Shannon Zaret: Hello, everyone, and welcome to the 2021 Better Buildings Better Plants Summit. Next slide.

Thank you for joining us today. We have a wonderful session prepared and some fantastic speakers. We're gonna introduce them in just a moment, but before we dive in, there are a few housekeeping points I would like to cover so, yes.

So, please note that today's session will be recorded and archived on our Better Buildings Solution Center and so, we'll follow-up when today's recording and slides are made available. And, just so you know, attendees are in listen-only mode – meaning your microphones are muted. So, if you do experience any audio or visual issues at any time, please, send a message through your chat window located on the bottom of your Zoom panel. Okay. Next slide.

So, I am your moderator for today. My name is Shannon Zaret. I am here at the Department of Energy. I manage our Sustainable Wastewater Infrastructure of the Future initiative, and we provide technical assistance to wastewater treatment facilities that are looking to optimize energy efficiency and implement advanced technologies such as renewable energy or advanced data management. And so, if you're interested in that, my contact information, along with the speakers, will be at the end of the presentation. I'd be happy to chat more about that. But, next slide.

Today, we're here to talk about critical infrastructure and resiliency. So, in terms of the agenda, we're gonna – I gave you a little welcome. We're gonna go through a couple more housekeeping items and then, we're gonna turn into the technical presentations covering data centers, wastewater treatment facilities, and then, high security facilities. And then, we'll end it all up with a Q&A session. Okay. Next slide.

So, I'm gonna talk to you today about Slido. If you guys participated in some presentations yesterday, you may be familiar with it – or last year. So, we're gonna be using this interactive platform called Slido. It's for Q&A polling and session feedback. So, if you go to www.slido.com, you can use your mobile device or on your PC and enter the code #DOE.

Once you enter that event code, you're gonna select today's session title from the drop-down menu. So, it should be "Innovative Strategies for Resilience at Critical Facilities". So, if you want to ask any questions, please, submit them in Slido at any time, and

what I'll do is during that Q&A, I'll bring them up. And then, if you have a specific question, you can let me know that you're directing it towards a specific panelist or if it's a question for all panelists as well. So, I'll give everybody a couple of seconds to open that up and select our session. Next slide.

So, this is a good example. This is what you should see when you dial in and get logged in into that. So, again, #DOE, select "Innovative Strategies for Resilience at Critical Facilities". All right. Next slide.

Okay. So, we do have a couple of poll questions up on Slido so, first is – what sector are you from? So, go ahead and start filling that out. Oh, we've already got a good rate coming in so, it looks like we've got quite a bit from the government – state and local sector – with contract service provider taking up a good strong second. All right.

Perfect. Okay. So, we'll go to the next question then.

All right. Poll two – where are you joining us from today? I got a lot from Virginia. That's coming in big there. All right.

Florida. All right. Great. Washington. Okay.

Well, it looks like we've got a pretty diverse group with us today. That's great. All right. Well, I'll move then to our final poll.

Okay. And then, what critical facilities do you guys work with the most? All right. We've got a lot – whoa. That was getting interesting there.

Okay. Good. So, people interested in learning more. We've got wastewater treatment – that's great to see. Hospitals, emergency management – all right.

Got a good mix. All right. Perfect. Well, I'm gonna then move to our next slide.

All right. So, again, if you have any issues – audio/visual – make sure you message our tech support by using your Zoom chat function. Okay. So, now, I'm gonna go into introducing our panelists, and I want to thank them for being with us today. So, we've got Jim Henry from Iron Mountain Data Centers, Jason Grant – Miami Dade County Water and Sewer Department, and Chris Halpin – NV5 Energy Efficiency Services. Okay. Next slide.

So, now, we're gonna start off with Jim from Iron Mountain Data Centers. So, Jim Henry is the manager of global compliance in Iron Mountain Data Centers and leads the division's enterprise information security, energy, environmental, and health and safety management compliance programs. Jim is primarily responsible for enterprise compliance and risk management, but also leads the overall program management development of the ISO 50001 and ISO 14001 certified energy and environmental management systems and sustainability programs. Now, I'm gonna let Jim take it away.

Jim Henry: Hopefully, everyone can see me and that worked well. Thank you, Shannon. I know that was a mouthful to read off, but there's a lot to unpack in data centers. And what's really interesting about this session is that data centers are both resilient facilities when it comes to needing to be on all the time; we're also facilities that need to be really energy efficient, but then, we're also super high security, especially at Iron Mountain. So, there's a little bit of a cross with other realms there.

What's often kind of interesting also about just my position at Iron Mountain is I'm an info sec guy by trade. So, information security, information systems auditing – that's kind of where – the world I came from. And I had expertise in the ISO standards that many of you have probably heard of. There's an ISO standard for really, everything. So, you know, when you look at Iron Mountain Data Center, the program that I've implemented here over the last roughly five years, we've got 14 facilities across 4 countries.

We're in the United States. We're in Singapore. We're in Amsterdam, the Netherlands, and we're also in the UK. We're also always expanding so, that list will look different next year. We are globally certified across all sites in ISO 50001, which is the de facto energy management standard, and then, we're also globally certified in ISO 14001, which is the environmental management standard.

So, those cross paths quite a bit. I'll talk about that in a couple of slides. But those are great ways to start to unlock your real potential energy management and environmental management, really, in any sort of organization. They're very flexible. If you've worked with ISO standards before, it's really easy to identify how those can help an organization push their efforts forward.

And, with that said, it's also the same in – like I said, data center is very high security. As far as an industry goes, we demand availability, integrity, confidentiality of data for at least what we handle, so, we're also globally certified in ISO 27001, which is information security management. We have a couple of other things implemented as far as ISO – you know, health and safety from a security standpoint. We're compliant with NIST 800-53, the FISMA High level. Everyone on the federal side will recognize those terms.

PCI-DSS with _____ card industry, HITRUST for security, SOC 2 and then, HIPAA. And the reason I mention all of these is because when we talk about resiliency and things being on all the time – and I'll get how that relates with energy management – but it's important to remember that we have to be resilient for a reason. It's because we serve all of these industries as data center providers. We're serving the health care customers, the hospitals, right? The federal facilities, different government agencies, technology companies, streaming and software providers.

So, there's really a lot that goes into what data centers do. Next slide, please.

So, what is a data center? For those of you who don't know, we're basically big boxes with a lot of servers that use a lot of energy, and that's the simple answer. But really, what data centers do is they power innovation. Quite literally. We power innovation.

