 percent reduction, and that's probably within the bandwidth of error on this one. So we think we saved energy but we're not completely sure. On the Myrtle-Date, definitely saved energy, we can verify that. And so this just shows with the two substations, we had pretty wide varying results. So we expanded the project. And really, what we're looking for now is to figure out, is there a set of cost effective feeders that we should automate so that we can implement conservation voltage reduction more throughout our system?

One of the other things we did on the distribution side was called Situational Awareness and Visual Intelligence. We call it SAVI. And this one basically provides our operators with a geospatial display so they can see all this information on what's happening on our system. So it's built

on a Google Earth platform. So here you can see SMUD's service territory, and you can see all of our bulk substations, represented by the green dots. And if you zoom in, you can pick a particular substation and you can go right in, and there it is. There's our substation. And you can see some of the details on that substation. Further, you can go in a little bit closer and you can select the particular circuit. And if you look in the upper right hand corner, you can see what the loadings are on the various phases. You can see the megawatts, you can see the amps in there, and on the different phases in that circuit. You go directly below that, you can see a video camera. So you can actually see real time what is happening out there at that substation. And then if you go below that, you can see the chart that shows the green line, which shows the loading on that substation, or the feeder, you can select whatever element you want over the last week. And it has so much more functionality, so many more things it can do. I'm just showing you just a really high level, brief overview.

Here we have one of our 15-megawatt photovoltaic plants, it's out in the south part of our service territory. And you can see it physically right there on the Google Earth map, and you can also see the loadings on that over time. In this particular case, you can see that it's currently only at 7.2 megawatts, so it's less than 50 percent of the load. But it's later in the day, and so you wouldn't expect it to be really operating at full capacity. Or it might be a cloudy day, I don't know exactly. And if you look down below, you can see the loadings and how the PV is generated over the past week or so. And based on the chart there, I would assume that we're probably in some time where there's some cloud cover and so forth, because if it were a purely sunny day you'd see more of a bell shaped curve every single day.

We provided a lot of different projects for our customers. And they range from programmable communicating thermostats, home area network, in-home displays. We actually developed an in-home display checkup program at the library. We provided the library with a certain number of displays, and they actually checked them out to customers for a period of a month or two, and then the customer brings them back. And in some cases, on the in-home displays, that seems about right, because what happens? Someone puts this in-home display and they have it maybe on their kitchen counter, and first you get it's oh, it's very cool, look at that. You see the energy? Turn on that light, you see how it changed? Or turn on the air conditioner, look how that changed. And you can get a sense of which device is using energy and how much energy they use. And you can make adjustments based on that. But after a month or two, the novelty kind of wears off and it just becomes a thing that's sitting there. And so we figured let's get them in the libraries, people can check them out for a limited amount of time, and they don't have to purchase them, and they can figure out if they want to make some changes in their energy use at their home based on that.

And we did a variety of residential, small commercial pilots. And a few things that I would note. Actually, I got that in the lessons learned. A little later we'll talk about that. Let's see here. One of the things I'll talk about is the commercial lighting program, the advanced lighting program. We went out, we decided we would install, we would give rebates for the installation of efficient lighting systems that also had a variety of controls. So the controls could be occupancy sensors, daylight sensors, a variety of sensing technologies. And we did this in, I don't know, 15, 20 customers. And the energy savings were incredible. We saved between 50 and 90 percent of the lighting energy use. And going back 20-some-odd years when I was out in the field trying to sell energy efficiency retrofits and new construction energy efficiency, if I could get a 10 or 15 percent reduction, that was great. You really did a great job. In these cases, where you go out and you get 50 to 90 percent, that's just amazing. And what we found was that when we did these retrofits, that 40 percent of the savings came from the controls, and 60 percent came from the actual retrofit itself.

