Rachel Shepherd: Today's webinar is on Distributed Energy Resources for Cost Savings and Resilience. Ever since we started planning this session a few months ago, I've been so looking forward to this session. It's such a cross-cutting topic for all sectors, and our panelists today are excellent. But before I introduce them, let's go over a few housekeeping items. Please note, today's session will be recorded and archived on the Better Buildings Solution Center. We will follow-up via e-mail when today's recordings and slides are made available.

Next, attendees are all in listen-only mode, meaning your microphones are muted. If you experience any audio or visual issues any time throughout today's webinar, please send a message in your chat window box located at the bottom of the Zoom panel. Next slide.

I'll be moderating today's session. I'm Rachel Shepherd and I work for the Federal Energy Management Program, or FEMP, within the Department of Energy. I lead FEMP's distributed energy program and work closely with other DOE offices, federal agencies, and natural lab experts to implement distributed energy projects at federal sites. Next slide.

Let's talk about what to expect in the next hour and a half. After we wrap up the welcome and introduction, I will turn it over to our first panelist, who will give an overview and context for evaluating distributed energy resources for cost savings and resilience. Then, we'll hear from two panelists on two different case studies. Throughout the presentation, we encourage you to enter your questions for all the panelists into Slido, which I'll go over in a minute. We'll address your questions at the end of the session. Next slide.

So we're excited to announce today that we'll be using an interactive platform called Slido for Q and A and polling. Please go to www.Slido.com using your mobile device, or by opening up a new window in your Internet browser. Today's event code is #BBSummit. Once you enter the event code, please select today's title in the drop-down menu Distributed Energy Resources. I will give everyone a few moments to open up Slido and select this session.

So once you are in the Distributed Energy Resources Session you will automatically be in the Q and A tab, where you can ask any questions for our panelists. There's also another tab called Polls that we'll be using throughout the session to conduct polling. So please keep your browser open throughout the entire webinar.

For the Q and A session, you can like other people's questions, and that will help make those questions a higher priority to answer. So please enter any question that you have. But also like other questions that you would like answered. I'll give you another moment to make sure that everyone is logged in. All right. Next slide.

If you're interested in what you've learned today and want to hear more about it, I welcome you to join the conversation on social media via our Twitter handle and LinkedIn pages here. Next slide.

Next, I'll briefly introduce our panelists for today. Emma Elgqvist with the National Renewable Energy Laboratory, Tina Jones with Chesapeake College, and Isaac Panzarella with DOE's Southeast CHP Technical Assistance Partnership. Thanks to our panels for being with us today, and I'll provide a little bit more information about the background of our panelists throughout the session.

Before I do, we'd like to hear from you first by going through a few polls. Next slide, please. So if you haven't done so already, again, please go to www.Slido – S-L-I-D-O - .com, either through your browser, on your phone, or your computer, and enter in BBSummit, and then select Distributed Energy Resources. Please click on the polls tab on the top of the web page to see the various poll questions.

Our first question is which sector does your organization best represent: commercial real estate, health care, hospitality, retail, food and grocery, K through 12 or higher education, local, state or federal government, energy service provider, utility or project developer? Wow. We've got an over – almost – we've got a large response from local, state, and federal government. That's awesome. About one-third. Other, as well. A good representation of K through 12 and higher education, as well as energy service providers. I'll give another moment just to see what our results are. But this is a good mix of people, and I'm really excited that you guys are all here today. Great. All right. we've got another poll for you.

So next poll. In one or two words, what is your area of expertise? It could be your title, or it could be something that you're an expert at. We've got a lot of different ones. Sustainability is popping out right now, which is awesome. Energy management and energy efficiency. This is great. This is great. It sounds like we're all in a really good community. We've got utility and fire protection engineering. We've got CHP, system design. Wonderful. All right. Let's move onto the next question.

So, this one I've been looking forward to asking. What is the strangest energy-related issue you have encountered? So it could be an odd building that you maybe did an energy audit in. I did one in a 500-year-old church facility. It could be an odd thing happening. COVID. COVID has certainly been the strangest energy-related issue. Vehicle to grid integration. That can also lead to odd issues. Energy audit of a sausage factory. I can imagine that that can be strange, as well. Animal research. We'll give it another minute or so, see people's answers. Unexplainable power surges. That could definitely be hard to – and strange to – address.

All right. If we can close the polls. And John, if you're able just maybe to slowly scroll through. Oh, I see. We're not able to see the answers after we close that. Well, I really appreciate your guys' response. There was a lot of great stories in there. So thank you for sharing those. All right. So let's move onto some more questions related to today's session. So the next poll, if you can launch that, what are your biggest barriers to using distributed energy resources?

And when I say distributed energy resources, the context for today's session, we're mainly talking about renewable energy, energy storage, and combined heat and power technologies. So you've got several options here, and this will be a great way to gauge what we can talk about in the Q and A section. Funding availability, that's not a surprise. But certainly a big barrier for many of us, many organizations. And as well as understanding potential savings, and leadership support. That makes sense, as well.

Funding's still at the top, which makes sense – about 50 percent. Lack of confidence in technology. I think we'll also be able to address some of that today, as well as getting that leadership support understanding the potential savings. So that's great. Thank you, guys, for sharing that.

And one last question, now, I promise. So let's move onto the last poll. Thank you, guys, for submitting your questions. So the last question is what kind of loads do you consider critical? Especially when we're talking about resilience here, and DERs for resilience? So you can enter a word, a type of building, like a data center, HVAC, health care, life safety – that's huge. Anything mission-related, which makes sense and is very diverse, depending on your organization and the mission of that organization. Hospitals are jumping out there, too, as well as refrigeration.

I'll give it one more minute, see what else jumps out. Life safety, HVAC and health care really standing out there. And anything that's mission critical. And IT, as well. I see IT there, and elevators. So this is great. Thank you, guys, for this feedback. This is really going to help us in our dialog throughout this webinar. All right. So, next slide, please.

All right. so with that, I'd like to welcome our first guest speaker, Emma Elgqvist, with NREL. Emma is an engineer and her work includes providing technical assistance and deployment guidance for distributed energy technologies, conducting renewable energy screenings, evaluating renewable energy and storage deployment potential, and resiliency benefits in integrating renewables in microgrid designs. Emma holds a bachelor's degree in industrial engineering from Georgia Tech, and a master's degree in engineering management from Colorado School of Mines. Emma, take it away.

Emma Elgqvist: Thanks, Rachel. Can you hear me okay?

Rachel Shepherd: Yep. You sound great.

Emma Elgqvist: Great. You can go to the next slide, please. So, I will start today's session by giving a little bit of overview and context for using distributed energy technologies for cost savings and for resilience purposes. You can go to the next slide, please.