What I mean by that, to just unpack it a little bit, is that any time a new application or a new software or a new streaming service is developed, you need infrastructure to support that, whether it's gonna be hardware that you're physically managing on prem, or it's in the cloud. I've often told my wife and my family that really don't understand data centers, "We are the cloud" right? When you think about the cloud, it exists somewhere, and we are the cloud. There are certainly a lot of data center providers out there. We're in the corner of the box that's called collocation so, we actually don't touch customer data, but we house their servers and make sure that it's always secure, always on, and – for Iron Mountain Data Centers – always green.

And that's one of our key messages that we put across – is that we really mean what we're doing, and we have a passion for it, which plays into our environmental and energy strategy. So, we provide power and internet connectivity for our customers for their IT gear, like I said. Racks and racks of storage arrays; any compute power,

any disaster recovery power to make sure that things are up and running all the time. And I guess a good segue to that is, you know, we're securing highly confidential information, ensuring that availability is at 100 percent all the time. I'm sure a lot of folks have been frustrated, perhaps, when, you know, streaming services go down.

Let's say it's late and you're watching Netflix and, all of a sudden, it just starts buffering. And it's buffering and buffering and buffering and you – let's say you go to Hulu and it's buffering and buffering and buffering. Could it be an internet outage – like, the fiber got cut somewhere? Sure. But I would say, 50/50 – maybe 75/25 – the data center's having a problem.

And when you think about resiliency, streaming services are important to comfort of life, but as far as criticality of life, hospitals, health care centers, and other things – critical infrastructure such as power grids and wastewater treatment plants – rely on data centers to keep some of the necessary functions of their actual function alive. So, like I said, we also cater to the business continuity disaster recovery purposes. So, if you have a production data center, you might have a disaster recovery or a business continuity plan that includes having an alternate site – you know, a hot site or cold site or warm site – however you chose to do that, and as far as sectors go, you can imagine anyone's in a data center. Tech and entertainment, hospitals, banks, and finance – of course, that's critical infrastructure as well – telecommunications, government, and other regulated markets. So, in the photos here, you'll see pretty much what a data center looks like, and I'll talk more about this over the next couple of minutes.

Lots of wires, right? Lots of cabling. Tons of copper. Tons of racks. Tons of air moving about and then, tons and tons of metrics and monitoring.

So, the shot on the far right of this slide is just a look into what a network operation center looks like at face value. It's like a space age sort of photo I guess you would characterize it as, but there's a lot of monitoring that goes into making sure that things are operating, at all times, the right way. And I'll talk about that in a couple of slides here now, too. So, next slide, please.

So, what do we actually do to improve energy in these data centers? Because one of the interesting things to talk about for this group – and folks who are really into energy efficiency – is that – and this is a ubiquitous stat that you'll hear from data center folks –

they'll say, "The data center industry uses so much energy that we're surpassing the entire airline industry in global emissions." That's true. However, the way we build things as an industry or as a society uses many more emissions. So, the energy part of it is essential, but also managing your environment, how you build things – what your supply chain looks like is critical to the overall picture.

So, that's part of our strategy, right? We understand that energy and electricity and emissions from diesel generators and natural gas for comfort heat is certainly an issue to take head on – and we have. Iron Mountain – our entire data center portfolio is powered by 100 percent renewable energy, and we pass that on to our customers in a program called Green Power Pass so that they can then green up their data center footprint, because a lot of the times, scope 2-3 emissions are really heavy in those sustainability reports. But other than that, what do we actually do to reduce the amount of electrons that we're using, right? Often times, even though folks will say, "Yes, we use renewable energy. We have onsite renewables" – the greenest kilowatt is the one that you don't use.

So, I've a couple of examples here. As far as data centers go, a lot of it revolves around air management. So, on the far right of this screen, you'll see some testing of containment at one of our new data centers. This is one we built – one of our data centers out in Phoenix, Arizona. We partner with many companies to see who can contain our air the best, what's the most efficient – of course, cost effective – and then, also, what's scalable?

What's strategic? What can we put in the data centers that actually allows us to keep hot and cold air from intersecting? And then, of course, making our equipment run harder. You don't want fan speeds to be running full bore all the time because, of course, then they're gonna be using more electricity. So, let's think about where we put the air.

So, there's a couple examples of cold and hot aisle containment here and then, on the far left, what you'll see is geothermal cooling at our underground data center in Western Pennsylvania. There's a couple more pictures of this on another slide – I'll talk about it some more – but there's some innovative strategies out there. Can everyone build a data center 220 feet underground in Pennsylvania and use an existing lake that's underground as part of the natural water table? No. But the opportunity is there, and we use that to cool our data center in a close loop system.

The relative temperature of that water is about the same, due to the fact that when you're that far underground, it's about 57 degrees year-round. We also use free cooling. So, you'll see some of the photos here at the bottom of just general infrastructure, right? Chillers, air handing units. We've got the CRAH unit on the far right.

That's a Computer Room Air Handler. The generator's in the middle. We do try to source the most efficient equipment that we can. And then, of course, how do you monitor all that? Next slide, please.

And these are the photos that I promised of the underground lake that serves the Pennsylvania Data Center. I threw this in here because it was super cool and I'm gonna talk about this data center in just a minute because the resiliency factor is super important. You know, people go to data centers for disaster recovery, security reasons, and putting a data center 220 feet underground is, believe it or not, super secure and super resilient because it's totally impervious to external things like earthquakes, tornadoes, storms, and things like that. But let's talk about resilience. Next slide, please.

So, one of the things that I like to harp on is even though ISO 50001, as an implementation tool or an implementation standard, is great for energy efficiency, it also offers a lot of benefits around resiliency. So, even if you have no knowledge of ISO 50001 right now, if you look at the standard, it makes you think about what goes in to powering your site or facility or your plan or whatever you have. You must know and review relevant variables affecting things called SEUs or Significant Energy Users. That way – and I'll show you on a diagram here in just a second – I'm trying to be gracious of time as well; I know I'm coming up on time – that way, you know where your energy sources are, what they are, and your dependency on them, so that in terms of resiliency, you can identify, perhaps, "Okay. Our diesel generators – we rely on them this much every year, so, let's plan on stocking up on fuel."

Or "Let's plan on maybe look at hydrogen, because we don't use that much diesel and hydrogen's an innovative solution that'll cut emissions." So, there's different ways of thinking about how you characterize your SEUs. There's an increased emphasis on the SEUs that impact you the most. So, if you're using steam power, for some odd reason, as most of your significant energy use, you're going to have to reflect that and saying, "Okay. Actually, what are you doing to maintain those components? The chillers, the air-

handing units – are you doing routine maintenance on them? How are you making sure that they're operating at optimal energy efficiency?"

