Cedar Blazek: Hello, everyone. Thank you for joining us this afternoon. We'd like to welcome you to today's Better Buildings, Better Plant Summit session titled "Renewables and Advanced Controls: Why Now is the Time." Today's speakers are here to highlight the use of distributed energy resources across their building portfolios, describing the key benefits and challenges of these opportunities.

My name is Cedar Blazek and I lead the retail food service and grocery sectors for Better Buildings. Before we get started, a few housekeeping notes.

If I can have all my speakers who are not presenting on mute. With most of our sessions, all the attendees are going to be on listen-only mode today. So your microphones are all muted. If you have any audio or visual issues at any time throughout today's session, please send a message in your chat window, which is located at the bottom of your Zoom panel.

This session today is going to be recorded. It will be archived and available on the Better Buildings Solution Center, and we will follow-up when today's recordings and slides are live.

Next slide please.

This is our agenda for today. We have a short introduction. I will be passing things over to our moderator for a short presentation on Grid-Interactive Efficient Buildings with David Nemtzow. We have some wonderful speakers lined up for today and we will have time for Q&A at the end of our session.

For Q&A, polling and feedback today, we're going to use an interactive platform called Slido. You can use your mobile device. You can open it up in a new window in your Internet browser. Go to Slido.com and today's event code is DOE. It's the same as it has been all week, if you've been at other summit sessions. Once you enter the event code, you can select today's session title from the drop-down menu. That title is "Renewables and Advanced Controls."

If you'd like to ask our panelists any questions, please submit them in Slido under the Q&A tab at any time throughout the presentation, and we'll be answering your questions near the end. If you have any issues, please message our tech support team by using the Zoom chat function.

Next up, to test out Slido, we are going to use a poll. We do want to hear from you. So if you haven't already, please go to Slido.com and enter event code DOE. Select Renewable and Advanced Controls from the drop-down menu.

In today's poll, we want to know what sector you are from. Hopefully, it's covered here. If it's not, you can select Other. It looks like we have a lot of representatives from state and local governments. We have some manufacturing partners, some service providers, higher education and k-12 representatives.

You'll see when we get to our speakers we represent a lot of different sectors across Better Buildings today. So, hopefully, this presentation serves you all well.

Okay. Thank you so much. That will be open for another minute or two. You can go ahead and add your input into there.

I'd like to take a moment to introduce our moderator for today's session, David Nemtzow. David is currently serving as the Building Technologies Office Director for the Office of Energy Efficiency and Renewable Energy.

He brings more than three decades of experience in the industry, running a large state government energy and water department, a prominent bipartisan nonprofit energy efficiency association, and an energy consulting practice.

David, take it away.

David Nemtzow: Great. Thanks very much, Cedar, and thank you all for being part of our panel today. It's been a really – exciting is not the word for it – exciting, important, energizing week at the Better Buildings Summit.

Before we get going on this panel, and this is – I'm going to put my job at risk in saying this is the best panel of the week. I say that because my boss and my boss' boss and the secretary are on other panels, but this is the panel you want to be at. We have Tim Wilson and Dana Schneider and Luba Zhaurova, who are going to talk about this central nexus that the country is facing on how we best integrate renewables and demand-side management, energy efficiency and flexibility, and use buildings to do that while delivering the services.

I do want to say about this weekend, I hope you have been participating in our sessions all week. I want to thank you, Cedar, for your leadership here, and I also want to thank the entire Better Buildings team for putting together this year's summit, really a great one.

If you folks in the audience were on on Monday, you saw, I hope, Secretary Granholm, our Energy Secretary, give her keynote, followed by our Acting Assistant Secretary, Kelly Speakes-Backman, and the important announcements they made, not only about Better Buildings, but about how much we are doing as partners, the $13.5 billion that have been saved by Better Buildings partners, and also all the announcements that came out of that in following the special event we had Monday afternoon, the White House Roundtable on building decarbonization.

We announced this week a new L-Prize, a new lighting prize for commercial lighting. It won't just be for inventing new lighting. It can be for manufacturing it and deploying it.

We made a major announcement on heat pumps, both at DOE and at EPA. Announcements, one I'm going to follow-up in a minute, I shall save for last; an announcement from the General Services Administration on what federal buildings are going to do; announcements on windows.

These aren't just announcements. This is the commitment of our department, the Department of Energy, the office that Cedar and I work in, the Building Technologies Office. This is our commitment to work with you in partnership, to help solve your problems. I know you have many problems. I can't help all of them, but the ones that have to do with how do you save energy, how do you use it more efficiently, how do you integrate renewables.

Look, when you leave work, when I leave work today, we're still going to be citizens and residents of this country. We're still going to be air breathers on planet Earth, and we know our responsibilities extend beyond office hours to make sure our buildings are resilient, affordable, and most of all, environmentally responsible.

Having said that, I'm going to tell you about one of those sub-air – I can't call it a sub-air. It's my favorite one, and that's grid-interactive efficient buildings. If you have ever met me, you have heard me talk about grid-interactive efficient buildings.

Why are they so important? They're this important. Energy efficiency is key. Buildings are the largest consuming sector in this country, and of course you all know that we waste at least a third of the energy use in buildings. That's what energy efficiency is for, but demand flexibility, which is akin to efficiency, is a way to take buildings and make them more grid-interactive, more dynamic, more flexible, so they're not just passive consumers of electrons, efficiently or inefficiently, but they're dynamic managers of electricity and other energy sources, but we're really talking about electricity here.

Here's our cheat sheet. We're working in our GEB initiative, Grid-Interactive Efficient Buildings initiative for buildings to be efficient – you know that story – to be connected, and I mean that connected in two ways, connected via Internet to themselves. They can communicate in real-time via wi-fi and Zigbee and Bluetooth and all that good stuff. Connected to the power grid, so they can take grid signals.

They have to be smart. Microprocessing is cheap and algorithms are cheap, as long as we get them right, and that leads to greater flexibility. With the nexus with renewables – look, some renewables are dispatchable. Hydro and geothermal are entirely dispatchable, just like a fossil plant, but the growth in renewables will be in the variable renewables and the less dispatchable ones, such as photovoltaics and wind. So we need buildings to be more flexible to help integrate that.