So, when we say distributed energy technologies or resources in this context, we're talking about renewable energy technologies, energy storage, and combined heat and power. For resilience, in particular, these technologies vary from traditional back-up generators in that they can provide a revenue stream and savings while they're grid-connected. And these savings may allow for the incorporation of additional microgrid components to kind of help lower the overall cost of a back-up solution.

In addition to that, when these technologies are integrated into a microgrid, renewable energy and storage technologies can increase the time that a site can survive a grid outage in the event that the fuels supplies should be limited. So they can provide both cost savings, as well as some resilience benefits when configured appropriately. You can go to the next slide, please.

So, I'll start first by talking about some of the techno-economic considerations for these technologies, and then towards the end of the presentation, I'll speak a little bit about the resilience considerations, as well. You can go to the next slide, please.

So, when thinking about distributed energy technologies for your site or a particular site, there's a lot of different inputs or factors to consider. That includes the renewable energy resources that's available at a site, the cost of the technologies, as well as any incentives that may be available to help lower these costs. Resilience goals at a site. The utility costs and consumption. And other financial parameters, such as discount rates and cost escalation rates. And so it's important when thinking about distributed energy technologies that you consider all of these inputs or drivers kind of within one problem statement. You can go to the next slide, please.

The group I work at within at the lab uses a techno-economic planning platform to think about some of these questions. So, I'll go through it really quickly here, just showing kind of the inputs and outputs to explain some of the later slides here. So, in general, the tool takes us an input loads at a given site. So both electric loads, servo loads, and we could also consider water demand. We consider here both the typical load. So kind of what distributed energy technologies would be kind of generating against when they're grid-connected, as well as critical loads. So what are the loads that need to be met in the event of a grid outage?

And then we allow the tool to select from a bunch of different technology options listed on the left-hand side here in deciding how these loads can be best met in a cost-effective or lowest-cost manner. So that includes renewable energy generation, like solar PD, wind, and biomass, conventional supply, so the electric grid, but also any back-up or traditional conventional fuel supplies; energy storage, and then dispatchable loads. So this could include things like dispatchable A/Cs or perhaps electric vehicles with smart charging.

And then what helps inform what mix and size of these technologies that's most appropriate for a given site? Depends on the current energy costs and potential revenues at a site, the costs of these technologies, and then what the goals are to the site. So are you looking to just minimize your cost? Do you want to know what technologies may be most cost-optimal for meeting a net-zero goal, or to meet a resilience goal?

And then the outputs of this tool includes the technology mix and size, how to operate the technology, and each time stop, and then the economics associated with that. You can go to the next slide, please.

So the way this tool works is we're looking at one week here of electric load at a site. The load is the thin, black line going across the top. And then that's met by either the utility grid in gray, solar PV here in blue, and then energy storage charging in dark gray and discharging in orange. And so while the PV system here is offsetting a lot of the area under the curve, or the energy consumption, it's not doing a whole lot to help lower the maximum load at the site. And so that's what the demand charges are based on here.

And so a fairly small battery storage system here is able to be discharged in the late afternoon when the solar generation is starting to decrease, but the load at the site is still relatively high. And by doing so, it's able to lower the peak demand from about 27 megawatts to about 22 megawatts here.

Later in the week, on Thursday, the load at the site is not quite as high. And so here the battery storage system is instead being used to shift energy from high-cost periods to low-cost periods. So it's being charged in the morning by the solar system when the cost of electricity is cheap, and then discharged in the late afternoon around the same time as when it was dispatching for peak shaving the demand in order to generate further savings.

And so important considerations here are both the sizes of these systems. And so you can imagine by building a larger system here, you could achieve additional savings. However, that would come at an additional capital cost. And so the tool is here considering those in conjunction to determine the optimal size. At the same time, it's also considering this economic dispatch of the assets. You can go to the next slide, please.

So when we talk about specific value streams for energy storage, there's a lot of possibilities out there for behind-the-meter energy storage. So something you would install at a commercial building, for example. The top two value streams listed here are pretty dominant. So that includes demand charge reduction – what we were just looking at where the battery is being dispatched to help shave that peak, and therefore save demand charges on the utility bill – as well as the energy arbitrage. So, shifting energy usage from on-peak period to off-peak period.

It is possible for behind-the-meter energy storage to tap into additional value streams, either through regional or utility programs. But, it's not nearly as common as using it for just offsetting your cost of electricity purchases. You can go to the next slide, please.

So, we recently did a study taking a look at what the opportunities for PV and storage would look like across the United States. We're looking here at representative commercial building using the electricity rate that has the most number of subscribers – most number of commercial subscribers in each utility territory. And then we're further kind of subdividing our study areas here by the solar resource intensity.

So the metric that we're looking at in green is the percent cost savings from implementing energy storage alone. The darker the green, the higher the savings. So, for storage alone, we see some moderate savings opportunity in California, kind of the Southwest regions of the US: Colorado, Utah, New Mexico; as well as in the Northeast. So, we often call that the PJM territory. But New York, New Jersey, Massachusetts, et cetera. And these savings here are primarily, again, driven by those demand charges. But also by some of the time-of-use rates.

On the right, we're looking at savings from solar PV coupled with storage. And so not only are there more green areas on this map, but there are several more areas that have this darker shade, indicating additional savings. In particular, in places like Puerto Rico, Hawaii, and Alaska, where the cost of electricity might be high, solar and PV together are cost effective. But storage alone isn't cost effective because you need that either time-of-use differential or demand charges to make that technology appear cost effective. You can go to the next slide, please.

So next I will talk through some considerations for using these distributed energy technologies for resilience. I should say that primarily my slides here include information on solar PV and storage, but that much of this is also applicable to other technologies like wind, and CHP. And Isaac's going to be speaking in a little bit to – and will talk through some of the CHP considerations, in particular. So you can go to the next slide, please.

So there are several different use cases for PV and storage. Starting on the left side of the chart here in gray, off-grid PV and storage. So here the technologies are providing power instead of the traditional utility. This application works well at remote sites with high fuel costs, or where there is extremely low grid reliability. Here the distributed energy technologies typically with diesel generators are providing the primary power supply. And there's not really a back-up power supply.

Next, it's grid connected PV and storage. So using these technologies to help lower the cost of utility purchases; much of what we just talked through. So this works where there is high demand charges, times of use rates, or other potential value streams to tap into the grid along with use of these distributed energy technologies are the primary power supply. And there's no back-up.