But then, also, that translates into reducing risk. So, you think about risk as an input for the energy management system. And then, of course, monitoring equipment for energy performance and forecasting energy performance – that'll let you know kind of what these components are doing. If you have proper monitoring – like a building management system – it'll tell you when things are failing, when things are in alarm, when things need maintenance. So, when you have a fully baked out computerized maintenance management system paired with a building management system, it'll give you a lot of the inputs that you would need to start developing a business resiliency plan for your infrastructure.

And then, of course, the standard – the lovely thing about it – is that it requires top management involvement as a requirement to continually improve. So, you're going to need to engage key stakeholders across the organization that have the wherewithal and the influence to make these things happen with you. So, that's, you know, just a quick shot of some benefits. Next slide, please.

So, this is kind of what redundancy in a data center might look like. You know, this is a block redundant design. So, you'll see at the bottom, you've got data center racks, and then, upstream, you've got power distribution units, and then, upstream, you've got some static transfer switches. Then, you've got some bypasses, because you're not always using UPSs – of course, that's only when you need to go off of utility and transfer to backup power – and then, you've got UPSs further upstream, the actual UPS themselves, main switch gear, and then, of course, you know, your generators would be tied into this switch gear, that way, you can go to backup power. So, the reason I show this diagram is not just because I want to talk about how resilient data centers are and how you could lose utility power – even lose a PDU, lose a UPS – even, in some cases, lose a generator and then, you have the middle diagram, which is your total redundant block, right?

Redundant generator, redundant switch gear, redundant UPSs – it's not really to talk about just how resilient we are; it's to talk about what 50001 will make you think about. So, if you're a data center, you're going to be tracking your energy use, usually at the PDU level, for your IT load – you know, what the servers are using – or, at the output of the UPSs. That's a pretty good measurement. Line loss isn't too bad there – down to their actual racks themselves –

but these quick little thought bubbles are what you're actually tracking. Utility, how much power's coming into the building, and then, how much diesel you're using when you're going on backup power.

How much should you plan to have on site for an outage? With your current load on the building, how much diesel do you need to run for 48-72 hours? Those are determinations that mapping things out like this will – that'll really help. And 50001 kind of makes you think about that. These are significant energy use components, just like UPSs.

So, you can track the actual use of these different components that will give you metrics to look at, and then, the top management side of it will be more aware of where your risks are so you can become more resilient if you don't have a setup that's actually appropriate for making sure your business can stay on when things go sideways. Next and last slide, please.

So, just to kind of cover this – and I know I've been talking a mile a minute – the benefits of resiliency and business continuity planning while being more energy efficient are really endless, but some of the main ones that tie directly to like, ISO 50001 – because I'm the ISO compliance and standards guy – are that you can operationalize incident issue corrective action reporting for significant energy users, and you can trend that over time. So, if you're having incidents happen with components and things like that, start tracking them. Because the standard itself actually forces you to have a corrective actions process. You can track the components of the SEUs – like the UPSs, the PDUs, the generators – for adequate maintenance activities and maintenance scheduling so you can have replacement plans for parts, reduce risks, and then, you can forecast those things so that capital intensive projects – they don't pop up out of nowhere. And that'll really help management make determinations for you.

Energy performance indicators are valuable for both energy reporting and risk management. So, these are things that the board's gonna care about. These are things that your stakeholders are gonna care about in any organization or any agency. Predicting energy use can quantify uncertainty and risk. This is a large one as well, because within the standard, you do have to project your energy use, depending on what your scope is.

You'll need to look, perhaps, a year ahead and determine, "Okay. Based on what we were doing in the past, what kind of formula

have we come up with to amalgamate what next year is gonna look like?" It can also serve as an excellent gap analysis for mergers and acquisitions. So, if you're in a business like I am, you may use 50001 and the methods that go into it to determine how prepared an organization might be from a resiliency standpoint. You're looking at the infrastructure the mechanical, the electrical components, and you're looking at how things work and what they're using. And then, again, adopting the ISO standard for 50001, just like any other standard, could be a nice gateway to other valuable standards like 14001 for environmental management, ISO 22301 for business continuity management, or 45001 for health and safety management.

And trust me when I say this – more and more folks are gonna be concerned about business continuity after the year that we just had. And, of course, discover opportunities for improvement, raise concerns to leadership, and reassurance for containing operations during periods of stress – and that is the key to risk management and business resilience. So, all of these points will feed into it. I encourage anyone who hasn't looked at an ISO standard to break one open. 50000's my favorite one. It's flexible. It's scalable.

It's not hard to get management buy-in when it comes to rolling out a program like ISO 50001 because it does have benefits for the financial side of the business, the operational side of the business, the scalability of the business, and then, of course, the resiliency of the business. So, with that, I'll close and pass it on.

Shannon Zaret: All right. Well, thank you, Jim. We appreciate those insights and feedback and outlining the benefits of strategic energy management and resiliency planning. It segues nicely into another sector that benefits from strategic energy planning and so, we're gonna introduce Jason Grant, who is with Miami-Dade County Water and Sewer Department. Doctor Jason Grant is the energy management analyst for Miami-Dade Water and Sewer Department.

Currently, he manages energy policy and energy related sustainability initiatives. He is a certified energy manager, distributed generation certified professional, Envision Sustainability professional, and has extensive ASHRAE industrial energy audit experience. As an adjunct professor lecturer at the University of Miami, Doctor Grant teaches Facilities Operation and Management and Introduction to Industrial Engineering. Jason, I'll turn it over to you now.

Jason Grant: Good afternoon. Thank you so much, Shannon, for moderating this wonderful workshop, and thank you, Jim, for an awesome lead into the resilience workshop today. I learned some great things from your presentation. Today, I'll be focusing on the utility aspect of resiliency and really, how it plays in the utility infrastructure and how we adapt to our approaches. And here, you know, it's really this term, right?

"Operationalizing Utility Resilience". It's almost becoming a basic hygiene, right, with resilience and how different firms operate. And I think Jim stated that exactly correct. Next slide, please.

So, Miami-Dade WASD really has over, or last couple of decades until we adopted our resilience division and really started looking at energy management in more of a holistic – from a holistic approach. It was really ad hock approaches to energy efficiency projects or different silos of operations – whether it be the wastewater treatment plants or the water treatment plants – perhaps, you know, a motor efficiency program or lighting, you know, some particular process improvements – but we really lacked the comprehensive approach of an energy management system. And those were effective, of course, but, as we proceed into the next segment of our resilience approach, we're gonna look more into a 50001 approach and an energy management system approach. We have had some very good successes – like, with our cogeneration. We have about 13 megawatts of cogeneration capacity using our biogas from anaerobic digestion.