Next slide please.

On Monday, we announced a national roadmap for grid-interactive efficient buildings. By we, I mean Jennifer Granholm. The Sectary of Energy announced it. This national roadmap, there's the cover of the report, look, May 17 on it.

So if you haven't read the whole thing yet, I'll give you a by, but you better read it by next week because it's a really good report. The meat of it is 40 pages with a lot of – I think very accessible. So I hope you'll take a look at it. The URL is where you find it. It's at the bottom there. It's hosted at LBL.

Go back one second. So this new report does two things, and it was done by my office and our colleagues at Lawrence Berkeley Lab, the Brattle Group, and other leading experts.

How do we know it's a $100 - $200 billion opportunity? If you go to the next slide – because Brattle and Berkeley did the first ever national analysis. What's the resource base here? I know you enjoy hearing me use qualitative terms, but I'm giving you some quantitative analysis.

So in the next decade, by 2030, we can be saving $18 billion a year just from grid interactivity. That's in addition to efficiency. That's in addition to renewables. Just the part that brings those two together, that overlaps. That's a total savings, depending what assumptions you use – that's what these scenarios are, in the next two decades – of as much as $200 billion.

If you look at these different scenarios, if you look at high adoption there or high-capacity value or the high adoptions on the right, the more renewables there are, and the more we adopt grid-interactivity for buildings, naturally the more value they'll produce. So when there's cloud cover right now, there's a drop-off in productivity. There will be. But if we can manage building demand by cutting off unnecessary lighting, by turning down water heaters and letting them coast for half an hour, we can deliver the same services to the building, but do it in a way that's responsive to the grid and to renewables.

Similarly, if there's peak demand – *[audio cuts out at 0:10:35].*

Cedar Blazek: It looks like we might have lost David. David, are you still with us? Just when it was getting good. Okay. Well with that, let's take it and move to Tim's presentation. You will have access to these slides right after this, and I definitely encourage you all to go read the GEP Roadmap. There's a lot of really great information in there.

So our speakers today, we do have Tim Wilson, the Manager of Engineering and Energy, responsible for leading and delivering energy conservation measures at Gundersen Health. We have Dana Schneider, Senior Vice-President, Director of Energy Sustainability and ESG for Empire State Realty Trust. And we have Luba Zhaurova, the Sustainability Project Manager for the City of Worcester, Massachusetts.

With that, I'm going to hand things over to Tim.

Tim Wilson: Thank you. Tim Wilson from Gundersen Health Systems here in La Crosse, Wisconsin. I title our presentation today "Energizing Healthcare." What I'm planning to do here is just kind of present

where we've been on our energy journey, kind of where we've been, the history a little bit, and then where we are and where we're going. Then at the end, I'll show some examples of some buildings that we're working on right now. We've done some exciting work on batteries and some things like that, just today actually. We've got good stuff going on every day.

So a little bit about Gundersen. We are a physician-led organization headquartered in La Crosse, Wisconsin. You can see we're tucked into that corner between Wisconsin, Minnesota, and Iowa. We're a physician-led organization. We've got about 9,000 employees, about 900 providers. Our main hospital campus is a 325-bed medical center in La Crosse, Wisconsin.

We've got 60-plus – actually, I think we're up to about 70 or 80-plus healthcare facilities kind of spread out in this area, a very rural, beautiful part of the country. We've got about 3.5 million square feet of space that we manage and work on trying to do certain energy consumption work.

Back in about 2008, Gundersen set out on a mission to become energy independent. For that process, that meant to produce more energy than what we consume through fossil fuel sources. Really, the main reason for doing that was to make healthcare more affordable. We're all aware of the cost of healthcare, so one of our big expenses on the outside is energy. It's the second-largest expense, other than salaries. So in our two-year trend, reduce the cost of healthcare.

Obviously, we're a healthcare company, so the benefits to human health, not burning fossil fuels fits right in with our company's mission.

Another key thing we want to do is to strengthen our regional economy. So rather than buying energy from power companies, we could buy energy from local sources, local companies, through buying wood or through – we've got a facility where we're buying gas from a landfill, so we're supporting a city landfill.

Then the fourth thing is really to improve the environment as well.

That roadmap lays out how we moved from 2008 to 2014 on energy independence. It really started with a lot of conservation work. The first phases for the first several years were just a lot of conservation, tweaking our buildings, improving our buildings.

Then we started doing some offsite wind. We did a wind farm in Lewiston. We did a landfill biogas project. That's where we were taking the gas, from the city of Onalaska. We did another wind facility.

We did a large biomass boiler project right here in La Crosse on our campus, where we burn woodchips to heat our campus.

Then we decided to add another new hospital facility. So we kind of took a step back. We actually produced what is considered a world-class hospital in terms of energy consumption, but it was still a big add to our load. So we added some geothermal heat pumps. We did some dairy biogas facilities. We did two of those. Then really to finish out, we did more conservation looking at our city building stock. So by 2014, we would be energy independent.

So on the conservation side, you guys are probably all familiar. These are the big users we did. So a lot of our work initially was with boilers, chillers, upgrading our cooling, our cooling towers. We had some really outdated equipment, pumps and motors and exhaust fans that are constantly just sucking treated air out of your building and ejecting it into the atmosphere. A lot of work on air handlers as well. So that's where a lot of the work was initially, just improving the control systems and upgrading a lot of that equipment.

Next slide please.

Then we really got into – we did a lot – lighting was a big one as well. Interestingly, we did a lot of lighting projects early on, back in '08, '09, '10, and a lot of those buildings we're doing again now. We've got some lighting projects going on right now. So they're on their second phase of lighting improvements. The interesting thing here is you do this stuff, but there's always opportunities to go back and find more, dig and find more opportunities to do conservation.

On the occupancy side, doing scheduling in our hospital. We've got a very efficient hospital, but just a year ago our HVAC tech was able to find about $20,000.00 worth of energy savings just by tweaking our occupancy and tweaking some of the settings in our HVAC system. So there's always things you can go back and find more opportunity, and dig and get more savings out of your building.