Next in green, we can take these same technologies and still use them for lowering the cost of utility purchases. But then also configure them in a way such that they can provide power during a grid outage. So this works well in places, the same as grid-connected PV and storage, where there's high demand charges, demand rates; but also where a site has resilience requirements. And so here the grid, along with the distributed energy technologies, are the primary power supply. But then the DERs are configured in such a way that they can provide power in the event that the grid should go down.

Last, you can also – and this is somewhat common, or we've seen this at some military installations that have significant land available – where they will host a large-scale PV or PV and storage system, but they're not the off-taker. And so they're just purchasing grid electricity during business as usual. But in the event of an outage, these technologies can be configured in such a way that the site that's hosting them can get kind of first dibs on the power generated. You can go to the next slide, please.

So, the top box here is kind of simply what you need for a PV and storage project. You need the PV system, and the storage system, and an inverter. If you want to be able to island these technologies or operate them in the event of a grid outage, you need a lot more components. And so I'm not going to list them all out here. I simply wanted to just make the point that PV and storage alone is not going to lend itself necessarily to be used during backup. You really need additional capabilities to be able to do so. And the cost of these components depend on the complexity and the size of the systems, how sophisticated you want your controller to be, and your connection voltage, and other functions, as well. Next slide, please.

So, when thinking about sizing and selecting technologies for islanding, there's a few different things to think about. The first one is the duration of the grid outage. So, how long approximately do you want to survive without grid power in the event that the grid should go down? And also, the timing of that. So, do you want to think about surviving kind of an average period of the year? Is it worst-case, best-case scenario?

Next, you'll also want to consider your critical loads. So typically, the loads that need to be served in the event of an outage are not all the loads at a site. And so the critical load is often just a portion of that typical load. And then finally, you want to consider, then, the technologies and kind of on-site generation and controls in order to be able to survive an outage. You can go to the next slide, please.

So, one way we think about these questions is to consider the life cycle cost and outage survivability for different technology configurations. In here, we define your probability of surviving an outage as a percentage, because it varies throughout the year; both because your load varies, and if you're incorporating distributed energy resources to generation from something like solar can vary throughout the year, or it does vary throughout the year and through the day.

So, we're comparing three different options here. First, the base case is a 2.5 megawatt generator that the sites have. And the total life cycle cost of energy purchases to the site, including utility purchases, is $20 million. With this generator, the site has a 90 percent probability of surviving a grid outage of five days or less.

Next, we looked at a lowest-cost solution. So here the tool is sizing a 600 KW PV system, along with 175 kilowatt hour battery. The life cycle cost now goes down to $19.5 million because those technologies are able to provide cost savings. And they also allow the sites to survive an outage, instead of five days, now it's six days with the probability of 90 percent.

Finally in blue, we're looking at a larger system. So here a two megawatt solar system and a half a megawatt hour battery system. So the life cycle cost increases slightly from $20 million in the base case to $20.1 million here. But the site now is able to survive a grid outage of nine days. And so these kind of numbers and metrics can help sites consider the trade-offs between costs and savings, as well as ability to survive outages of certain lengths. You can go to the next slide, please.

Finally, one other consideration is to think about the value of resilience. And so here we're looking at two different results on sizing, PV, and storage with and without including the avoided outage cost or the value of resilience. And so what we see in this case where the resilience is valued, it increases the PV capacity at the site, as well as the battery size and duration. And it also increases the overall net present value to the site. You can go to the next slide.

So, the tool that I was describing today that we use to do a lot of the modeling work is also available – it's publicly available and free both in a web tool, as well as an EPI and an open-source version. So I'll just put a plug in for that here. I believe those sites will be shared after the session so you can go and click the link and take a look if you're interested in learning more about it.

And then I'll just go to the next slide and end with a couple of key takeaways. So many factors affect whether distributed energy technologies can provide costs, and savings, and resilience to a site. And they need to be evaluated concurrently. It's important to consider site-specific features like the load profile, and the utility rate structure when assessing techno-economic potential. There's many use cases for on-site distributed energy technologies and not a one-fits-all solution. And then finally, that enabling the use of DERs for back-up provide resilience benefit, but is oftentimes more costly. And so the value of resilience could be considered as an additional benefit when doing this analysis. Thank you.

Rachel Shepherd: Thanks, Emma, for that great overview. I've seen a lot of great questions entered into Slido. So keep all your questions coming. Next, I would like to introduce Tina Jones with Chesapeake College. Tina serves at the vice president for administrative services at Chesapeake College. Tina serves on the Talbot County Economic Development Commission and the Queen Annes County Emergency Operations Center COVID-19 Response Team, as well as the Board of Quality Matters, Inc., and TransLiance.

Tina received her bachelor's in economics and MBA from Virginia Tech. In addition, she has completed graduate-level courses in organizational leadership at both the University of Maryland, Eastern Shore, and the University of Chicago. Welcome, Tina.

Tina Jones: Thank you. Next slide. Okay. I'll be speaking about the application of what we've actually done here at Chesapeake College. Next slide, please.

I'll tell you a little bit about the school, first. Our school is a community college located on the eastern shore of Maryland. We have about 2,000 students that are transfer students, meaning those are going to go on to pursue a four-year degree after they do their first two years here. And then we have a bout 6,000 other students coming from our community to learn a skill or a trade so they can go back out into the workplace to work.

And from an employment standpoint we have about 250 employees that are full-time. And then we have an additional 300 faculty and other staff that work with us on a part-time basis. So again, we're relatively small. Our total operating revenue is about $25 million. An important thing to know about us, we are in a very rural area in the state of Maryland. We sit about an hour due East of Washington, DC. However, our community college serves roughly 20 percent of the land mass of the state of Maryland, but only three percent of the population for the entire state. Again, we're very spread out.

And again, because of that, there's a lot of rural area. We happen to be sitting right in the middle of a large field. Where this college is. And we sit outside of any municipality, which means all utilities have to be provided for ourselves besides grid power. So we provide our own freshwater. We provide our own wastewater. We even provide our own gateway to the Internet backbone that sits off of our property. So again, resiliency becomes very important when you're in a remote area and there is a lack of additional resources and support. The next slide, please.

So the energy resources that we have at Chesapeake College are a lot of the ones that you've already heard about. We do have a 1.8 megawatt EV solar array. When we first installed it, it was providing about 40 percent of our power. Today, it actually provides over 50 percent of our power demand on a 24/7 basis. During its peak hour productions on beautiful sunny days like today here in the eastern short on Maryland, we are actually completely off the grid, relying entirely on our solar power.

In addition, we have installed car chargers along our campus. We do that for resiliency for our own use, but we also do that to be modeling best behaviors in our community. As a community college, we're not about research. We are about providing and demonstrating best practices that everybody can take out into the community and use themselves. When we couple that EV array with solar water heating that we use to heat the water in some of our buildings to a core temperature.