The capacity that we have is actually more than we can utilize at the moment because of our interconnection agreements with the utility and we're working on those to remove that barrier. We also had some consent decrees and ocean outfall legislation, which required us to do some upgrading on our digesters and adding fog facilities and stuff like that, which will add to our biogas production. So, we'll actually get a lot more renewable biogas over the next several years and, of course, with the cogeneration, we use the waste heat for anaerobic sludge digestion. Here at WASD, we also use EnergyCAP. It's the utility billing management system – an excellent software program for collecting data from our utility bills, specifically electricity, and we use that to do all sorts of analytics from our electrical consumption.

Now, these are monthly bills, and our next plan is to integrate real-time and ongoing data logging through smart meters and such. But the EnergyCAP system is great for doing overall analysis, and we're beginning to integrate both natural gas and diesel

consumption, propane – all sorts of fuel sources into that system so that we have it all in a centralized location. In the past – I guess it was a couple of years ago – we finished the SWIFt Accelerator from the US DOE. As part of this SWIFt Accelerator, we developed a wastewater energy master plan. Within that, we really focused on developing energy management system approach and using the 50001 standard. Next slide, please.

So, as part of that approach, the first thing we developed was this commitment statement for energy policy, and we really wanted to focus on the 50001 in developing and energy management system. We wanted to basically extend all of our initiatives for energy management, energy efficiency, conservation – even security – and get it entirely down throughout the organization to every end user. We supported this by adhering to and reviewing performance targets for all programs for conservation energy, integrating energy conservation in the planning, and operating decisions for informing training and making all employees accountable. So, what we really tried to do was to get this down to the end user level and make it a cultural adaptation. Also, we wanted to integrate renewable energy adoption for the long term.

This does well with the mayor. The mayor is initiating a climate action plan for 80 percent reduction of carbon emissions by 2050 so, renewables will play a major part, and of course, we have energy performance indicators to evaluate our progress on an ongoing basis. And it's a continual plan/do/check approach so, it's a continuous improvement methodology. Next slide, please.

So, the Miami-Dade WASD Resilience Division is comprised mostly of our three programs. We have our Resilience Program managed by Debbie Griner, our Energy Efficiency Program that I'm in charge of, and also, our Water Use Efficiency Program managed by Patrick Martin. And with these three, we have a comprehensive approach to our resilience here at the utility. Asset management, of course, plays a major part with cyber security and emergency communication and response as well to really operationalize our efforts with resilience. Next slide.

So, why resilience, really, with the water utility? You know, as with all other water utilities, many challenges are similar. I think we face some challenges that are slightly different. Being a coastal water utility, we're gonna be facing sea level rise in the next couple decades. I think the forecast – the NOA forecasts are about 3 feet by 2050, which will have a considerable impact on our plants.

Our wastewater treatment plants are on the East Coast of South Florida because we used to do _____. So, they replaced there, but with the sea level rise, that's playing an impact. And, as we move forward with plant expansion, we have to take into consideration future modeling, you know – how high are new buildings to be, reinforcing, flood-proofing, and making our existing resources more resilient. Also, saltwater intrusion into our aquifer is another problem with sea level rise. Our wells, on the East Side, have had to be abandoned for the most part.

Fortunately, most of our water comes from the aquifer and is tapped off the west side of the county, but that sea level rise will have an impact over the long-term, so, that's something we must consider. And I think the natural disasters, of course, with the hurricanes – hurricane management – that's another unique prospect for Miami-Dade Water and Sewer to deal with, and we look to build up a resiliency with energy redundancy and all sorts of upgrades to our infrastructure to endure those storms that come through. And the rest are typical challenges faced by most utilities. Workforce attrition, of course, as our workforce ages is an issue that we need to deal with, and our precipitation – just due to the local environment, our tropical weather patterns, really contributes to INI, and we have to deal with that. Next slide, please.

So, qualities for a resilient utility really include reliability, redundancy, reduce, reduce, reduce, right? Reduce your energy, its costs. Reduce carbon footprint. Regulatory compliance is our foremost objective with safe, healthy, drinking water and wastewater treatment so, that's always on the agenda at the top, but comprise of other components like reliability, redundancy, and reduction. Data-driven decision-making really is at the forefront now.

It's big data is a challenge itself. We do well with many aspects of our business, but especially with energy data and energy efficiency, we're trying to get a handle on real-time acquisition of data and be able to do forecasting and analytics to drive our energy efficiency. Next slide, please.

Okay. Increasing infrastructure resilience. Here, we are part of the 100 Resilient Cities, and there, we conducted many workshops for vulnerability analysis. We did some planning scenarios there. In our Envision Rating System, the county has adopted that all new construction is to be silver, and we've tried to adopt that process to all new pump station project construction and buildings that are at our treatment plants as well.

There's groundwater modeling and renewable energy is something that's really exciting here at WASD. We're looking into floating solar on our lake beds and our water retention ponds. Energy efficiency, of course, is part of our energy management system and 50001 approach, and we have advanced metering prospects with AMI on the water side, and our capital improvement plan, which is comprised of about $8 billion over the next decade, and, of course, all of our integrated technologies. Next slide, please.

So, some practical outcomes that we've had with energy efficiency – our cogeneration has been very successful. We've had many successes with plant process management – primarily flow-based – and we've been able to measure and verify these over the last several years. Other specific processes – whether it be water treatment or pump station division or wastewater treatment. We've incorporated equipment standards for efficiency and procurement stuff, and then, of course, our EnergyCAP with the utility billing management system. Next slide, please.

And, to wrap it up, WASD really has benefited a lot from the US DOE. We participated in a cogeneration accelerator about five years ago to advance our eight-megawatt build up at our South District Wastewater Treatment Plant. We participated in a SWIFt accelerator to develop our infrastructure energy plan, and then, lately, we joined the Better Plants as a partner in 2019 and established our baseline for 2019 and that's well under way. There, we intend on reducing our energy use intensity by 25 percent over the next 10 years, which is great for the department. And as part of that Better Plants partnership, we've now initiated participation in the ISO 50001 Ready Program, and that really gets back to our development of the energy commitment policy statement and our 50001 approach to energy efficiency and resiliency with regard to energy, and we're gonna start that program at one of our water treatment plants in the next couple of months.

And then, of course, there is in-plant training that we participate in. We work, conjunctly, with the University of Miami Industrial Assessment Center for energy audits at our water treatment plants and our wastewater treatment plants. So, there's ongoing engagement with them, and also, the Florida International University. I think we do some research with them as well. Thank you so much and I appreciate your time today.