Here's an example that we did. This was, I can actually say who the customer was. Blue Diamond Almonds, and they had a warehouse where they stored the almonds, and the lights were essentially on 24 hours a day, 7 days a week. What we found was that there was a panel where you actually had to go and flip the circuit breaker to turn off the lights. So apparently these lights had been in for a while, because there wasn't even a switch to turn them off. And we went in there, and installed LED lights. We repositioned the lights such that they were in the areas where light was needed. Because the earlier system was sometimes shining over pallets of almonds and it wasn't really lighting anything that was useful. So we put them in useful places. Then we put in motion sensors. You can see the base case lighting in the red line there. They were running 33, 34 KW of lighting in that warehouse. When we put in the new lighting system, even just without the controls, it dropped below 15. So it dropped over 50 percent just from the lighting retrofit. And then when you added occupancy-sensing controls so that the lights come on when a forklift comes in there and moves around, you got additional savings. So you can see they were running between about 5 and 10 KW in general, so going from over 30 down to 5 or 10 on average.

From the technology infrastructure viewpoint, we implemented an enterprise service bus. And if you're not familiar with this technology, I think it's pretty common, it's not an uncommon technology in the information technology space. Typically in a large company you have all these different computer programs. They don't always communicate well. And the enterprise service bus kind of brings it a central location for all these things to be able to communicate with each other, so all these add-on programs can communicate with your central system. Things have been going so quick and aggressive in the smart grid space with respect to IT needs, new software and hardware, and having to interconnect and integrate, that we're going to need another enterprise service bus pretty

soon. I talked to our IT manager, he said our data storage needs are growing, they're doubling every 18 months now. And I believe it. There's just so much information now. And we also did a new customer relationship management system.

On cyber security, honestly, they don't tell me what they're doing, other than they're doing things at least to military grade specifications. And it's all pretty hush-hush and quiet. But we are definitely aware that we need to protect the consumer data, our hardware and software from attack, and these attacks do happen. We do have some software that kind of shows how people are trying to get in, and it's really a constant, consistent thing of people trying to poke into your system and see if they can find that hole. And I don't think any system is hack proof, but you try to make it as hack proof as possible and as secure as possible.

So some of the lessons learned, and these are I think an important part of the program, really. We found that management, executive, board support is essential for these large-scale projects. When we were applying for the DOE grant, we immediately went to our executives and our boards and said look, here's what we're doing, and they engaged immediately. They jumped right on board. They saw the benefit of this project, and they promised full support. And they gave us full support. As we were implementing this project, we needed to take people from different departments, and a lot of times it was key people. You're looking for, I know this person does a great job in that area, I want them. And the manager had to give up that person for the project.

During the course of this project, over half of the SMUD employees charged time to the project. Over 1,100 SMUD employees charged time to this project. And I think that's probably on the low side, because I'm sure other people worked on the project and never charged their time to it. If you don't have support from your executive team on that, it is not going to happen. Because if I were going around telling managers I want this person and that person, they're just going to say no. And so the support is essential.

Customer communication is critical. I talked about that earlier with respect to the advanced meters. If you want to do a big project like that, rather than try to quietly sneak it in in your service territory, I would suggest developing a communication plan and getting out in front of it, and letting your customers know what you're doing and why you're doing it, and let them know what the benefits are to them and the community. And I think when people get that type of information, they're more likely to support you. And in our case, talking to each of the elected officials I think was very essential for the success of our project. Because that way, if their constituents came to them and said hey, what's with these smart meters? You know they're going to be spying on us, or they're going to have health issues. They know what we're doing and why we're doing it, and they'd be able to respond to their constituents appropriately.

If at all possible, if you're working with someone like DOE or someone else on contract, if there's any way you can get some kind of flexibility in the scope and schedule, that's pretty important. Because we found this, we got into the project, of course you sign up for one thing and you realize, once you get into it, oh, I don't know if we can actually do that. I thought we could, I thought that technology was available, it's not quite here. And you might need to adjust some things. So if there's any way to incorporate some flexibility into the scope, it sure will make your life easier down the line.

Data accuracy, timeliness is important. With all the new applications, if you're throwing bad data at them, and you're sitting there looking at this information and you're making decisions based on the information, and you have bad data, that's not good. And so you want to make sure that the data's accurate. You are going to need to do some data cleanup in some cases. And some of the things are going to take a lot of time to fix up. Like if your GIS system isn't up to speed and some of the things aren't correct, you'll find these things over time. But you need to have mechanisms in place to improve and to correct the data. Also, from a timeliness perspective, we're providing customers with day behind data, and in time we'll be providing pretty much real time data. You want to make sure that, that's reliable.