Next slide please.

The result of a lot of that conservation, we were able to improve our EUI across our system by about 54 percent, from 2008 until about 2016. Through 2020 we crept up a little bit, but we've had about a 54 percent reduction in our EUI over those years.

Annual energy savings has been about $28.2 million since 2008. Interestingly, when you look at 2020, we spend about $4.6 million on energy. Back in 2008, we spent $5.3 million. So we're actually spending less than we did back in 2008, and we've added about a million, a million and a half square feet of space over that period of time. So we've done a lot of work as we launch new buildings to make them very efficient and to improve our existing buildings.

We also did a lot of renewable work. We've got about seven solar projects currently out there. We've got two wind sites I mentioned. Those are joint venture projects, where we actually produce and sell to the grid.

One of my favorite ones here is the biogas landfill project. This is the one where we buy gas from Onalaska. We bring it in to our campus up there. We burn it. We sell the electricity back to the grid. We pick the heat off of that generator. We use that to heat our campus during the winter. During the summer, we pick that heat and we put into an absorption chiller and actually cool our campus. So it's kind of a tri-gen system that we've got set up, up there. It's also supporting that Onalaska landfill with the monthly payments for the gas.

The biogas digesters, we talked a little bit about this. We actually divested those last year. We made a shift, which I'll talk about. We've kind of a made a shift in our energy direction. So I'll talk about that in a little bit.

The biomass boiler project, their largest project, this is working on our campus. We have five local suppliers of woodchips. We pick their fall off from their scrap. They chip it up for us and bring it here. We burn it, and we basically offset almost all of our gas consumption on our campus. There's also actually a backpressure steam generator there, too. So we produce electricity from there as well. So we offset our gas and pick up a little bit of electricity as well.

Then we've got multiple geothermal sites as well. That's actually the site here on campus. You'll see some examples. That's kind of

become one of our mainstays as we build new buildings, is to do geothermal when it makes sense.

Next slide.

The result of all this work, the conservation and the generation – *[inaudible]* – 85 percent of our emissions, it's going to be clean energy in 2014.

You can go to the next slide.

So what's next? From 2008 through 2018, we focused on this energy independence goal, to conserve or to make more energy than what we purchase from the grid. We're making a shift – we've made a shift. I told you we sold those digesters. We're taking that money and we're reinvesting it in a different direction.

So where we're going now is we're looking at zero energy new construction. So as we build new facilities, our starting point is to try and make those new facilities zero energy or net zero. We just call it zero energy. It's our own term. We make our own rules as we go.

Then the second piece is to achieve 50 percent site-based energy independence by 2026. The way we measure this is we've benchmarked all of our facilities. We've given them an energy score, basically using Energy Star. We've benchmarked our facilities on Energy Star and came up with an average, a national average, and our goal is to be half of that in terms of energy consumption per square foot.

It really drives down to these two charts. You look at the Lawrence Livermore National Laboratory's chart. You look at two-thirds of the energy is rejected in our current system. You look at the bottom of that is source energy, the amount of energy it takes to get energy produced and delivered to our sites. There's just a lot of waste there. So our goal is to not use as much, and the amount we do use, we want to generate as much of that as we can onsite. So that's the direction that we're pursuing currently.

This is an example of our first zero energy building. This is our Sparta Clinic, built a few years ago. We need to update this slide. It's actually completed its third year of energy independence. It's on average actually producing somewhere around 150 KBTUs extra every year. When you look at this building, the national median was 98 KBTUs per square foot. So a 50 percent goal

would be 49. The building, what it actually pulls off the grid is about 25 KBTUs per square foot in terms of energy use.

You can see what we did in terms of the design. Obviously a big thing there is the geothermal system. It's got a geothermal system with heating and cooling. We did decentralized heat pumps, a very efficient way. It's reduces the amount of fan load that you had to move air around the building.

Rooftop solar. Spray foam insulation we found is far superior to other insulation products that we looked at. Thermal break windows, double-pane windows, LED lighting, occupancy sensors, heat recovery vent system. So the air that we do discharge, we try to capture as much of that heat out of that air before we discharge it out into the environment. Then there's a solar garden with Xcel that essentially offsets that 25 KBTUs that we're pulling off the grid. So it ends up being a net zero building.

Next slide please.

So we've tried to duplicate that again. This was a much larger building, about twice the size. So we started out trying to get to zero energy. We're not quite there yet. We're still working on it.

This building had a national median of 109 when we put it in. So 50 percent would be 54. We're currently running at about 46. We are currently adding a solar array to the facility, which is going to get us a little closer. When that's done, it will be somewhere around 34 KBTUs per square foot.

So we did a lot of the same things, but we added – one of the things we did here is we added a Tesla battery. So you can see it at the red circle there. We've got the battery added. What we did, rather than doing a generator, a standby generator, we decided to take the battery route.

Basically, what this battery does is we reserved half of it, half the capacity. You can see that in the chart, that dark blue shaded area. Half of that battery capacity is reserved for standby power. So it's always there in case we lose power.

The other half we just recently turned over to Tesla Opticaster software. It's got a machine learning software package. We plug in a bunch of information about the building, and it monitors the building load, which is the red in that chart. It monitors the solar generation, which is the yellow. And it makes decisions on when

to charge and discharge that battery. So right now it's try and optimize and save us as much money as we can to offset that capital investment.

So the first part there, that was our zero energy new construction. The other side is our site-based energy independence. We're trying to get our existing buildings to 50 percent for their benchmark score.

So what we've done is we've went out and benchmarked all of them. That's the gray you see on each one of those sets of bars. So each one of those represents either a campus or a building. So the gray is the national median that we benchmarked. The colored bar is the actual building consumption. For example, you can see the Sparta Clinic in there, the third bar over at 24 KBTUs per square foot.

So the green ones are the ones that are at goal. Yellow, those are buildings that are not quite at the 50 percent line, but they're certainly below the national median. Then the red, those are all buildings that are above the national median. Those are our bad guys.