Shannon Zaret: Thank you, Jason, and that last slide really highlights the opportunities in partnering with the DOE, and I appreciate that.

And for all of our private and public sector partners out there, if you could benefit from technical assistance on implementing some of these strategic energy management approaches and principles that we're talking about in the sessions, please, do reach out to us at the end. I'll have my contact information. I'll put you in touch with the right group. Through our Better Plants and our SWIFt initiatives, we work pretty heavily with the 50001 Ready Program, and so, we would be happy to talk to you and help you, if we can, incorporate some of those ideas into your energy management plan.

Okay. Well, thank you, again, Jason. And so, we're gonna move on to talking to Chris Halpin. And so, Chris has worked for several premiere energy consulting firms and ESCOs in engineering, management, and sales, and is a former Global Energy Manager for NCR. Since 2003, he has been a FEMP-certified facilitator for DOE's Super ESPC Program, where he's managed over $2 billion in projects for all branches of the US military, DLE, VA, GSA, DOE, FDA, and FBI.

His group also manages ESPC projects for nine states, dozens of universities, hospitals, and school districts. He is currently working on public/private partnership energy projects and resilience microgrid projects for several clients. In 2018, his firm, Celtic Energy, was acquired by ND5 Global, a large, multidisciplinary engineering and technical services firm. And so, with that, I'm gonna let Chris take it over.

Chris Halpin: All right. Can you see me and hear me, Shannon?

Shannon Zaret: Yes.

Chris Halpin: Okay. Great. Good afternoon, everybody. Thanks for joining. And Jim and Jason did a great job lead in and talking with a lot of issues and challenges I'm gonna talk about here.

I'm gonna try to be quick, 'cause we only have about 20 minutes left. So, what I want to focus on is talking about critical facility resilience and energy management and how they work together naturally. And you've already heard some of this – both Jim and Jason. What I want to focus on is using energy management strategies consisting of whole system thinking, which has been around a fair amount, a fair while, and integrated design approaches, which sometimes get used, but often do not. There's a lot of ad hock work that gets done.

And mainly, using those two approaches to reduce loads in your buildings – especially in critical facilities – make your building operating profile more nimble – using things like demand response so that as there is either a natural or man-made disaster or just a really hot summer day like we saw here in the Southwest last summer. There were calls for shutting off cooling or changing temperatures in four states over a few days. And ultimately, once you've got those buildings, those facilities more energy efficient and more nimble to be able to respond to market signals and so on, then, really consider renewables and battery storage as a backup. Look at this graphic here. I like to think of it as making your facilities more energy stealthy.

So, these bombers, made by the US government, look like seagulls, basically, on radar to our enemies, right? So, you want to try to do that with your facilities when you're looking at energy efficiency, and especially climate change, and try to make as small as target as possible. Like Jason was saying about their plants – they're trying to make them as efficient as possible so when they do some _____ _____ and things like that, it allows you to have less work to get to the same end product, and ultimately, to mitigate your future energy risks. Next slide.

So, some of the things that we see in hazards for any kind of facility, but especially critical ones, are these black sky hazards, things that you really cannot plan for, but you have to really think about. They're all from natural ones like we've seen – you know, the February cold snap in Texas, fires in California, the flooding in Nashville last year, and even – I had the slide decks in just a few weeks ago – before the Colonial Pipeline cyber attack, which would show, yet again, how vulnerable our infrastructure is. Next.

So, pretty much everybody has to think about this, right? This is a Design Basis Thread Map, and you can see everywhere from, you know, Boston to LA – and this doesn't even include Alaska or Hawaii – it's something that's prevalent in our life every day and really needs to be thought about and planned for. Next slide.

So, how do we do that, right? So, what I've seen a lot of – and I've been at this since 1985, right? I've seen a lot of things come and go, a lot of approaches in the energy efficiency business, especially – and now, more and more in the resilience business – is we're starting to slowly see a trend going from first, cost-based ad hock sort of fighting fires, if you will – putting out fires with hoses and people just running around – but what we really need to be doing is doing a whole system thinking-based approach. But you look at

this graphic – you know, if a fuel-input power plant's at 100, by the time it gets to you in your facility, that's less than 10 percent of that energy is available. It all depends on the efficiency of all those systems and equipment in between.

But if you do something like cogeneration – like what Jason was talking about – that cuts a big chunk of this out, right? That's one way to control it. In order to really do this, you have to follow the processes and not just think about the end use, but everything behind that, where it goes – sort of an outcome-based planning, right? So, we say, it's, "To leap forward, think backwards". And this is all courtesy of E Source, which is a great source for a lot of this stuff. Next slide.

So, one of the ways that this gets done – probably the best way – and then, this is really something that's championed – has been championed by Amory Lovins at Rocky Mountain Institute for 40 years, right – is the Principles of Integrative Design, right? People aren't interested in megawatts of electricity, coal, gas, all that. They want hot showers and cold beer, right? That's the end of the day – a kind of fun way to think about it.

But whether it's data centers, water delivery – treating the sick that we've seen is of paramount importance the past years. Every single critical facility can follow this process using integrative design. That starts off with getting everyone on the same page. You really have to have sort of an integrated design workshop or "charrette" they're called, if you've done the lead work for Green Globes. Charrettes are a big part of that.

That's getting everybody that is a stakeholder in the process – from the architects and engineers to the owners, to the folks who are gonna be running these buildings – on board at the beginning to put all of their ideas forward early before you start to build anything, right? Get everybody on the same page. Think about things where you could have multiple purposes, right? So, we think about a single expenditure for multiple benefits, right? They can use – water tanks they could use for fire suppression can be used for heating and cooling your buildings, right?

Like the underground lake that Jim was talking about that Iron Mountain uses – that's been done by Cornell, say, for 30 years. Those are the kinds of things that really need to be thought of when you really want to be resilient and energy efficient. And, as I mentioned earlier, making efficiency first, right? The most important thing you can do – and the cheapest, by the way; that's

why energy efficiency is called our first fuel, 'cause it's cheaper than renewables by a long shot, even though renewables are getting cheaper – way cheaper than battery storage – which, you know, it's getting much cheaper. Costs are down by 70-80 percent in the past 5 to 7 years, but efficiency is still way ahead of all supply side, really, and you can handle other issues, right?

Deferred maintenance, making things more monitor-able, and really, operationalize. It seems to be the theme word today. Capitalize projects that sort of sit on the shelf for many years. Another thing to think about is past the design. Recovering wasted heat, right?