Immature technologies, this was an area that we, I alluded to, we hadn't quite planned on. We thought, well, we're going to do controllable appliances. We're going to do this, we're going to do that. And then you got into it, and suddenly it wasn't quite there yet. It really wasn't ready for prime time, it wasn't ready for broad scale implementation. And a lot of the different appliance manufacturers came out with smart appliances, and they hit the market running, and the uptake was slow. Customers weren't buying them. I won't say that the controllable appliances, that there was anything wrong with them, I don't think there was. It's just a matter that the customers weren't buying them, and the only ones that were being sold were being sold to utilities for pilot projects. And from a manufacturing perspective, that's not the way you want to go. You don't want to do ten here and ten there, you want to be able to sell them on a mass scale. I really think that the manufacturers were probably a little bit ahead of the curve on this one. We weren't quite ready for the controllable appliances. And I think in time, as more utilities implement smart grid and have the ability to actually control those appliances, I think you're going to see the demand increase once again. And I think you'll see controllable appliances back on the market. One of the things we did notice with the appliances, they tended to implement the smarts in the more expensive appliances. So once again, the average person isn't really going to be buying this high-end appliance that's got a couple hundred-dollar add-on it just to control, provide a little bit of control to it. This was one of those things where, from a utility perspective, you would need an awful lot of appliances to control to get any significant reduction in load. I will say,

though, that in the five years that we've been working on this project, some of the things that weren't ready at the beginning are ready now. So you're seeing improvements all along the way.

The heavily technology dependent assets should be procured as close to implementation as possible, because things are changing so rapidly. The functionalities are improving and the prices are tending to come down. So if you buy an early stage device, you're probably going to pay more than you would if you wait a little while. I mean, you can see that with anything. If you remember, flat screen TVs, remember how much they were when they first came out? Now you get them at Walmart and all over the place now, and they're quite inexpensive. It's the same way with some of the utility technologies that come out first, and you've got all these R&D costs you need to recover, and the prices are high. And price comes down over time. And so you want to make sure you're not ordering that stuff too quickly. You also want to make sure that you do allow enough time, though, for testing and so forth. You don't want to just get it at the last minute, it has to be installed now, and off you run. You want to save enough time for testing.

But we did find, and I don't think this will come as a shock to many people, that the vendors tended to over-promise and under-deliver. And that varies across the board, from utmost honesty and up front and telling the truth to flat out lies. And so you need to kind of work through that process with your vendors, see if there's any references that you can check or if you're planning a larger deployment, maybe get a couple of devices and test them for a while to make sure they work as advertised. We got into a few projects where we had to actually close the project over time, because it, we had these early promises that just didn't come to fruition.

So the next steps. For us, we still feel like there's a lot of work to do. Some of our projects are 100 percent, like the smart meters. They're 100 percent installed. However, having said that, even though they're 100 percent out there, there's a lot of functionality that we can get from that data, maybe some programs that can be developed or ways to improve the reliability of the system or the efficiency of the system. But we're not going to install more smart meters. It's done. I mean, we'll install more new customers, but we're not going to have a big smart meter project again for a while.

But things like the automated feeders, we did 18 percent of our system. So there's still 82 percent of our system out there that theoretically could be automated on the feeders. And so we're wanting to figure out, what are the next steps there? What are we going to do with all this infrastructure that we've installed? The SmartSacramento project, our contract with the DOE, ends December 23rd. I thought that was kind of an interesting date, at least we get Christmas this year. It's over 99 percent complete now. We're just wrapping up the last few things on here.

So our plan now is to develop a Smart Grid Roadmap to guide our future deployments. The RFP was actually issued, did I say the 8th on there? It was actually issued, yes, the 8th. Yesterday it was issued. And we're planning to hire consultants to evaluate the SmartSacramento project and to develop a Smart Grid Roadmap. We have over twelve existing evaluations from individual projects. We did really over 40 projects. Some of them are sub-projects that are tied in to larger projects. And we've evaluated most of the customer projects, but we haven't evaluated any of the distribution projects, except for conservation voltage reduction. So we're proposing that the consultant evaluate an additional eleven projects, summarize all the evaluations into a single kind of SmartSacramento evaluation, so we can actually see the overall benefits of the larger scale project, and the cost effectiveness, also.