Each one with an arrow on it – I told you we sold those digesters. We've reinvested that money into a bunch of site-based projects, which is represented by those green arrows. So these are projects that are currently ongoing or are currently underway.

So those kinds of projects, we've put quite a bit into solar and this is all site solar, on our facilities, on our sites, offsetting what we buy from the grid. We did a lot of lighting. I mentioned lighting. We've got five lighting projects going. We've got three energy storage projects going, and two big HVAC upgrade systems going.

On the solar side, we're going to more than double – yeah, it says right there. Currently, we're about a 1.1 megawatts site. This year, we're going to be adding about 2.1 megawatts of solar on our sites. The picture you see there is a rendering of our parking ramp here on campus. We're currently working on a project to build a canopy over the top of that parking garage.

Then on the lighting side, we're just going a bunch of fixtures, so about 4,000 fixtures, a bunch of projects throughout our building stock there.

So what does that look like when you're going into your existing buildings? This is a clinic in Decorah, Iowa. If you look at the chart there, the graph, you can see the red. That's our electrical consumption for the building. Blue is the gas consumption for the building, kind of month-to-month, year-over-year.

You can see this is a building that was actually at, when we started back in 2018 looking at this, it was right around 110 KBTUs, which is worse than the national median. Our goal, when you look at the EUI summary, you get down to around 49.

So we did a lot of HVAC scheduling. In 2018, we did some LED lighting upgrades. We added rooftop solar in 2020. This year, we're adding ground mount solar, which you can see rendered in the picture there. So it's a large 202-kilowatt ground mount solar array right next to the clinic.

After we get those done, this will be a building that we've moved from about 110 KBTUs. We'll get down to about 48 KBTUs per square foot, and it should be right under our goal for the 50 percent line.

I've got one more here to share with you. This is a distribution center, actually, that we just moved into and did some renovation work on. We approached this is three phases.

The first phase was the main remodeling work that was done. This is a little different for us. We hadn't done a distribution center before. We're used to working on clinics, hospitals and that kind of, so the things we were looking at were a little different.

We went about getting the docks to seal up, so it wasn't leaking. We were doing air curtains, ceiling fans to move air around in the tall ceilings. One thing we did do that we working into the budget was a geothermal system. So we've got 65 wells out of that facility, LED lighting. We added building automation and some things like that in that first phase.

Then that got us to about a 49. We wanted to get down to about a 38 on our emissions here. So the second phase, we're adding solar, battery, and microgrid kind of functionality. This is actually taking place this Saturday. We're going to be shutting the building off for a couple hours, and we're going to be hooking up the battery and the solar to the building this Saturday.

In the picture, you can see the Tesla battery is sitting there next to the building on a solar array, just to the side of the building. The geothermal field is in that grassy area, just above the solar array. So when you look at this, a lot of the energy for this building is generated right next to the building.

We're also adding some heat pumps to the office space, to take advantage of that geothermal that added to the warehousing space. So when we're done here, hopefully we're going to be sitting somewhere around 27 KBTUs per square foot, which should be well below our 50 percent goal.

With that, we'll turn it over to Dana, I believe.

Dana Schneider: It's nice to see you all. My name is Dana Robbins Schneider and I am Senior Vice President and Director of Energy Sustainability and ESG at Empire State Realty Trust.

Just some background on Empire State Realty Trust. We are a publicly traded company with over 10 million square feet of Class A commercial office space and retail usage. We are largely based in Midtown Manhattan and the Greater New York metropolitan area.

One of our buildings is the Empire State Building. It's the most famous building in the world, and what we'll talk about today is largely based on leveraging our leadership there, not only to lead throughout our portfolio, but also to influence policy and legislation and scale to buildings at a much larger scale than we are able to do in our own buildings alone. So we do a lot of work on the policymaking side.

I have over 20 years of experience, a background in engineering and optimizing the performance of existing buildings, building new buildings. I worked with JLL for 18 years as a managing director of energy and sustainability projects in the Americas. I was a mechanical engineer at WSP before coming here. But I've been working with Empire State Realty Trust for 14 years, here full-time for about a year and a half.

I work on the Mayor's Advisory Board and Technical Working Group for the implementation of Local Law 97 in New York, which I'm sure people will have questions about, the most stringent climate legislation for buildings in the world. We're the lucky ones that get to figure it out.

I'm a LEED Fellow. I work in a LEED steering committee, and do a lot of work with the Real Estate Roundtable Sustainable Policy Advisory Committee as well.

So some of the things I will talk about today are to prove what is possible. The Empire State Building is an amazing example of this, and it's one of the more difficult buildings you could possibly try to work in. It's a 2.85 million square foot building. In non-COVID times, we have over 20,000 occupants, over 4 million visitors a year, over 100 different tenants in a historically landmarked building that is a tourist attraction. So if we can figure out how to do this kind of work here, you can do it anywhere.

We'll also talk about Local Law 97; pathway to 80x50, which is the scientifically-based agreement globally on where we must get; challenges of renewable delivery, and immediate needs for renewable success.

So from 2007, which is our baseline year, until 2019 – we don't count 2020 right now because it was such an anomalous year – but we have reduced energy consumption by over 40 percent. We've actually reduced our emissions by 54 percent already. So we're really proud of that work.

Local Law 97 was passed in April of 2019 and it creates a cap for emissions for all building, all qualifying buildings in New York City, starting January 1, 2024. So we're all preparing for what's to come. We have committed to carbon neutrality for the Empire State Building by 2030.

So Local Law 97, we have an implementation timeline here from Urban Green, an amazing organization. I'm on their board. They do a ton of work in New York and have done for like 20 years around the environment, really ESG-focused, energy emissions, water, waste, diversity, equity and inclusion, a ton of great work on educating the community as well.

As I said earlier, Local Law 97 was enacted in April of 2019. There's a carbon trading study underway now, the technical working groups, on which I get to participate. I'm actually on the Commercial Building Pathways Working Group. If Tim was in New York, he might be on the Hospitals Working Group, which is a separate one.