If you have an air conditioning system that it gives off heat in the generation process, reuse that to be able to reduce the load in the building. And really aim for the sweet spots. I've seen a lot of designs over the years – again, I've been at this for a long time – a lot of systems are designed for the absolute very hottest or coldest day, right? And the systems are optimized for that versus, you know, that 70 percent of loads – say, in cooling – is where the system spends half of its time. So, that's where you want to really design the most efficient spot in a system, right?

And you're always gonna have those outlier days where it's 105-110 – at least out in the Southwest where I live today – but those are the kinds of things that end up costing a lot of money and have very little pay back. One of the ways of seeing this very clearly is optimizing the cost of ownership over the first cost, right? You value all the benefits. I've seen this – especially in public procurement over the years – that they put out bids, cut projects – and usually, it's the high-quality heating, cooling, and controls that get cut out of a building. They'll still have the nice architectural elements, but you cut a lot of the mechanical out of the building and then, that's the stuff that uses the energy and increases your risk for both climate change and resilience over the next 40 to 50 years.

So, that really needs to be thought about and integrated. And look at the total lifecycle cost of all of the features of a building and don't just look at one. Look at three to five at a minimum. And the last topic is really – don't cherry pick, right? We've seen a lot of these things where, "Oh, we're just gonna do our lighting in our building."

I'll show you an example in a few minutes where that got done for years and years and it's really wasting an opportunity to bundle a

low payback measure like that – you know, a three to five-year payback measure – with stuff like cogeneration, new boilers, new chillers, new windows that are the 10 and 15 and 20-year payback. By putting them together and bundling these sort of things, that's where you really are going to stand the best chance of having your organization really hit its marks for both efficiency and resilience. Next slide.

So, what kind of tools can you use for this and where you can get money to do this, right? And Department of Energy is a fantastic source of a lot of this information. If you're a fed, you can use this Energy Savings Performance Contracting that was mentioned at the beginning. It's basically very high-quality focused design build of energy projects – both supply side and demand side – over a long term – usually 15 to 25 years – where most of the risk is put on the developer, right – on the energy services company. But it has to be done well.

That's something we do for a living – is manage these kind of things for DOE and a bunch of other agencies. As well as you can work with your local energy provider, and they can write a contract with you to do a very similar thing. If you're a federal site, you can use enhanced use leases where you basically grant the use of some land to do solar and battery storage to a third party. You can look at energy as a resilience and energy as a resilience. That's becoming bigger and bigger every day.

And these are all live links. When you get these slides after the presentations, you'll be able to click on these and go to these sources. And if you are a fed, contact your Federal Project Executive and they can fill you in on all of this information. If you're not a fed – if you're a business or you're a state or local government AG, NGO, hospital, or whatever the case may be – school district – your state energy office is one of the best sources of information for this, right? And each state has one.

All the territories have got one. You've got the National Association of State Energy Officials. That's another great organization that works closely with the state energy offices and the energy services marketplace to develop programs and provide guidance – technical support and guidance. If you're a state energy official and you want to look at doing more energy services projects, the Energy Services Coalition – which I'm on the board – is a non-profit consortium of state energy officials and energy service companies and other third parties like myself and financiers and so on that are promoting the use of performance

contracting energy as a service and all these other alternative financing schemes around the country. So, now, if you're in the commercial real estate sector, Commercial PACE is your new best friend.

That's a way to do all of these things we're talking about and pay for it through your property taxes so that it goes to the new owner if you sell your property, which is a big, big hurdle to efficiency and renewables in the commercial real estate space, 'cause people don't want to put that money into facilities if they're gonna flip it in two to five years. So, here's a way to get around it, and that link will take you to PACE Nation, which is sort of the source for a lot of this information. And anybody can use FEMA's pre-disaster mitigation grant program. A billion dollars just got dumped in this program a few months ago. So, instead of waiting till a Hurricane Katrina and then, spending billions, you can go to FEMA ahead of time and get millions that prevents the expenditure of billions down the road.

And then, if you happen to be in a rural area – which most of this country is – you can use USDA's World Development Energy Programs. They'll give you low-cost or no-cost interest loans to be able to do efficiency and renewables programs in your facilities. And there's more and more, but this is enough.

Okay. So, here's one case study, which is about all we have time for. So, this is a project we'd been working on for a contract with Defense Logistics Agency. We're helping the federal government, on a third-party basis, act as an owner's rep on about 40 different bases in the US, Asia, and Europe. This project was just awarded in – I think it was 2019.

They're just finishing up construction. It's what we call a Super ESPC project financed over 22 years. It's about at 16–17-year simple pay back. It includes 900 buildings and 5 bases, right? So, this is like a portfolio look as opposed to doing it individual building or individual base.

You're doing it across five bases using that economy of scale. It's creating $280 million total cost savings, right? That's all of our tax money being saved. It's reducing energy use by 24 percent on the electric side. That's what I was talking about – reducing your footprint and being more resilient because you're a smaller target, if you will, which works perfectly for a military base.

And they're gonna be spending $134 million or so in energy infrastructure improvements to enable all of this, right? Which it's all gonna be paid for by savings. Zero dollars out of the owner's pocket, right? Zero dollars. It's gonna be paid for out of their savings over time.

And finally, what they've been able to do is include 20 megawatts of photovoltaics, combined heat and power generation on these sites, plus 4 megawatts – which equals about 8 megawatt hours of storage – in batteries and microgrid control systems. And all of this together is helping them really achieve energy security, which is absolutely imperative for defense facilities like this. Next slide.

So, here's some of the things that they've done that I really like, that we need to see more and more of. Like, most projects like this you'll see over time – lots of lighting upgrades. Of course, LEDs – that's the de facto, you know, king of lighting today. Not only is it gonna save money, but it reduces the cooling load, increases the light quality, comfort, and productivity – which is really important as everybody's getting back to facilities now full time. We want to make them as conducive to productivity as possible, right?

Upgrading controls makes the most sense, right? A lot of places put a new HVAC in, but they don't control it properly. Here's a way to eliminate a lot of the obsolete systems. Attack deferred maintenance. Improve the HVAC systems and then, monitor it over time.

So, you can prove that you're complying with CDC guidelines over time now, for the next 20-25 years. And then, _____ thermal storage – which is basically creating the cooling and heating at night, using it during the day when the prices are high, right? And it really extends your resilience by multiple days by doing this as well. And then, once you do all these sorts of things, then the icing on top is this on-site renewable energy generation, right? Or offsite using PPAs, virtual net metering, and so on.

All of this together really enhances the energy security resilience admission assurance, but also provides other intangible benefits like shaded parking for the soldiers and others that are on these bases. And it shows environmental stewardship. So, this is an example of what I see most projects going to over time. Next slide.