Here's a chart that shows the different evaluations. If you look at the yellow boxes, those are the, those are where we want additional evaluation. And the ones that have no color in them, the white ones, those are the projects that have been evaluated. We don't need an additional evaluation. And then if you see the green boxes, those are projects where we didn't feel like we needed an evaluation, like say the first green line there, mobile data terminal replacement. Those are heavy-duty computers in trucks. You know, that's something that we do, we don't really need to evaluate that. We need those in the trucks, and when the time comes we'll replace them. But there's no reason to do a formal evaluation of that. And there's similar reasons on the other ones. I'm not going to evaluate cyber security, for example. That's up to the cyber security group to look at that.

And then the second part of the Roadmap is to actually develop that Roadmap that incorporates the lessons learned and current best practices. So we expect the consultant to understand our projects and where we should go with respect to those projects, but to also understand what's going on in the industry at other utilities, at universities, at research organizations, entities like the California Public Utilities Commission or the California Energy Commission, and incorporate that all into the best practices and give us a plan of projects that they think we should do. So the projects would include descriptions, benefits, risks, budgets, staffing impacts, and then prioritize those by priority. It might be return on investment, it might be other customer benefits, a gap analysis. So once again, the RFP was issued yesterday. It's up to half a million dollars, and we expect a pretty quick turnaround on this. I'm thinking by the time we get the proposals back in three weeks, evaluate the proposals, go through any little negotiations and what not, it's going to be toward the end of the year before we have the consultant on board. And then we expect the Roadmap to be complete by the end of June. So pretty aggressive timeline.

So once the Roadmap is complete, we'll review those recommendations and we'll develop business cases where needed. So I don't expect that they're going to develop business cases for us as part of this project, but to have generally a very good idea of which projects are cost effective, and

then we'll develop business cases around that. And then the projects that make sense, we'll take to our executives and ask for budget and resources to implement those projects.

So here's another view of our vision. The first pictorial I showed kind of showed our service territory and all the different elements out there. But I see the time when we're going to have the central control, where from central location we will be able to manage all the distributed energy resources, micro-grids, storage, electric vehicles, demand response, to optimize the grid, improve efficiency, increase reliability, reduce the need for additional infrastructure. So I think there's some big opportunities there. It's been an exciting project, and it's been a lot of fun. And I do have some slides on R&D, but I think at this point I'd be ready to take some questions. Sean, are there some good questions out there?

Sean Yeah, Jim, we did receive quite a few the audience. So yeah, if you're ready, we can move to those.

Jim Okay

Sean So the first question I received asks, what are the penetration rates for the pricing programs before and after the project period? The pricing programs are the TOU and TOU CPP.

Jim Well, of the customers that we signed up, those that stayed on the program, I think you're talking about persistence on this one, the persistence was quite good. I don't remember the exact numbers, but you can pull down the report and get that. But it was something like 85 percent after two years. But that did not count people that dropped off due to moving and things like that. So the drop off rate was actually higher than that, but we didn't count moves as like someone who's dissatisfied with the program so they're leaving it. They left because they physically moved. And so it was pretty high persistence on this over the two-year period of that pilot.

Sean Great. The next question asks, when will analysis of CVR benefits versus feeder characteristics be completed? And will the analysis results be made public?

Jim And will the analysis? It'll be done the end of this year. And so we're in the middle of that right now. Now whether we'll have the feeder characteristic portion done I'm not quite sure, but we will have the results. Right now, we are averaging a .6 CVR factor, which, what that means if for every volt we drop, for every percent of voltage we drop, we get .6 percent energy savings. So in other words, a 2 percent reduction will give us 1.2 percent savings. And that's the average across the 14 feeders. But it ranges from a low of very close to zero to a high of over one point something. But average of .6. And we've already run some cost analysis numbers on that, and we found that even down to .3 CVR factor, it looks

like it's cost effective for us to do the automation. So I am anxious for that report to come out, because I think that's clearly one of the projects we'll be asking executives for additional funding to move forward.

Sean And will those results be made public?

Jim That's a good question, because we're working with EPRI on this, and we're part of the EPRI smart grid demonstration. And I need to work with them on that, because I want them to be public, but yet as a condition of working with EPRI, a lot of times those results are only available to the members of the smart grid demonstration. So I don't know the answer to that one yet.