Geothermal systems that provides the base level temperatures for almost all of our buildings on our campus. And then with the heat setting systems that we have, high energy, HVAC, where we do heat recapture and we do energy heat transfer, as well. Finally, through a gift that we have received, we have a two megawatt storage battery actually on our campus, which is very important for us when it comes to both resilience and cost savings. Next slide, please.

In addition to the resiliency items that we have put on the campus themselves, the physical assets, another part of our initiative really centers around our employees, our students, and education. We are an educational institution. We realize that one of the best ways to be more resilient, one of the best ways to trim costs, are through reduction and actual power usage.

So we've done a number of things on this front. One is educating folks to do the simple things: turn off your lights. Turn off your computers. Those kind of things when you go home at night. We've put in place modern building automation systems that are actually coordinated with our schedule of operations for our campus that when we are not serving as many people, we can actually set down sections of the campus to reserve that energy.

We have moved to a place where we now have planned replacement of all of our major facility resources with high efficiency systems. So we actually manage a plan replacement system that goes out five year on all of our technology and our physical plants. Again, with the model being that we're going to incorporate in high efficiency assets there so that we can reduce that demand further down the road. Ultimately, reduce our costs.

Finally, we do a lot of incremental work. We have done a lot of replacement of our LEDs. We've entirely revamped our outside of our campus with LEDs. We've done essentially all of our buildings on the inside now, as we go through our plan replacement on our computer resources, which is another one of our big energy users. We are also looking at high efficiency systems there in both the towers, the workstations, and then of course along with nay of the racking systems and anything else we need. Next slide.

Why is this important? What is the difference that it makes? So from a cost and cash flow consideration, I serve two roles here at the college. I am their chief financial officer, but I'm also in charge of sustainability. And then 2011, we have actually reduced our energy consumption by 24 percent. During that time, we actually increased our square footage, our footprint, by 20 percent. We've seen our energy costs decline by 40 percent, $600,000.00 a year to $350,000.00 a year.

Why is that important for a little community college here on the Eastern Shore? First of all, it's one percent of our total budget. A community colleges are like most small community colleges. We have razor thin margins. It's very important that every dollar we have can go to activities for our students. A one percent reduction in total budget for us is monstrous. It's actually power is our second-largest cost beyond personnel cost. So that's why when you see this, when you think about our costs in terms of non-staff cost, this is a five percent reduction that we've achieved in the last nine years.

And for us, it's also equivalent, which is where we look at everything. It's equivalent to 50 full-time student tuitions. And in a community college realm, it's really important that we be as cost efficient and as effective as we can for our students. Many of our students – this is the one chance they'll get at education. We have to make it affordable, especially in these days of rising costs. Next slide, please.

Other things to consider. Because we've taken this very incremental approach, we've actually done all of these things without adding any capital, budget, cost, or any increased maintenance and repair costs. Our budget has remained constant since 2015, for the last five years. We've been able to do all this within that same existing cash flow.

We procured our solar through a power purchase agreement. We did not build it ourselves. We did that for several reasons. We bid that, first of all, because we're small. My facility staff consists of one electrician, one plumber, one HVAC person. We have to be very – we know where our knowledge base lies and where it doesn't. And so by working with the power purchase agreement, we could shift that responsibility to a third party.

And we also have in our power purchase agreement performance guarantees. So that if we do not actually receive the amount of output that was promised in this power purchase agreement for 20 years, then we will actually have checks written to us on average five-year cycle to match the cost savings we should have generated from our purchase off the grid compared to on the solar array itself.

When we installed our solar array in 2015, we were buying our solar PV power, our PPA rate was approximately 40 percent of what the grid power was costing us at that point in time. We were able to do this by going out and getting a competitive procurement on the street and had the companies compete against each other.

The other thing that we've done, the solar obviously provides us with these performance guarantees. We've hooked that now to our storage battery that was gifted to the college. This becomes very important for us because now we have the ability, number one, to leverage that power if the grid goes out. Because having that isolator from the grid, we can keep the solar PV up and running now, which we couldn't do before. We also are able, if we decide to continue to up-size the solar array, if the economics makes sense, we can actually do that and then use the battery storage to help us in our night time hours from the solar it's not producing.

Finally, the other thing that we've done since then are 20 percent addition to our buildings here on the campus was actually one single building, which is a health professions and athletic center. An interesting combination, usually would be the highest energy user on campus. We through design practices and within our building schedule, we actually were required to design this to LEED Silver. Through continued work with our vendors on this project, we were able to keep the budget unchanged and actually met LEED Platinum status on this building. We had the first educational higher ed building in the state of Maryland that was LEED Platinum.

So, again, what we've seen is that where our routine maintenance budget is up to date, that we're unchanged for the last five years. And we are actually anticipating that as we move forward, our maintenance costs should start to decline, because a lot of the assets that we put in place actually have a lot longer life expectancy than a lot of our other components that we've replaced. So that will save us in terms of the replacement value of those assets, as well as the manpower hours to do the maintenance itself. Next slide, please.

From the resiliency standpoint, I want to talk first about our college. All of our key information technology assets have redundant power sources now. That's particularly important in light of COVID-19, where we've all had to shift very quickly from an on-site presence to an online presence. We were able to make that shift in less than a week. It allows us to have availability 24/7 for on-campus and off-campus remote instruction, as well as our back office operations.

We now have 3 of our 12 buildings that are actually, as well as all of our freshwater and wastewater plants that have multiple energy sources now, so that we are able to continue those operations on site for an indefinite amount of time. We have also the future expansion of our battery storage project, which we're in some discussions about, would allow us to actually microgrid our entire campus and keep us up and running on a much more reliable basis. So next slide.

So why does it matter? Again, for our students, it's increase operational reliability for them, because they can learn when they need to learn. Many of our students are part-time. Most of our students are part-time. Most of our students are working adults. So for them, it's not about going to school between 8:00 and 5:00 PM. It's about going on the weekend. It's about going on the evening. It's about doing it from home. So that ability to have reliability 24/7 becomes very important for them.

And also, the decreased costs are tremendously important. Over the last three years, we've only increased our tuition by two percent total, because of our ability to control our costs. A large part of that is through our sustainability initiatives, including the use DERs. Again, for our faculty and our staff, we have less down times now because our system is much more reliable. We have greater flexibility when it comes to work locations and the times that people are able to work.

It was important before because a lot of our faculty are teaching, are working another job. They teach for us on a part-time basis. It also allowed us with the COVID-19 and the stay-at-home orders that we all went through, it allowed us to rapidly shift from this on-site instruction to off-site instruction and to work-from-home from the working at the traditional model at the college campus itself. Next slide, please.