All right. So, that's pretty much it. It was drinking from a fire hose, sorry. A lot of information in a short period of time. Thank you again.

Shannon Zaret: All right. Thank you, Chris. All right. So, now, we're gonna transition into our Q&A session, and so, for those – as a reminder for those who joined us a little late as well – we are using Slido.com for Q&A. So, you just go to Slido.com – again, put #DOE in there, and then, select "Innovative Strategies for Resilience in Critical Facilities" and I'll try to get through as many questions as we can.

But, again, we have contact information for all of us. If you want to follow-up after the call or the presentation, please do. And so, I'll get started right now and let you guys know if it's directed for all panelists or just one in particular. And so, I'll do our most popular. So, this is for all panelists. "Where do passive strategies play in the realm of critical facilities? Are there any successful case studies of solar, pre-heat of ventilation, air, *et cetera*?"

And we can start – you know, we can start with the first – Jim, if you have anything, and Jason and Chris?

Jim Henry: I mean, I think for the data center industry, this one's a little tough. I think we're probably so wrapped in resilience as kind of a – and I know there's another question about what does resilience really mean to us. We can get crafty with some of – you know, passive strategies and things like that, but I think one of the agents of change that'll need to happen in the industry is customer expectation – that data center customers would have to be comfortable with these strategies, too. Because from a risk perspective, we're often times an agency or an organization's highest risk vendor. So, any time we make any changes to the way that we operate the building from a utility or a backup perspective, it's under a little bit of scrutiny.

Recently, too, Microsoft has announced that by 2030, they'll eliminate all diesel generators from their data centers. You know, that's something that, I have to admit, is probably giving people some heebie jeebies because it's new. You know, they'll be using hydrogen rather than diesel so, any real strategy of change that we make in data centers – it's kind of gotta be something that's at least accepted by the industry, first. So, that challenges us, but, at the same time, it's a change that needs to happen. So, even though there's not anything active I can talk about, I think that's the challenge with it.

Shannon Zaret: Great. Jason?

Jason Grant: Yeah. I would have to say – I mean, everything we do is so active. Passive strategies – it's, you know, you might look to our energy redundancy, which is kind of built in. You know, we can't go down ever for any reason. You can't lose water production pressure. You can't lose wastewater management.

So, it's kind of – it's just part of our process. I don't know if that would be defined as passive or active as far as resilience is concerned, but we have so many different things like that that are just kind of integrated. I guess the newer – you know, the new adoption of solar, maybe, in that regard, or even additional fuel sources like liquid natural gas for additional redundancy and resiliency for energy resiliency would be things that we're looking at.

Chris Halpin: I have some good examples, Shannon. So, there's things as simple as air-side economizers and water-side economizers that you can do in any building. I know it gets down in – depending on the climate you live in. Like, I lived in Miami for a while, Jason, and it's hard to do air-side economizers in Miami 'cause the humidity, right? But out here where I live now in the West, it's dry all the time.

So, air-side economizers are big. In Northern Nevada where Google and Facebook all put in huge data centers and Tesla's Gigafactory all use outside air economizers and water economizers, right? So, when it's cool enough outside, they used a free air cooling and they used the cool air to cool water which are then run through the buildings, right? We're starting to see more and more things and – like you were saying, Jim, if it's new and different, people are like, *[Makes noise].* I've just read an article last week about using wastewater as pre-cooling for buildings, right?

It's 50-60 degrees – kind of depends on where you are; in Florida, it's 65 and Minnesota, it's 55 – but you can use these sort of strategies and build them in. And some of them make for great defaults, right? If your chillers and redundancy all goes to hell in a hand basket, you still have the free outside air, right? Free cold water. The Romans did this. The Ancient Chinese did this, right?

So, there's things like that we can learn from history and include them in things that we do now. It's not always about technology.

Jason Grant: You know, one example I did think of is we do have solar drying beds for our sludge, but, unfortunately, we've been doing that long,

and it's actually a great source of heating energy for our sludge. But through plants expansion, due to population growth and other factors, we're actually losing our solar drying bed so, we're gonna have to replace that through other means and dry our sludge either with more biogas renewables or natural gas purchase.

Shannon Zaret: Great. In talking about these projects, do you guys have anything exciting coming down the pike? And, if you could, go into more detail about the types of technologies and implementation plan that you have for that.

Jim Henry: I can kick it off with a quick and dirty one, and Chris mentioned this many times, and I think Jason did as well. Metering, metering, metering, and monitoring, monitoring, monitoring, right? Any time you can enhance the amount of points that you're monitoring, it'll give you better data on what's going on in your building. So, for us – especially in the data center world – you've got tons of monitoring points, and then, set points for those monitoring points if they're controls. So, you know, we're in a large initiative right now to enhance the amount of metering that we have, one of which is centered around – and I kind of mentioned in the presentation – being 100 percent powered by renewable energy's great and that's what a lot of – at least in the data center industry – a lot of people are striving to covering their entire load with renewable energy – hopefully, locally sourced – but the second kind of – it's really a paradigm shift – is being 100 percent renewable 100 percent of the time.

So, in order to do that, you need to be able to match your building load with what your renewables are actually giving you in terms of racks, be it PPAs or *et cetera,* right? So, monitoring the actual building load 24/7 and making sure we can match that with our renewables that we're purchasing is kind of the next realm. So, you know, we've been 100 percent renewable since 2017 and the next phase of the industry's making sure that you can do that 24/7/365. But, as we always know, the wind doesn't always blow and the sun's not shining at night. So, you've really gotta work with your providers to do things like this. So, just monitoring, metering, and better data.

Jason Grant: Yeah. I'd have to agree with you, Jim. Data – big data is a major challenge for us, given our system being so large. We've accomplished putting in smart meters throughout our system. I think we have about 400 post-main entrance – so, service entrance and also on our substations, stuff like that.

It's just hard to integrate those and then, start doing analytics where it's important. I think the other area where we're really progressing is with our biogas. As I mentioned earlier in my talk, we're increasing our biogas production through a new fog facility and some renovation on the digester clusters that we have for two of our plants. So, we expect to get much more biogas production and then, of course, in order to utilize that, we'll have to expand our cogen capacity. We have the engine capacity; we don't have the interconnect capacity yet with the utility. But that's underway and that should be correct in the next six months. So, I think those are some major initiatives for us in the next year.