We are working to analyze all of the areas identified in Local Law 97, which was passed, to advise on the rulemaking, which is how

these laws usually do work. The first set of reports on the advisory board's recommendations are due January 2023. The emissions limits begin in January 2024.

It's pretty aggressive. The Local Law 97 basically targets 40 percent energy emissions reductions for New York City, 40 percent by 2030 and 80-plus percent by 2035 to 2050. So this is really an aggressive set of legislation.

So there's a tremendous amount of work that will go into achieving 80x50, and we are dedicated to figuring that out, how to do it. What is the technical pathway? What is the economic pathway? What is the legislative pathway that will enable the grid to get where the grid needs to be in the buildings to do their part as well? It has to be a partnership between the two.

So not only is there a partnership between the building and the grid, the grid in New York State, including New York City, has committed to what is called CLCPA. That law commits the state to achieve renewable grid, and there are different gateways and checkpoints for that. I think it's 40 percent by 2030. I should have looked it up exactly and put it in my notes, but the grid itself is to reduce emissions by 85 percent by 2040. So we have to figure out what the grid will do when, and what buildings need to run in order to have this partnership.

There's also a partnership between the – so there's this partnership between the utility and the buildings, and also a critical partnership between the buildings and our tenants in order to do this right. I made a note here around smart metering, because ultimately, not only will the buildings have to reduce their load and the grid become more renewable and more efficient, but we'll also need a way for buildings and the grid to communicate back and forth in real-time.

So our pathway to 80x50 and, frankly, our commitment for the Empire State Building to commit to net zero by 2030, and we've made a commitment to commit to net zero for our portfolio by 2035. The pathway to do that is to initially reduce our building energy consumption and operational utility usage as much as we technically, economically, feasibly can do, understanding that we also have a responsibility to our shareholders. So we try to innovate as much as possible and are constantly looking at reliable ways to do this. That combined with potential development of our own renewable energy projects and partnership with the grid in

their efforts is how we'll get to Local Law 97 and the CLCPA target.

Part of what we were asked to talk about is the challenges of renewable energy and how to get there. So I think it's important always to talk about the role of the buildings and the occupants of those buildings to reduce the load on the grid, to reduce the strain on the grid, to manage peaks and usage in partnership with the grid.

But there are also challenges of renewable delivery that matter to us. Our responsibility is to - and, frankly, the grid's responsibility. Here for us, it's NYISO. The New York Independent System Operator manages and is responsible for the grid in New York State. So we need to ensure that the energy is still reliable. Reliability is really important, because renewable energy at its core and by its nature is intermittent. So the ability for affordable, safe storage is really important.

The transmission and delivery of reliable, consistent, renewable energy is a challenge, because the sun is not always shining when we need our power, and the wind is not always blowing when we need our power. So we need effective ways to sustainably not only harness that energy, but store that energy so that it's readily continuously when we need it.

Storage, like I said, we need a comprehensive plan. It is also a challenge. Tim is a great position as a hospital or healthcare client. They're able to manage their own closed loop system sometimes, and also are held to different kinds of payback structures than private owners sometimes are or publicly traded companies are. And that is awesome for the municipal, university, school, and hospital/healthcare fields, because the life of their facilities and the need for their facilities as public service facilities is on a different payback scale than publicly traded companies, and that commercial and residential properties that have shareholders are.

I think it's important to acknowledge that, because I can't make a justification for a 20-year payback project, but Tim may be able to. So we should look to the solutions that that market has implemented to learn lessons. How effective have they been? How efficient have they been? How could they have reduced their payback through technical and implementation strategies, so that we can leverage those in the commercial market and even in the residential market?

But we need a comprehensive plan for storage if we're going to have state-level and national-level energy goals. Distributed energy systems all over the place need some kind of comprehensive plan to ensure that they are done efficiently, effectively, and that they're managed at the grid-level, too, because all of our buildings are not closed loop. So for large scale distributed energy resources, like I said, we need to make sure that they're organized and managed to be reliable.

Then flexibility. In order to have a reliable, resilient grid, we need to make sure that we partner. Smart meters are part of that solution. Communication between the occupants of the building and the owner, and then between the owner and the grid becomes very critical for demand management at a possible 15-minute interval level, but certainly hourly. So the ability to manage occupancy and building needs and usage along with the grid, and what the grid's energy source is, how strained the grid is, what the load on the grid is. So I think in the future we'll see a lot of a trend towards real-time responsiveness.

We have some immediate needs for the success of renewables and the success of achieving that zero in commercial real estate. That I think falls into three main areas: legislation, market signals, and incentives around energy efficiency.

On the legislative side, there is new legislation all over the country that mirrors Local Law 97. It's really important and great for that legislation to be passed, to drive change.

But it's also important for the bills to be based on outreach and engagement in the market, so they need to understand what they need to do and how to do it. It's really difficult to just say, "Okay buildings, you have to reduce your energy 50 percent of you'll have a fine." It's really important to engage and show them how to create success stories and share lessons learned. NYSERDA has been a great partner with us in doing that here.

A lot of people talk about electrification as the ultimate solution. Clearly, the way renewable energy works now, that's part of the solution, but we also have to look at district steam in our big cities and see how to manage district steam. Heating is the biggest single usage type in all of our buildings. So we have to look at ways to manage that better, look at embodied carbon and not just assume that ripping out all these district steam systems is the only way.

There may be other ways to better manage and reduce those loads, and to look at alternative fuel sources as well in combination with electrification, because ripping out all those systems is extremely disruptive. It does have a huge carbon footprint, and it may not be economically feasible right now and it's not in high-pressure steam districts. So we need to continue to push technology and innovation.

Major electrification without major energy efficiency improvements is something that we would be careful about. So long-term electrification and decarbonization. I think decarbonization is the goal, not just electrification. So looking at how buildings can improve their efficiency, and manage and reduce their loads in ways that have measurable ROI is critical, and not just to assume that we immediately electrify everything, because we need to be sure that the grid is in fact clean before we start increasing the load on the grid.

Thank you very much.

David Nemtzow: Thank you very much, Dana. That was very insightful. This is David Nemtzow. I'm back. I found your and Tim's presentations wonderful.