Again, why it matters for our students. It's actually our operational reliability. Why does it matter to our community? As I mentioned before, we are in a very rural area. And for that reason, we serve a lot of other purposes besides just education. We are the cultural center in that we have a theater on the campus that does live productions. We also provide easily available and affordable meeting space for many of our businesses and our non-profits in our regions.

And probably equally as important and even more so here in recent times, we play a big role in our community in times of crisis. We have served as a shelter, emergency shelter, for hurricanes and natural disasters. We are actually certified as a FEMA shelter here. One of the buildings that I mentioned that we have that has resilience built into it is our health professions and athletic center. That serves as our shelter, and that building is redundant through both the grid power where our solar array, plus the diesel back-up generator system. Again, as we are looking at this, we know we need to have at times of crises the ability to provide the services, water, sewer, electricity, for all of our populations, including those at risk.

We also are established as a regional medication point of distribution site for our region. So at a time where we may have to do mass immunization, something that could actually be on our horizon now, one of the things that we're required to have is refrigeration and a large venue where we can handle large number of folks at a time. So what we've done there is our other two buildings that we've linked was actually our cafe and student center, as well as our theater. Those give us the opportunity to actually handle large volumes of people and give us the refrigeration we need for medications for any kind of a medication distribution site.

The other purpose we serve here is as a free distribution site. We were in conversations with the state of Maryland and the National Guard early stages of COVID-19 to talk about providing food for the local community here. We have a number of underserved people in our community, and food insecurity is a continual issue. Again, that ability to have large spaces to store cooling spaces where you can preserve materials is very, very important.

And finally, we were called to serve as an alternative health care site for COVID-19. That means that we were the overflow hospital if our hospital was to actually fill over capacity. So we had to have the ability to actually be able to handle patients, including patients up to ventilator status, on this campus. And that was in our FEMA shelter, again, back in our health professions and athletics center.

As you can see, it serves a lot of need for our students, for our community. But it's especially critical at those times when the community needs us most. Next slide.

And I want to thank you, guys, for taking the time to join us today. And hopefully there's some questions a little later.

Rachel Shepherd: Yeah. Thanks so much, Tina. It was great hearing about all the good and important work that you and Chesapeake College are doing. So thanks so much. And I want to remind everybody to please go to www.Slido.com and enter in BBSummit into the event code, and then select Distributed Energy Resources. There is where you can ask all your questions for Tina, as well as the other panelists, as well as where you can participate in our polls.

So we actually have another poll. We're going to take a quick break from the presentations and ask a quick poll of you all. So if you can go to the next slide. So, our next poll is what is the primary reason you are interesting in distributed energy resources? Economics, meeting an energy or sustainability goal, resilience back-up power, or other? Right now, we have about almost half are resilience and back-up power, which makes sense. Really important. As well as meeting an energy and sustainability goal.

I'll give it one more second. See what other entries we have in. resilience and back-up power definitely seems to be the highest priority, which makes sense, especially given the times we're in with different threats, and disasters, and everything else that we need to protect our buildings and power. Great. Well, thanks for providing that feedback.

And that's going to transition us into our last panelist for today, which Isaac Panzarella. So we can go to the next slide. So, Isaac is the system director at the North Carolina Clean Energy Technology Center in Raleigh, and the director of the US Department of Energy's Southeast Combined Heat and Power Technical Assistant Partnership, CHP TAP. Isaac has a mechanical engineering degree from North Carolina State University, where he works at the NC Clean Tech Center. Isaac, take it away.

Isaac Panzarella: Thank you, Rachel. Hi, everyone. I'm so glad and honored to be a part of the conversation today on how distributed energy resources can yield cost savings and resilience, especially for critical infrastructure facilities. I'm going to share details of the combined heat and power system at Shands Cancer Hospital in Gainesville, Florida today. And it's a really great story about how the hospital partnered with their municipal utility, Gainesville Regional Utilities, to achieve a resilient microgrid with CHP.

First off, though, I really want to thank both Shands and GRU for being awesome partners to DOE and the CHP TAPs. Back in 2018, they hosted a CHP TAP workshop on energy resilience and gave a tour of their CHP plant for end users and policy makers. They're also committed to generously sharing their story. They've presented at many, many energy conferences over the years, such as IDEA's Campus Energy Conference. Next slide, please.

I'm not going to spend a lot of time on the basics of CHP. Thankfully, this is the only slide I have on the basics. And the key thing that I want you to know about CHP is how it – back one, please – it greatly improves efficiency in a localized situation where you need electricity and heat at the same time. And that's pretty much anywhere, especially when you consider that CHP can handle both heating and cooling. So, hospitals like Shands can use CHP. Airports can use CHP. Military bases and more. Today, there's over 81 megawatts of CHP operating at over 4,500 sites in the United States. Next.

CHP is a really powerful solution with lots of additional potential in the United States. And so DOE established the CHP technical assistance partnerships to serve as a resource and help develop these opportunities. The CHP TAPs engage with regional end users and stakeholders, and most importantly, we provide technical services through a national network of experts, such as those at the Midwest CHP TAP, which is housed at the University of Illinois, Chicago, which pictured here. We see last October where UIC hosted a national manufacturing day event, where they toured a manufacturing research lab on their campus, and their combined heat and power system. Among their visitors was Valri Lightner, who is the deputy director of DOE's advanced manufacturing office. Next.

The CHP TAPs serve ten regions of the United States, providing national coverage. I know that some of my fellow directors interesting the CHP TAP staff are on the call today. Thanks for supporting. I'm the director of the Southeast CHP TAP that covers eight states plus Puerto Rico and the US Virgin Islands. I also should mention that we have partnerships with UF Gainesville and Tennessee Tech to help us provide better service throughout our region. We're supported at the headquarters level by Bob Gemmer and Patti Garland, who many of you know. Next.

So I've been with the CHP TAP program for the past ten years. I really enjoyed working on it. And over that time I've seen CHP become more and more relevant to the power sector as it transitions to cleaner energy sources. We've also seen CHP stand out as a proven solution for energy resilience. And are seeing a new focus on hybrid systems that combine flexible CHP with other distributed energy resources like solar PV and energy storage. Next.

One this slide, I'm going to talk about how in recent years, we've witnessed increasingly frequent weather and climate disasters. These have killed many people, unfortunately, and significantly impacted lives of scores of others. NOAA tracks their frequencies of disasters that cause more than $1 billion in damage. And this map shows the locations of 14 $1 billion disasters, or excess of $1 billion disasters that occurred in 2018, with a combined total of $45 billion in damages. In 2019, there were another 14 of these billion-dollar disasters, totaling over $92 billion in damages. Next.