Chris Halpin: I think I mentioned – some of the examples before, I think, really speak to this – of using things like – and I went very quick over this, but using water tanks that are used for fire suppression – this got done in – I think it was a Salt Lake City public works facility. It was like the first lead platinum 100 percent resilient facility that was built, I think 7-8 years ago, something like that. I know we were doing a big resilient plan for the state of Rhode Island – that was one of the sources that we used – and it allowed them to really use that one static asset, right – a tank of water sitting somewhere. It just sits there. It doesn't really do anything in case of an emergency.

But here, you can use it on a daily basis 'cause you're used to using the heating and cooling benefit that you get from that water, right? Whether it's a lake like Jim was talking about or other sources like that. That really is a smart use of money, right? And, like I said, if something does go wrong, you often have a good backup that isn't dependent on a tremendous amount of interactivity and interoperability between systems and people, which is really the weakness, right, that we saw like – and Super Storm Sandy taught everybody a lot of lessons that critical facilities, 10-12 years ago, where everyone was like, "Oh, we got –" all the hospitals "We have diesel backup. We have three days of oil on site. We're in Manhattan so, what could happen, right? We're the center of the universe."

And, well, you couldn't get diesel trucks into the city because streets were blocked, right? And things like that, the people have to really, really think about. So, I think if we – if society got back to thinking about how the pioneers and original settlers thought about facilities compared to how we think about them today, we'd get very far with a lot less money and really make this resilience picture look a lot more natural than the way it sometimes tries to get forced. Like, I see so many solar systems going up today

everywhere, right, all over the place – on buildings that have got 1980s controls or 1990s cooling systems in them, right? And that's something that needs to stop.

And there's a lot of technologies now you can do this, do it all at once – and, like I talked about before – bundling. Don't just do the lighting, right? Use the lighting as something that can basically pay for other things. And for me, it's not the technologies that are as important; it's the business models and the thought processes that are used to take technology – we have plenty of technology out here today to do any of this.

Shannon Zaret: And I'll do one more and I'll do a timely one. So, with the recent Colonial Pipeline hack, how has your organization addressed cyber security threats at your facilities?

Jim Henry: So, I'll go first on this one, I guess, as the info sec guy by trade. It's honestly a terrifying thing and it's akin to – even though it's ransomware as opposed to an all-out controls attack on a SCADA system – similar to what we've seen with Stuxnet. It's still kind of terrifying, because ransomware, in the past – and kind of what's happened with the sand worm attacks – for anyone who's in the info sec arena, appeared as ransomware but was actually eraser-ware, where it looks like ransomware but really, it's erasing your set points and your data. So, any time you're operating critical infrastructure – and, of course, this is something I talked about earlier in my presentation – you, at least should be practicing or are already scrutinized by some sort of regulation or standard, right? So, if you're in the government arena, you're familiar with the FIPS series and the different regulations and standards underneath NIST – you know, NIST 853, 800-171, and all the risk assessment and risk management that goes around protecting systems.

So, I mean, at the end of the day, from a pretty basic perspective, it's pretty simple – don't connect anything to the internet. *[Laughs]* It's like, it's best practice one, two, three, right? If you have a building management system or a SCADA, it's, again, supervisory control and data acquisition, right? So, just don't even put it on the internet. If you've got something that's reaching out to the internet and you don't have a cyber security team, get a consultant in there and figure out how you can air gap that thing, and then, make sure that any updates to that system – let's say you're running Johnson controls or Siemens or something like that – don't upload your patches to that system if it's air gapped right away.

Because if there's a supply chain attack on the actual data or the software update, then all of a sudden, your air gapping is for nothing. So, I mean, applying patches is incredibly important when you're connected to the internet, but, as simple as it can be, there's no reason that SCADAs need to be connected to the internet. And I could teach my six-year-old how to go on SHODAN and look for open ports and start scanning and sniffing and we could probably get into something that's totally illegal. But there's no reason for things to be connected to the internet period. Air gap everything.

Make sure you have processes and procedures for accessing that when you're on site. And if there's a need to access that sort of data remotely, VPNs, *et cetera.* But you shouldn't need to do that stuff. You have technicians at your sites, your facilities. You know, wastewater treatment plants – I worked for a wastewater treatment plant before for a municipality – controls should be totally segregated from the internet 100 percent, no questions asked, and I think that'll become more ubiquitous now with these sorts of things happening.

Shannon Zaret: Great. Jason or Chris, any last thoughts before I close it out on that?

Chris Halpin: Jason, you first.

Jason Grant: Yeah. I would concur with Jim. Anything critical cannot be connected to anything ever. And we do a really good job with that. We have an internal technology department – or division, rather – in the county that takes cyber security very seriously.

We have – we're a major target as a major municipality, and with major events like Super Bowls and stuff like that, we're constantly dealing with this issue and it's at a very high level – mayoral level, commission level, and also, in coordination with Department of Homeland Security.

Chris Halpin: And I think that it was a – yet another learning moment in a year of many, many learning moments that we've had here as a society in the US. We seem to think we're above and beyond many things and we're really not. And it shows, yet again, the vulnerability we have to fossil fuels, number one, right? And then, that needs to be dealt with above and beyond – all the other things were vulnerable with the electric grid are vulnerable as well. But when you can't fuel planes and get gas to things – luckily, it was not in the dead of winter, 'cause it would have been much worse.

It goes back to what I was saying earlier. Whole system thinking, right? We'll need to think about these things in whole over a long period of time, right? That's why Native Americans thought seven generations out. So, you could think about how what you do now is gonna affect your descendants. And then, the more we do that, the more these questions will answer themselves.

Shannon Zaret: All right. Thank you, guys. And so, I'll just take a minute to close this out here. I know we had a lot of great questions and I'll make sure that I include our contact information at the end if we didn't get to them. You can catch up with us that way. Just so you know, we do have a couple of additional resources I would love to highlight. We've got our Better Building Solutions Center. Next slide.

And so, on that center, you'll find over 3,000 different solutions to help you. They're proven, cost-effective strategies to help you reach your energy, water, and waste reduction goals. Next slide.

And then, of course, I'd like to invite you guys to attend our Better Building Summer Webinar series. That starts in June. Partners will discuss some of the most pressing topics that you're facing, share best practices, and innovative new approaches to sustainability and energy performance. And so, if you want to register, go to the Better Building Solution Center and click on "Events and Webinars". And then, finally, last slide.

I'd like to thank all of our panelists very much for taking the time to be here with us today. We do have a short feedback survey. We'd love to hear from you. That helps to design our programming. And again, if you would like to connect with us, we have our contact information.

Please, don't hesitate to reach out with any questions. I'm happy to connect you to the team here at DOE. And again, thank you for joining and thank you to our panelists again. Have a great day, everybody.

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