I'll just say before we turn it over to Luba Zhaurova of Worcester, Massachusetts, seeing Tim's photo of the rooftop covered with solar panels and them him having ground mounted solar to it, and then looking at the Empire State Building really showed us the contrast between high-rise and low-rise and how you're using renewables to be part of your mix. Very interesting.

Our next speaker is Luba Zhaurova. Luba is the Sustainability Project Manager for the City of Worcester, Massachusetts, leading city and its energy program. Luba coordinates their work on sustainability and clean energy, including the Worcester Energy Program. Luba, please.

Luba Zhaurova: Thank you, everyone. I'm very happy to be on this panel, the very ambitious and progressive work that you guys are doing. I am a generalist, so my presentation will focus more on the work we have done and what enabled that work, and the lessons we have learned.

Next slide please.

So just a little bit about Worcester. It's pronounced Woost-er, not Wor-ches-ter. We are located in central Massachusetts. We are the second-largest city in New England, after Boston. There are some stats if you are interested, but we are a great city. We have a lot to offer for our residents.

We have nine colleges and universities, lots of green space, a vibrant art and culture scene. Our major industries are healthcare and biotech. We are a gateway city, which is a Massachusetts designation for cities that used to be a gateway for an American dream. So now post-industrial cities that have specific needs, but also assets, a very dense, great urban fabric, and some stubborn social and economic challenges as well.

We have been revitalizing the city in the last 15 years or so. The city is changing and attracting a lot of new people who love living in Worcester.

Next slide please.

Just to give you a scale so it's easier to compare to other speakers, our budget is about $722 million in this past fiscal year. We have 5,500 city employees, 25,000 students in pre-K through 12. We have 90-plus municipal buildings, and 53 of those are public school buildings, adding up to 6.5 million square feet. I also listed 14,000 street lights and many other assets that we have to manage that consume energy.

Next slide please.

For about a year, we've been working on developing a municipal strategic plan that crystalized our vision, values, and goals as a city. Our vision is to become the country's most vibrant and livable mid-sized city. We're not competing with New York. We are a very different kind of city.

Our values are inclusion, integrity, and innovation. And our goals are a thriving, vibrant city, strong neighbors, strong fiscal government, and opportunities for all. I guess as a public sector, we seek to lead by example and to see where opportunities present themselves to incentivize private sector and our residents to lead a more sustainable lifestyle.

Next slide please.

The most important plan, from my perspective, is the one we just recently completed. Our city council approved it last month, the Green Worcester Plan. The full name is the Green Worcester Sustainability and Resilience Plan. The vision is to become the country's greenest mid-sized city.

There are many goals in that plan. It's very ambitious, but the ones related to this session are to provide 100 percent renewable energy for all municipal facilities by 2030, and 100 percent renewable electricity citywide by 2035. Our main vehicle for that is the Municipal Electricity Aggregation Program, which is a legislation in Massachusetts, which deregulated electrical industry and allowed cities to procure their own electrical supply.

So a municipality can aggregate electricity of all its residents and businesses, except for the ones who don't want to participate, obviously. We can increase a percentage of green electricity in that supply, above the default percentage provided by the state's Renewable Portfolio Standard. So that's how we see our main vehicle for achieving those goals in the next five and ten years.

By 2045, five years before what IPCC says, you know, we absolutely must get there, is 100 percent renewable energy in all sectors, including heating and transportation, requiring new building to be net zero, and stimulating deep energy retrofits of existing buildings. Our city is pretty old. It's pretty much built out. There's not that many opportunities for new building stock. So I really want to acknowledge the need for retrofitting of existing buildings of all kinds.

The last goal is promoting climate resiliency and healthy homes programs.

Next slide please.

I wanted to highlight this example of how powerful planning and visioning like that is. So as we were finishing up our Green Worcester plan, in parallel, about a two-year effort to design a new high school was also finishing up, except that the design included efficient natural gas fired boilers to provide the primary heating and cooling for the building.

So these two things were kind of happening in parallel. At the very last moment, I would say the design team was able to pivot to primarily an electrical HVAC system designed for the building with solar on the roof, resulting in potentially a carbon negative

building. I'm saying potentially because there are some challenges with connecting to the grid of such a large array.

I do have a slide on that, and that's previously what Dana was speaking about, the importance of utilities and modernizing the grid and storage when connecting very large renewable energy projects. So our design team is still figuring out exactly what the size of that PV system will be, but we do see that as a future accomplishment for that building, that at the last moment we were able to decarbonize the building as much as possible, and it will be our greenest yet to date.

Next slide please.

I was trying to think about what are the forces that drive sustainability in the city, and I see it as a three-legged stool. Each leg is as important as any other.

The first one is policies and incentives at the state and federal level. Massachusetts has been very progressive in that respect. So we've been lucky to take advantage of living in Massachusetts and taking advantage for the last ten years of the incentives.

The external forces are equally as important in Worcester. We have a lot of grassroot advocacy groups that care about sustainability and look at it from different perspectives and lenses, a lot of equity concerns, green jobs, decarbonization, natural gas leakage causing indoor air quality issues and killing trees through leaks, but all of these things kind of converge on the same solutions.

The third leg of the stool are internal forces. We have great leadership by our administration head as well as support by elected officials, which are, obviously, also affected by external forces. All these things are connected, the constituents and advocates. City councilors show up to the meetings and apply pressure.

The last one is internal advocates and subject matter experts. So that's kind of where I ended up in Worcester 13 years ago, and I was seeing what a powerful and often invisible force it is, a force for good. So all these three things in tandem, working together, drive sustainability.

Next slide please.

There were a lot of sustainability actions, but I wanted to just highlight, to show the trend. It's not something we've been doing for the last one, two, three, five years. Even prior to 2007, there were a lot of things that we were doing in Worcester, but I guess we could start with 2007, which was the year when our first climate action plan was completed and approved.