Now, utilities are doing a lot of work to harden the grid against these climate and weather events. But one of the surest ways to defend against these natural disasters and other interruptions to the grid is to invest in resilient energy systems at critical infrastructure sites. Hospitals top this list, that also include emergency operations centers, military installations, and food production, storage and distribution facilities. A properly configured CHP system is capable of handling long-term interruptions. So the powers apply for sites like these, where no outage should be acceptable. Next.

So, Shands Cancer Hospital at UF. It's a premier example of a resilient CHP application. And it came about through an innovative partnership with their municipal electric utility, Gainesville Regional Utilities over ten years ago. With 12 megawatts of capacity, the CHP system at GRU South Energy Center meets the full requirements for power and thermal energy at the hospital and its attached research facility.

The facility also combines hurricane-resistant design with a microgrid that can island from the grid in response to an outage, or even if there's a pending outage. At the link below, you can find a project profile that we've created to share the story and lessons learned about Shands and GRU. But for now, let's delve into the details of the partnership, the development process and the technology, starting with the next slide.

The partnership between Shands and GRU goes beyond the traditional utility to customer model. And the basis of it is a 50-year agreement that has important benefits for each partner. This agreement has helped Shands receive all of the resiliency benefits of CHP. It's given them a LEED Gold certified facility and helped them avoid over $45 million in capital investment. For GRU, they've been able to invest in a highly efficient distributed generation resource with a committed customer that helps them towards their goals of becoming a low-carbon utility. In this model, Shands can focus on their core business of caring, and GRU can focus on their core business of serving their customers. Next.

In 2008, when the first phase of the CHP system was opened, Shands had a capacity of 200 inpatient beds. And at that time, GRU invested in a 4.6 megawatt gas turbine CHP system that's capable of supplying 45,000 pounds of stem per hour. That's a lot of steam. And part of that steam drives a 4,200 ton steam turbine chiller. A chiller like this that's driven by thermal energy helps maximize the use of the output from the CHP system with the added benefit of reducing the peak electric demand on the grid by almost around two megawatts.

Now, in phase two of the project that was completed in 2017, GRU decided to add a 7.4 megawatt reciprocating engine to the CHP system. Originally, the plan was to add another turbine. But after a really detailed study of the electric and thermal system needs at the facility, the engine was chosen because it has higher electric efficiency. Now, with the engine about half of the thermal output is used to produce steam, and the other half is used to produce hot water. And you can see that in the diagram here.

In UF Shands master plan, the cancer hospital will grow to 1,200 beds by the year 2040 to support the growing community. And this system will be capable of serving much of that future load, especially when you take into account the energy efficiency improvements that should be made between now and then. For now, however, GRU is able to supply the excess power from the CHP system to their distribution grid. Next.

And how is it performed? Well, hurricanes are really the key threat that you see in Florida. Hurricane Irma was one of two major hurricanes that made landfill in Florida in early September, 2017. It hit the Florida Keys as a category three and made its way northwards through Florida. Gainesville, where Shands is located, saw sustained winds of about 45 miles per hour.

And in events like that, Shands can monitor conditions and island from the grid if outages are expected. And if they island, again, they can support their full facility with power and heating and cooling. Hurricane Maria, as was the second storm that made landfill in late September of 2017, it had less of an impact in Florida. But as we know, it really devastated the island of Puerto Rico. And in Puerto Rico, there's a lot of facilities looking at installing – that have installed, they're looking at installing – CHP. Next.

And here on this slide I have the definition of a microgrid. This definition says a microgrid is a group of interconnected loads and distributed energy resources that have clearly defined boundaries that acts as a single controllable entity with respect to the grid. And that microgrid needs to be able to connect and disconnect from the larger utility grid to enable it to offer it in both grid-connected and island mode.

This widely accepted definition of a microgrid came out of the microgrid exchange group that was organized by DOE's Office of Electricity in 2011 and 2012. While Shands was really one of the first real microgrids, and it met this definition before the definition was even written. But we're seeing going forward combining power can really serve as the heart of what we call these hybrid microgrids that combine all sorts of DER resources. Next.

Now, with a microgrid, it's very important to evaluate it very carefully and design it correctly. And in developing the microgrid islanding scheme for Shands, the engineering team had to consider and optimize three different areas. The first one was to look at all the different types of operating scenarios; modeling the system under different loads, as well as in both grid-connected and in island mode. Then they also had to look at protection schemes. These protection schemes ensure that faults are detected, that they're managed and isolated to keep the microgrid from blowing down.

Finally, they had to look at utility interconnection. Primarily, you want to operate safely, not back feed to the grid when the grid is down. You want to determine how much power can be exported safely, while at the same time maintaining control of frequency and voltage to synchronize with the grid. So the end result of this whole process was a seamless system that allows the microgrid CHP system at Shands to seamlessly and without any flicker of the lights transition from grid connected to island mode and back to grid connected mode. I'll just note at the bottom of this slide and many of my slides provide links for you to go to for additional information. Next.

So, clearly, Shands is an example, a great example of resilience with CHP. It's won many awards for excellence, including the EPA ENERGY STAR award. And, like I said before, there's many other critical infrastructures and lots of potential for combined heat and power around the US. Next.

So, as CHP TAPS, like I said before, one of our key services is to provide technical assistance. This slide shows the process that we would work through. It starts off with a screening and preliminary analysis of CHP for a site. In that, we can help a site determine what an opportunity is, what the simple payback is and whether or not to move forward. We'll also help a site with during feasibility analysis stage. We can provide third party reviews of studies that an ESCO or an engineer might do for a site. And then we also provide other services, advanced services during the procurement process.

The next slide shows an example of our screening analysis. We really can take average utility bills and come up with average energy loads, and demands, and again come up with this simple payback and capacity to help a site determine whether or not CHP is a feasible option for their site. Next.

And this is my last slide. I invite you to contact your regional TAP. You have the slide with the map with all contacts for the ten regions. They can help you, again, with the screening. They can help you look at a CHP plant that you might want to expand, and also help you with an unbiased third-party review. We love helping people. And with that, I thank everyone for your time and attention. And we'll turn it over back to Rachel.

Rachel Shepherd: Yeah. Thanks, Isaac, and thanks for sharing this impressive project at Shands. We really appreciate it and great information.

Interviewee: Sure.

Rachel Shepherd: So before we transition to the Q and A, we have another poll. It's the second to last poll, I promise. We've got one more after that. So I hope you're on Slido.com and can see the full question pop up. So, the question is to what extent have your questions been answered about distributed energy resources for cost saving and resilience so far? This question is have we answered your questions, any questions you had prior to coming to this session? I know we haven't gotten to the Q and A section yet to answer the questions you have now. But, we'd like to take a pulse of where everyone's at.