Sean OK. And next question refers to lighting programs. It asks if they were delivered to customers by SMUD, or if SMUD hired a consultant to deliver that program?

Jim We were involved in designing the program, but it was actually up to the customers to work with contractors to implement the project. So we basically gave the criteria that said you will have these types of controls and these are the conditions if you want to get a rebate. And we offered a significant rebate. So in essence, we brought in a lot of the lighting contractors and told them about this product, and they went out and sold the product to the customers. So different lighting contractors we knew came in for training, understood the program, then they went out and they solicited customers. What we did find, I'll say, with that advanced lighting program, we it tended to be cost effective for customers that had long hours of operations, kind of manufacturing, warehouse type things that were long hours of operation. It didn't work well for offices. Not that you couldn't save energy, you saved a lot of energy, but the payback wasn't there. And so this is one of the areas where I'm looking for the price of the technology to come down, or trying to figure out if there's an 80/20 rule on this. Is there some way to get 80 percent of the benefit with 20 percent of the cost by installing maybe a little bit lesser controls, or not requiring so much detail on graphical user interfaces and things like that? And I think there's some ways to improve that program and make it more cost effective. But there was clearly winners and loser in that project, and those with kind of industrial type long hours of operation facilities really benefited and won in this advanced lighting project.

Sean Great. And the next question asks, if the geospatial tool, SAVI, has been integrated into operational tools to aid in real time distribution management?

Jim It's near real time, and it is installed in our control room. And so yes, it is used for near real time information. Our control room operators have the SAVI tool right there with them. Because of the nature of the NERC requirements and construction and different things, they just kind of moved into the control room and so I can't really tell you at this point how much they're using it. But it is intended for real time use on a daily basis.

Sean And is SMUD going to try to track the customer purchases of smart appliances that aren't part of a smart program?

Jim I don't know that. Because the smart appliances were largely pulled from the field, I think what we would ultimately offer would be some sort of a demand response program that would, something that we would offer some sort of incentive that would incentivize customers, basically, to allow us to control their appliance. At this point, I can't tell you whether we're going to attract those or not. We may do it through some industry partnership or something like that, because I think it would be awfully hard to tell who bought an appliance and how we should approach them. But I see a day in the future, probably not too many years off, not months, where we'll have some sort of a program around controllable appliances.

Sean And by what date does SMUD intend to deploy a TOU and CPP rate to all customers, and what changes would you do and how would you address customer fatigue?

Jim We are planning to implement full-scale residential time of use rates in 2018. We currently have two tier pricing, and we are going to in 2017 collapse that to a single tier, so instead of just two tiers it's going to go to one tier. And then the next year we're going to go time of use. Kind of an interesting approach, because right now, the low users are subsidized by the high users. So in essence, if you go into Tier 2 very much, you're subsidizing the people that never leave Tier 1. So Tier 1 might be, I don't know what it is, 10 and half cents, and Tier 2 is 18 cents. So those 18-cent customers are subsidizing the low users. When we collapse that rate and go to a single tier for just no matter when you use it, it'll be one price for that one year, what's going to happen is the low users are going to have a higher bill, and the high users are going to have a lower bill. And then, the next year, we'll go to time of use. And that's the methodology we chose. We had a rate case on that. We went out into the community, and we presented this to the community. Our Board of Directors approved it, and unless there's some change in rate case, that's the direction we're going. And in 2018, we'll be full-scale residential time of use rates. And I would see that being your typical kind of three-tier rate, off peak, mid peak and super peak kind of a rate, or we'll have some hours it'll be super peak rate. Right now those are from 4 p.m. to 7 p.m., because that's the time, in our service territory, where commercial customers tend to still be operating, the air conditioners are running and so forth, and everyone goes home from work and they turn on their air conditioners and their stoves and their lights and things, so we hit a peak usually around 6 o'clock in the evening.

Sean Thank you, Jim. And what does the automated feeder mean beyond SCATA installation? They've heard that 75 percent of feeders have been SCATA, correct? While only 18 percent of feeders are automated.