2009 was a pretty seminal year. That was when we started negotiating for the Energy Savings Performance Contact, which was the main vehicle for the city to do a lot of energy efficiency and renewable energy work in a very large portfolio with very limited internal staffing. So this contract enables municipalities, at least in Massachusetts, maybe in other states – I'm not sure how transferrable that is – to bond a lot of energy efficiency work and to pay for this work through energy savings and revenues from solar projects or renewable energy projects.

This contract is ongoing. We've had it for ten-plus years. We are in phase five now. The first phase enabled most of the energy efficiency work. The next phases were solar projects as well as 14,000 street lights converting to LEDs, and a landfill solar farm, which I do have a slide on.

This project also enabled our commitment to a Better Buildings challenge, a 20 percent reduction of EUI and a 2010 Green Community designation, which is a state designation, which committed us to a 20 percent energy reduction measure, MMBTUs.

Then in 2021, as I mentioned, we passed our Green Worcester plan. In this coming fiscal year, we are looking to establish a Department of Sustainability and Resilience, which allows us to build internal capacity to start implementing many important, ambitious goals of the Green Worcester plan.

I'll just mention, going back to this ESPC energy savings performance contract, it allowed us to avoid 64 tons of carbon tax and equivalent. I have a lot more stats on it, but that's not what this session is about really.

Next slide please.

This session is about solar and behind-the-meter energy resources. So we have 15 projects to date, totally in 10.5-megawatt capacity. Most of them were put in between 2011 and 2016. We are actually in the design stages of more solar projects on municipal properties.

All solar projects are municipally owned, which I know is unusual for municipalities in Massachusetts at least. It was a conscious decision, so that we could take advantage of very attractive solar renewable energy credits in our market, as well as net metering credits. The revenues from those are also funding our maintenance costs.

PowerDash is a company that provides energy monitoring and solar energy verification, which is needed to issue renewable energy credits and sell them on the NEPOOL GIS market.

The second from the right column with the big arrow at the top is the one that doesn't fit on this axis. It's the biggest solar project that we have constructed. I think the next slide is on that.

Next slide please.

All right. I know we're talking about behind-the-meter solar projects. Well, first of all, it's a cool project, so I did want to highlight this. It's the largest municipal solar array in New England. It was a $27 million project with only a six-year payback, an 8.1-megawatt capacity.

The virtual net metering credits from this project are sold to our municipal school buildings. So in a way, it's kind of like a behind-the-meter solar, in a way. So we are able to get revenue from this project, but the school building is also benefitting from it by purchasing electricity average use rate.

I have only two slides left. So challenges and lessons learned. Every single bullet is based on our experience. So I stand behind it and I hope that it help some of you who are considering doing solar.

The first one is clear communication of post-construction management responsibilities. That's incredibly important. You want to bring on the team as early as possible.

You also, to jump into the fourth bullet, you also want to connect solar revenues to the budgets of the teams responsible for solar maintenance. That will ensure a smooth transition and timely maintenance and repair of your systems.

Balance the cost of designed critical equipment versus risks of repairs. This has to do mostly from our landfill solar, which is a

very large array, in thinking about how many inverters and how many combiner boxes do you want to put in. So the more critical infrastructure you have, the more costly the project. But on the backend, that means that you can isolate the problems when they arise, and one inverter that is down will not disable the entire system. So you suffer less on the other end, but it does cost more upfront, so something to consider during the design phase. There is no right or wrong answer, and I think it depends on the size of the system as well.

Guide the urgency of the decisions to repair based on cost/benefit analysis. If you have a large array and it's down in June, you may just want to pay out-of-pocket for the repair versus trying to chase the manufacturer and warranty, because the cost of waiting is more than what it would cost to repair it.

Municipal procurement challenges are obviously specific just to municipalities, but given that there are a lot of them tuning in – and I'm sure it's the same in every state, municipal procurement is notoriously lengthy and lost time is lost money – we are looking at innovative contracting language that would allow us to not have to bid out large early payers, which means lost time. So it's something to be aware of.

Ensure the best possible coverage on the warranty. Even the best warranties may have holes in them and you want to be aware of what they are, and anticipating that there will be unknowns.

These last two bullets refer specifically to our example of a lightning strike that disabled a portion of our landfill solar. It was unanticipated. It was not covered by warranty because it was considered an act of God. It took a really long time to fix and figure out who was responsible for which portion of the costs.

Electrical grid modernization – and storage I should have added. I just will echo what Dana was saying. Right now, at least in Massachusetts, we have so much solar that it's coming to a head with the electrical grid that has not been modernized and cannot take on all this solar. The result of it is that the developer of solar is often required to pay for the transformer work, which makes some solar projects economically unfeasible.

There are a bunch of solutions for that, but not all of them are market ready. It's something to be aware of. As advocates, I think we need to push at a higher level, at a state level for faster grid

modernization. I feel like it's moving at a much slower speed than renewable energy resources and it's coming to a head.

In Massachusetts we have done a lot of piloting of storage solutions and it's very promising. It's not quite there yet in terms of economics.

The last slide I'll go through quickly.

David Nemtzow: Luba, we need to leave some time for questions for the panelists and we have some for you. So we need to run through this quickly please.

Luba Zhaurova: Yes. So why now? That's the name of this section. More matured solar market than it was ten years ago, which means _____ the leaders of the market and for reputable companies. Experience from doing earlier solar projects benefits everyone. There is a trend towards better alignment of policies and incentives in all states.

And why now? Another good reason is responding to pressure from stakeholders to respond to the urgency of climate change.

That's it. Thank you.

David Nemtzow: Thanks so much, Luba. You had a great question we're going to get to in a minute about Worcester's role as a template for other cities. But before we get to that, we have some questions. Again, anybody in the audience, use the Slido function, don't use the chat function, and submit your question.

The first one we have, and it's to any and all of the panelists. It's a broad one, but it's such an important one. "As the utility generation mix in your region has changed, getting it greener, how has that influenced your decisions about onsite renewable investments?"

Does anybody want to take that one on? Dana, you talked a lot about how Local Law 97 is affecting your trust. I would imagine ConEd's mix or for you, Luba, National Grid's mix. Tim, I don't know what your host utility is. But is that part of your calculation or are you going forward regardless?