All right. So we've made some progress. I see some fours. That's great. No ones yet, which is good. I think the poll results went away for a second. But, great. Well, thanks for giving this feedback. This is excellent, and I hope we answer more of your questions in the Q and A portion, now. So if I can ask all the panelists to turn on their videos and their microphones, and we will get into the questions.

So, the first question is for Emma. Emma, can you talk a little bit more about valuing resilience? One of the slides you had showed incorporating value resilience in re-app screenings. So you might want to touch on that, as well as what NREL is working on with valuing resilience.

Emma Elgqvist: Sure. And can you hear me okay? I had to switch from the phone to the computer audio.

Rachel Shepherd: Yep. You sound great.

Emma Elgqvist: All right. Awesome. Yeah. So, I guess I should start by saying that valuing resilience is really hard and really complex, and there's not necessarily either one value to use, or one specific methodology. One thing you can do is to estimate it by looking at an individual site and building up a customer damage function. That's very specific to a particular site and the operations there, and kind of what specifically would happen, and what costs would be incurred as the grid goes down.

Lawrence Berkeley National Lab has something called the ICE Calculator, it's the Interruption Cost Estimator. And so that allows you to get some high-level estimates of interruption costs based on kind of national outage survey data. For the particular chart that I showed, kind of the last or second to last slide that looked at the net present value with and without the value of resilience, that came from a specific publication also from Lawrence Berkeley, looking at the value of service reliability estimates for electric utility customers.

And so they had, they published values for outages of different time lengths for different types of customers. And so that's another research area at the lab is trying to understand kind of and incorporate into these techno-economic decision tools and models the time varying value of resilience and how that changes, kind of as the duration of an outage grows.

Rachel Shepherd: Awesome. Thank you. Next question is for Tina, and then Isaac, if you want to talk about it for Shands, as well, you're welcome to. So, Tina, can you talk more about the relationship and the grievance that you had to maybe get into with the utility, especially, to island your DERs from the grid?

Tina Jones: Sure. It's an actually quite an interesting story. Our relationship with the utility actually began with a denial for interconnection for our PV. So, we went back to the utility and instead of trying to fight them said, "We have a dialog here and look at ways that we could possibly still make this happen, size it down a little bit, maybe there's something we can do for you."

Now that dialog turned out that they were interested in actually doing a research project and needed a site where they could actually monitor real-time PV production related to grid stability. And so what we were able to do, they agreed to put the report with the fully-sized PV. But then, what we did in working with the solar provider, which was a different company, actually installed a weather station actually on site at the solar array.

So we were grabbing real-time weather data – cloud cover, things of that nature – so they could test throttling back our production in one-percent increments, never to be more than three percent. That would allow us to keep our array up and brought in even in times when the grid was not stable, which is a fairly decent big issue here in a rural area. And it allowed them to have better control of the system.

That's how we built the relationship, that partnership that came about in that. And out of that came the desire to work through us. And that's how we've actually been the benefactor of the battery, as well, which they've installed on our site for no cost.

Rachel Shepherd: Great. Thanks. And Isaac, I don't know if you want to add onto it. I also, the next question is for you, as well.

Isaac Panzarella: Okay. Well, Rachel, for the GRU and Shands partnership, actually there's not a lot of issues related to interconnection and islanding, because GRU is actually the utility and they own and operate the CHP system. And we're seeing more and more utilities enter into this type of partnership. Duke Energy is doing one with Clemson

University that's under construction now. There's Chesapeake Energy with Ranier in Florida, where the utility, that's what they do best. They generate electricity. So they control the CHP system. Of course, in that partnership, the host – such as Shands – needs to have access – primary access – to the power that comes from the CHP system. I think that answers the question.

Rachel Shepherd: Yeah. That's awesome.

Isaac Panzarella: What's the next question.

Rachel Shepherd: The next question is are there alternative fuels other than natural gas now and possibly in the future that can be used for CHP systems while having a better emissions profile?

Isaac Panzarella: Absolutely. CHP is adaptable to a variety of different fuels. We at the CHP TAPs, we're very fuel agnostic. But we do like to support the use of renewable fuels when the site has an opportunity to use them, because that actually has lower cost, potentially, and helps the CHP system to have a better payback than with fossil fuels.

I'll just put in a plug for the CHP website. It's energy.gov/CHP. At that site, you can find a database of all the existing CHP systems in the US. And if you look in that database, you can see all the different CHP systems that are fueled by biomass. There's a lot fueled by woody biomass, and others fueled by renewable biogas or renewable natural gas, which some people call it today.

But overall, it's important to understand that because CHP is so efficient, it really, it reduces the amount of emissions from the power and the heat that it produces compared to the normal way of doing things by typically around 50 percent. So it's a great way for a campus – at NC State's campus where I work, we put in a CHP system – it was an 11 megawatt system – a few years ago. And that one system reduced the campus' overall greenhouse gas loads, or emissions by eight percent. And it was definitely nowhere near the size of the load for the entire campus.

Rachel Shepherd: Right. Great. And I think we also have the links to some of the resources that you talked about in our upcoming slide. So we'll ask people to check those links out, as well.

Tina, the next question is for you. Can you talk a little bit more about your evaluation process when you guys were making decisions about what distributed energy technologies are going to be deployed at your site?

Tina Jones: Sure. Again, it's a small group of us. And part of how we did this, none of us are experts. Again, I'm a business person. I do have, my facilities manager is a high-voltage person who worked for the utility, so that was very helpful. But what we did is we actually kind of looked at what our need was, what our demand was. We estimated what our flows were going to be. And then we, instead of coming up with what the solution had to be, we actually went out with a fairly open-ended solicitation from us on solar PV. It got to be cost.

We didn't have a capital to invest in the system itself. We also wouldn't get as a government entity, we don't get the tax incentives that come from the RECs. So, we put out a solicitation. We knew, we had estimated how many megawatts we could get on a piece of property we own. We actually, again, were very fortunate. We sit on 173 acres and about 70 of that is not used currently by the campus. So I had available land that I was getting paid $100 a year for rent. And so it was an easy – it was a no-brainer for us to look at that.

And so we just went out and said, "What we're interested in is a ground mount system combined with a canopy system." Because we wanted the canopies as a statement piece. The term I use a lot is is the canopies are our show pony, and the ground mount system is our work horse. So that's really where the work gets done. But everybody sees the canopies when they come on. Because we want to start a conversation. And that was a lot of how we went about that.