Jim It's the automated feeders that allow us to do the CVR, so we could, theoretically, do CVR on that entire 18 percent. Now, it's 118 feeders that each substation has, say three or four feeders that come out of it. So when I say 118 feeders, that's probably impacting, I don't know, some 25 substations, 25 or so substations. So when did the CVR at 14 substations, we did it on a significant number of our substations. I'm having to look up line automation to see what else we put on there, because there's different things on there besides capacitors, and I don't really know that off hand. I'm just trying to see. We put on some automated switches. It looks like switches is the big thing. Switches and capacitors. Motor operators, free closers, and capacitor banks. And then communication. So those are the main control components on there, the main components plus control. And please don't ask me what all those things do because I really don't know.

Sean Thanks. And so I have two questions that are related to one another. The first part is, did you encounter intellectual property barriers, and if so in what area? And the second question is, would licensing been a viable way to resolve intellectual property barrier, or did you just choose different solutions?

Jim We did not run into any IP issues that I am aware of. That's a good question. The thing we were more concerned about at the beginning of the project was what we call patent trolls, where someone, a company may be out there, a startup company, that may have developed a product and someone may have purchased a patent down the line that linked to this product. And we were afraid that we would install some product on a broad scale and then we'd get a lawsuit from some patent troll. It didn't happen, and there were no intellectual property issues associated with this project. In general, we look for things that open protocol and so forth to try to avoid that and try not to get locked into specific licenses with companies. But in some cases you do. Like our advanced metering, we have Silver Spring that works, and that's their own intellectual property.

Sean And are you continuing and/or expanding the pricing programs after the five-year project period?

Jim Yeah, that's where we'll be going into the full-scale time of use in 2018. And so it's interesting that we so quickly went from we're not going to do TOU to we did this smart pricing option, and suddenly we're going, we're doing it. And so it is on the books, and I don't see too many things that could block it at this point.

Sean And are you doing continued public outreach in anticipation of that?

Jim Right now, we're not doing much on that. But I imagine as we get closer we will. We're planning to do some pilot tests with some of our customers, maybe as early as 2016, and that's really a function of whether we have the infrastructure in place. I will say that this Smart Grid project helped us from one perspective, in that we figured out what we need to do it on a broader scale. For example, we do demand response, and you have several hundred customers. Well, you suddenly have to sit back and thing, what if we had a hundred thousand customers or two hundred thousand customers? Do we have the infrastructure in place to manage that? And the answer was no, we did not. We managed to do it with manual processes and so forth, but you suddenly expand this greatly, you're not ready to do that. And so what we're doing, and the same thing with the smart pricing options, there were a lot of manual processes that went on, and now that we step back and take a look, you go uh oh, there is a lot of infrastructure changes that need to happen before we can implement this broad scale. And so that is in process right now. We have a team of people working on just developing that infrastructure, making sure the software platforms are in place, the data storage, the billing, all those things are in place to do this. And so as soon as possible, which I say may be in 2016, we're planning to go out with some of these pilot rates to test them on a subset of customers. We would continue that in 2017 before going out full scale. And what that would allow us to do is to see customer acceptance and then be able to tweak the rates somewhat by 2018 before we get what we'd call the final rate. And so that's the process we're going through, and I expect as we start going into that pilot stage there will be a lot more communication and training going on and let more customers know what we're planning.

Sean Great. And our last question that I've received so far asks, is there an approximately dollar amount for total benefits already realized for the $350 million of investments over the five years?

Jim Do not have that yet. The individual plans are on the Dealy website. But like I said before, those are mostly customer plans. And so through this process with the evaluation and road mapping, I expect to get some sort of benefit like that, a dollar benefit plus other benefits. There's some projects that you do not just because they're cost effective. There may be some customer service benefits or some other benefit that you can't really put a dollar on, and you'll do them anyway. But when we look at projects, we're kind of looking at them from the long haul, so we're not looking at the one-year payback or the two-year payback per se. If we see something that pays back in ten or fifteen years, that's going to be around for thirty or forty, we go hey, that's a good investment. We can pursue that path. So I would have a sense that if I were to look at, if we have all of our projects evaluated, you'll look at some of them and go, you know, if we had to do that over, probably wouldn't do that, because that really was not cost effective, we didn't get the benefits we wanted. But other projects you'll look at and go that was great, we need to do a lot more of that. And so the

project was such that we got the grant, we had the budget for it, but had a timeline that was very aggressive. And so we're just going forward and implementing these projects sometimes in kind of a siloed fashion, rather than really having the time to look back and go really, how do these things integrate? How do they fit together? And that's what we're doing now. It's not too late, and so we're saying OK, how can we make these, optimize these projects that we did?