Dana Schneider: Do you mind reading it? I'm sorry, I don't see the question.

David Nemtzow: Okay. For you, "As ConEd changes its generation mix going forward, does that affect your decision on renewables, or are you just doing your own thing and letting ConEd do its own thing?"

Dana Schneider: That's a great answer and I'll try to answer it carefully. It's not just ConEd. The New York Independent System Operator at a state level makes decisions as well about our grid, and the CLCPA is a statewide goal. The requirement or the ultimate goal in New York is to move towards a renewable grid and towards more efficient buildings.

So the CLCPA is the Climate Leadership and Community Protection Act. That really flows off the tip of your tongue, I know. Basically, what this does is tease up requirements for the grid to become more renewable.

The challenge, frankly, to your question is that we don't know quite when these updates will be made or where they'll reach first. So in New York City, we are in Zone J, and transmission and distribution of that renewable power to Zone J is a challenge. So part of what we're going through now is careful consideration of how to coordinate the timing of a more renewable grid.

As I had said, we don't want to – we as a city and state and country, frankly, should not prematurely electrify. We need to make sure that electrification is timed to be put on a more renewable grid, and with nuclear power, which has no emissions, shutting down in New York, that's very challenging for us.

So I'll say that for Empire State Realty Trust, for the past decade-plus we have led the way in energy efficiency based on an ROI. So we'll continue to do that because regardless of what the state or city committed to now, we've been pushing for over a decade to lead investment and creating a business case of tools for ourselves, for others, for our tenants to invest in super-high-performing energy efficient buildings and spaces, which are also the pinnacle of healthy buildings.

I wanted to make sure to mention that because you don't have to compromise on that. We're the first portfolio in the Americas to achieve a WELL Health Safety rating for the entire portfolio. We were the first commercial building as well to do so. We are really proud of that because it demonstrated our leadership in indoor environmental quality.

We have MERV 13 filters in every ESRT unit. We have bipolar ionization installed for air purification in over a million _____. Our ventilation rates have always complied with ASHRAE 62.1. We have no _____ BOC requirements for all the work that occurs throughout the portfolio as well as no red list. These are things we've focused on for years and will continue to.

David Nemtzow: Great. Thank you. Cedar, what other questions has our audience been asking our panelists?

Cedar Blazek: We have a lot of questions around cost and payback for these systems. So I'd love to hear from Tim and Luba: one, what is your expected payback on a lot of these investments? And did you leverage any federal, state or utility incentives to help fund these projects? Luba, maybe you can go first and then Tim.

Luba Zhaurova: Sure. We sure did. We sure did leverage any incentive we could be eligible for. Mass Save it's called in Massachusetts.

In terms of payback, I think part of the winning strategy for the Energy Savings Performance Contract is that you could bundle up so many energy conservation measures, so that you look at the average payback for the entire project, which means that you could address some of the issues in your building, especially when it's a very large portfolio, that otherwise would not have been funded such as window replacements in really old, historic schools.

So on average, I believe a ten-year payback was kind of this golden number, but some paybacks were less and some were more. And yes, we were qualified for a lot of incentives and ultimately paid using bonds for the projects that was supposed to be – I believe it's a 10 to 20-year bond.

Cedar Blazek: Tim.

Tim Wilson: Yeah. Typically, we pretty much self-fund our projects. We do get, obviously, the grants when we can. In Wisconsin there's a program called Focus on Energy that gives us some grant funding to do large projects.

Our typical payback ranges from – lighting projects typically run on shorter paybacks, three to five years. Solar is in the 10 to 15-year range. We don't get any tax incentives, obviously, as a nonprofit organization. *[Inaudible]* – more than most people are through those things.

Battery storage projects, they're 15-plus. The batteries typically are expensive. That's why when we do those battery projects, we've got them in a position where we're not buying a generator instead. So we look at it as I'm not going to buy this generation. I'm going to spend 40 or 50 percent more and do a battery project. Then I've got an asset that actually is going to save me money over its lifetime, rather than a generator that typically just sits there and I spend $3,000.00 to $5,000.00 a year – *[inaudible]*. I just go out and do oil changes. So that's one of the ways we look at justifying a battery system, is offsetting a generator – *[inaudible]*.

Cedar Blazek: Thanks, Tim. Like I said, we got quite a few questions around the challenges, and the challenges that are little bit different facing private sector versus public sector. Hopefully all the attendees got to hear a couple different perspectives on how those decisions are made and prioritized.

I think with that, we're going to wrap up our Q&A. We have a few additional resources that we would like to share with the attendees today. I do just want to say a big thank you to all of our speakers and presenters. Thank you to David Nemtzow for helping moderate this session and dealing with a couple of our technical issues.

We do want to highlight we do have a Renewable Energy Resource Hub on the Better Buildings Solution Center. It is full of information. This is where the slides are going to be made available online. You can find cost effective strategies, cases studies, solutions, resources to help reach your energy, water, and waste reduction goals.

I'd also like to highlight our Better Buildings Solution Center, which has over 3,000 solutions. I don't think we're going to play that video for you, but it's wonderful. Check it out, tons of resources for you guys online. A lot of the questions you're asking, the answers are in there.

This summer we have a webinar series coming up. So if you've enjoyed this summit, please join us for our summer webinar series. It's going to kick off in June. Partners are going to discuss some of the most pressing topics you're facing, your best practices and innovative approaches to system _____ and energy performance.

David Nemtzow: Cedar, before we hang up, let's just give a quick shoutout to the new Better Buildings Low Carbon Pilot. Many of you are participants in that pilot and that's going to expand very quickly.

So you will be on the pilot. So if you want to know more about it, please contact Cedar, myself or any of us on the DOE team.

Cedar Blazek: That's a great point, David. Thank you and thank you all for participating with us today. Panelists, thank you very much. Attendees, if you're able to provide us some feedback in a short survey on Slido, we'd love to hear from you. Your answers won't be available to anyone else, but it will help us design better webinars, resources, and future summits to serve you. If you'd like to learn anything more, please reach out to us, as David said, and check out the Better Building Solution Center. Thank you.

[End of Audio]