And we've made the decision as a college that we're committed to sustainability overall. And if we could at least break even with our grid power projections, then we would be happy with that. If we could be able to come back and get a 60 percent savings the first year, and we have guaranteed zero escalator for 20, there's no way not to do this. So it really worked that way.

Rachel Shepherd: Awesome. And thanks. The next question, Emma, can you talk about the tool and methodology re-opt that you talked about? And particularly incorporating optimizing for energy efficiency or energy savings opportunities?

Emma Elgqvist: Yeah. So, it's not a building energy model in the traditional sense, where we can look at energy efficiency measures that way. But we can kind of tap into or work in conjunction with a building energy model, for example, where that tool can provide kind of hourly energy reduction. So kind of a negative load profile, if you will, from the various ECMs. And then also kind of a cost estimate associated with that ECM. And then the tool can determine at what point you go from installing these energy efficiency measures to kind of start installing renewable energy technologies.

So I think traditionally, the school of thought has been efficiency first, and then kind of on-site renewable generation. But it just kind of trying to find where that threshold is is some of the research areas we've gotten into. The other kind of related research is around flexible loads. So, in particular, we've done a couple of case studies looking at for residential buildings, smart domestic hot water heaters and A/C units and quantifying the benefits associated with installing those in conjunction with battery storage and solar, in this case.

And so we've found that with these flexible loads, you can take advantage of additional solar power. You can kind of pre-cool or pre-heat during times of otherwise low energy demand at your sites and low cost periods, so they function essentially, provide some of the same benefit as a battery storage system.

Rachel Shepherd: Awesome. Thanks, Emma. So this next question is for both Isaac and Tina. Maybe, Isaac, I'll ask you first, and then Tina. So we've got a couple of questions around the economics of the project, both for did it incorporate like peak shaving, or demand response? And how did that impact the economics? As well as incorporating kind of maintenance costs of your systems over time in economics. So Isaac, do you want to start? And then maybe, Tina, you want to add after? Oh, Isaac. I think you're on mute.

Isaac Panzarella: Yeah. Sorry about that. Somebody was leaf blowing outside.

Rachel Shepherd: No worries. *[Laughter]*

Isaac Panzarella: *[Laughter]* So, the economics with regard to this particular system, it's really up to GRU to optimize how they manage and operate the CHP system. But for utility like GRU, it's really one of their lowest-cost resources. Because you basically take and can take the thermal that's recovered and credit that against the fuel that you put into the CHP system. Now, I do want to point out for our site that maybe invested its own CHP system and owns and operates itself, it really depends on the tariff that they're operating under.

But we do see some very good circumstances where utilities incentivize sites with CHP, maybe, to run more through either time of use or real-time pricing schemes so that the CHP system can operate when the grid is under periods of higher demand.

Rachel Shepherd: Thanks, Isaac. Tina, you want to add on?

Tina Jones: Sure. So for us, my background is an economist. So that's my training. And so economics is very important for me in this. From looking at the solar, as I said, we look at it from a life cycle cost, as well as the cash flow perspective for the college. And it made it very apparent the only way that we can look at this model was to look at a power purchase agreement. The great thing with our power purchase agreement, it also incentivizes the provider to keep the system maintained.

Because again, they've got a performance guarantee. So they are responsible for all maintenance. They were responsible for the design, the build, permitting, the operation of it, any maintenance. And at the end of the 20 year life, they're responsible to actually take that site back down to its original state. That was all specified in our procurement. So again, that's a leverage for us when we get to that 20 year site, they're going to have a significant cost that they may not want to incur. We're hoping that gives us the leverage to do the next agreement.

Rachel Shepherd: Right.

Tina Jones: So we're always trying to think forward on this. So that's very important when you think about this. Think about the full life cycle cost. We were able to get this with a PPA rate that's fixed. We were able to guarantee what our cost structure was going to be. And that was really, really important. All of us know we can't control what rate the power's going to be now or in the future. None of us – I didn't think I'd see prices at the price they're at right now. But even there, we've had a 25 percent reduction in our grid power price, and we're still saving significant money, in spite of that.

As far as peak shaving, we don't take quite as much advantage of that because we actually are in a purchase with a cooperative. So we actually are working that way to also save energy costs. By being able to go out there and work as a group and leverage our larger buying power, we're able to actually negotiate some of those terms better. So that's something everybody can do, as well, find a cooperative in your area. Figure out how to participate in it. For the other items, we are constantly looking at everything we do.

I can tell you that an LED bulb that we put in our outside lights, our return on investment period is 15 months. We know that. The numbers are actually – the data's gotten so much better that as an end user, I don't have to do terribly sophisticated calculations. And when I know that I want to pay that back and that light's going to last me five, ten times longer than the traditional light that was in there, becomes very easy.

So again, a lot of this is simple math. This is not necessarily very complex calculations. You're doing this on the ground. Again, like I said, we do this with a facility staff literally of four people, and maintain 350,000 square feet, and that's all systems.

Rachel Shepherd: Yeah. Yeah. Thanks for sharing that. And actually, one of the highest-rated questions was just, Tina, your savings rock. So, I wanted to point that out. *[Laughter]* As everyone's pretty impressed with the savings that you guys were able to provide.

Tina Jones: *[Laughter]* Cool.

Rachel Shepherd: So that concludes our Q and A portion of the session. Please don't go anywhere. We've just got a few more minutes of things to cover. So, if we can pull up those slides to the next slide, we'll show you some additional resources. If you were inspired today by our conversation or just want to learn more, please look at this list of resources. You can click on it once the slides become available. These resources are available on the Better Buildings Solution Center, as well as the DOE website. The Better Buildings Solution Center has over 2,800 solutions to help you find proven and cost-effective energy and water efficiency solutions. We've got a short video for you to watch and learn more.

[Video playing from 1:27:12 to 1:28:04]

Awesome. So we encourage you to check out the Better Buildings Solution Center to see more, to get more information. We've got one more poll for those who are able to stay on. DOE is always looking for better information, resources, to make available to help our stakeholders. So when the poll shows up in Slido, we're interested in hearing from you what additional tools, trainings, information would help you in your organization implement successful distributed energy resources.

I'm not surprised by the funding. But that's certainly a good one, as well as training and case studies, not sure where to start. Case studies. That's really important. Analysis tools, data records. These are all really great feedback, great information. All right. Well, thanks for sharing toolkits, as well. This is all really great information. Thanks for sharing. We're going to go to our last and final slide.

So with that, I want to thank our panelists very much for taking the time to be with us today. I want to thank you all for attending and being here, participating in this session. I hope it was valuable for you. Feel free to reach out to us. This is our contact information. I hope you have a wonderful day and we'll see you virtually in one of the other sessions occurring this week. Thank you.

[End of Audio]