Sean Thank you, Jim. And that is the last question I received, so Jim, at this point, before we go ahead and wrap up the webinar, is there a website that people can go to for more information, or do you have any closing remarks?

Jim I should have that website. It's a DOE, a grant DOE website, and I don't know the exact website. If you looked up DOE grant reports, or SGIG reports like on Google or Bing or something, you would be able to come up with those reports. So sorry I wasn't more prepared on that front. But I would just say the project was very exciting, and it's not over. We still have a lot of work to do. And if you're looking at projects to do, if you're involved in a utility and you're looking at projects, I think you need to look at the resources on the DOE website and other sources such as EPRI or research organizations and universities before pursuing these projects. Because there were a lot of lessons learned. And you can learn from the mistakes of others, and you can learn from the wins of others in developing your project, such that you will insure success.

So I want to thank everybody for listening. It's been fun on my side, and I hope it was educational for you also.

Sean Definitely. We had a couple comments come in. One just says that on smartgrid.gov has all the error reports out there, so that would be a great place to go check.

Jim There it is. Smartgrid.gov. Alright, good. Thank you.

Sean And then someone else was wondering about the R&D slides that you had following. I would just say if you go to the Clean Energy Solutions Center training page, you can see Jim's presentation. We have the pdf version of that out there, so you can actually see the slides yourself, all of that, his last slide there. And so Jim, we did have one more question which I'd like to ask you before we wrap up. What do you think the key lessons, if you could just choose two or three, learned in your project that might be useful for other countries?

Jim Well, the key things from my perspective, and this isn't like into the projects themselves, but the leadership support is essential for your project. And the communication turned out to be the two big things in preparation for the projects. So whoever your leadership team is, executives, board members, whatever it is, get their support before you pursue these projects. Communicate with your constituents, because that's very big. And if you don't, you will learn that that was a mistake to not communicate. On the project side, I would say that you need to just insure that the technologies that you're looking at are ready to go. Like I said, some things were early stage, and you need to make sure that its viable companies and that they can follow through. You also need to prepare for the IT side of things, because that was huge for us. We basically had to defer most of the planned IT projects when this smart grid project came through. They just had to be deferred, because there were so many integration things that had to go on with all of these projects that they just worked strictly on smart grid for almost the entire five-year period, and then kind of went back to the projects that had been on the books. Some of them were overlaps. They were kind of completing killing two birds with one stone, if you will. They were able to do projects that were planned that linked to the smart grid. So those were kind of some of the key learnings that come to mind.

Sean Alright. And Jim, I'd just like to thank you again for the great presentation and responding to all those questions that we received from the audience. That was very helpful. And now turning to the audience, I'd just like to ask you to take a quick minute to answer a very brief survey that we have on the webinar you viewed today. Just three multiple-choice questions that you can respond to directly in the webinar. And the first question is, the webinar content provided me with useful information and insight. Great. And the next question asks, the webinar's presenters were effective. And finally, overall, the webinar met my expectations.

Alright, I'd like to thank the audience for answering our survey, and on behalf of the Clean Energy Solutions Center, just thank everyone for joining us today. We very much appreciate your time. And I do invite the attendees to check the Solutions Center website. If you'd like to view the slides from today's webinar, and also to listen to a recording of the presentation, which will be posted within about a week of today's broadcast. Additionally, you can look for other SCN webinars that are on that website, and webinars with other partners. Additionally, you'll find information on upcoming webinars and other training events, and just a reminder, we are now posting webinar recordings to the Clean Energy Solutions Center YouTube channel. Please again allow for about one week for the audio recording to be posted. And we invite you to inform your colleagues and those in your networks about the Solutions Center resources and services, including the Ask-An-Expert policy support and the webinar outreach program. And with that, I hope everyone has a great

rest of your day. We hope to see you again at future Clean Energy Solutions Center events, and this concludes our webinar.