*[Begins at 00:52]*

*Bruce Lung:* Good morning, everyone. Welcome to the 2020 Better Buildings, Better Plants Summit, our virtual leadership symposium, today. I want to thank everyone for meeting with us today, including speakers and attendees. This is gonna be our second Best of the Betters section, in which we were gonna recognize this year's awardees of the Better Project and Practice Awards. We had a great number of excellent applications, and now we're gonna have some excellent presentations, and some of the best energy management professionals in the country as well as in North America, as we have one from Quebec, who I will introduce in just a few moments.

Before we dive in, I just wanna cover a couple housekeeping points. Please note that today's session is being recorded and will be archived under the Better Buildings Solutions Center. We will follow up when today's recording and slides are made available.

Next, attendees are all in listen only mode, so your microphones are muted. If you experience any audio or visual issues during today's session, please send a message in your chat window located at the bottom of your Zoom panel.

I'd like to welcome you, again. My name is Bruce Lung, and I will be your moderator for today. We have a lot of presentations going on, so we're gonna start at a pretty good clip and hopefully finish within the time limits. The agenda today is that we're gonna have some opening remarks from our Director from the Advanced Manufacturing Office, Ms. Valri Lightner, and then we'll dive right into the presentations from the speakers.

I'd like to bring on our colleague, Eli Levine, the Program Manager for Better Plants, who will perform an introduction for Ms. Valri Lightner. Eli?

*Eli Levine:* Hey—thanks, Bruce, and thanks, everyone. I'll echo what Bruce said, that this was a very challenging competition, we've received more applications than we've ever received before, and really, just blown away by the level of all the great work that you guys are doing.

So, I'll keep this short and sweet, but it's my honor to introduce Valri Lightner who, Valri leads our Advanced Manufacturing Office. She's been with the federal government in various capacities for 35 years now. Prior to being with the Advanced Manufacturing Office, she served in the Loan Programs Office and worked in the Bioenergy Office as well. She has a background in Chemical Engineering.

So, with that—Valri, thank you for joining us and your leadership running AMO.

*Valri Lightner:* Thanks, Eli. So, I want to welcome everyone to this session and to congratulate the award winners. Like Eli said, there was a lot of competition this year, and we were really excited that so many of you submitted applications to the award process. And I want to thank Eli and Bruce and Cliff for organizing this session and also for organizing the whole award process, so, I really look forward to hearing from you guys on some of your great achievements.

To kick off the session, I thought I would just start off by giving a little context of AMO, just reminding you of how you fit in as Better Plants partners and then, also, give you some, I guess, ideas of the way maybe you can expand your partnership by partnering either with the National Labs or through some of the other opportunities that we have in AMO that are in addition to being Better Plants partners.

So—

*Bruce Lung:* Next slide?

*Valri Lightner:* Yes, thank you. So, do I just say, “next slide,” or do I have—

*Bruce Lung:* That’s correct.

*Valri Lightner:* - okay. Alright, so, I know you're all familiar with the role of AMO and our mission space is to catalyze research, development, and adoption of Advanced Manufacturing Technologies, and where you fit in as Better Plants partners is that adoption piece, and specifically, focused on energy management. And with the manufacturing sector comprising 25 percent of the nation’s energy use, you partnering with us to establish and meet goals to reduce your energy intensity by 25 percent over 10 years is really impactful in the energy space in the United States.

Eli and his team have continued to work with you and to look for opportunities to expand your partnership with you, and some of the things that they've done recently is expanding to include water and wastewater treatment facilities, and also, offering opportunities to partner with our National Lab such as the National Lab Technology Days, and then also, starting pilots like the waste reduction pilot that was started this year. And something that we planned—I think, Eli mentioned this on Monday—to kick off later this summer is another pilot on field validation. And in field validation, we're really looking for Better Plants partners to be first adopters of some of the technologies that have been developed in AMO or have been developed by our energy management partners.

So, next slide. And so, in our next slides, I'm gonna focus on some of the recent work that we've been focused on in AMO and give you some examples of ways that you can engage in partnerships with us. And with COVID being on everyone’s mind, I thought that I would just share some examples of some of the work that the National Labs are doing, taking advantage of partnerships that they have developed with industry through programs like AMO, and then being able to use that relationship to assist industry in rapidly changing their manufacturing where they have capabilities to make—and in this particular case, it’s some of the medical supplies that had been in such short supply as the COVID ramped up. So, particularly, they're focused on making masks, ventilators, and consumables. So, next slide.

So, taking advantage of some of the capabilities at the manufacturing demonstration facility which focuses on additive manufacturing—Oak Ridge has used their metal manufacturing capability to make injection molding tubing for parts such as collection tubes for test kits. So, what they've done is shared the designs for the injection molding tool being on an open source platform, and they've shared it particularly with certain companies they're already working with, but then they wanted to make that available to any company that might have injection molding capabilities so that they could also help support making some of these needed test kit supplies such as test tubes.

Another example of something that Oak Ridge did was recognizing that the preforms for soda bottles that Coca-Cola makes look a lot like test tubes. They reached out to them and connected them with some laboratories that could test their preforms for use in the test kits, and it turns out that they worked great. And so, as to last week, Coca-Cola issued a press release saying that they had already made 7,000,000 of the tubes and provided them for test kits. Next slide.

Another example of some of the work that we're doing with industry for COVID is related to our carbon fiber technology facility. And here, it’s an interesting story where the inventor of the N95 mask actually recently retired from the University of Tennessee, and he ended up partnering with the CFTF to develop a melt blown process to make N95 materials, and so it’s first melt blown and then there’s an electrostatic charging that occurs to make the material active in preventing the transmission of the virus.

So, Oak Ridge has been working with him and has partnered with Cummins to then transition this technology to Cummins, who has melt blowing capabilities, and they can produce millions of pounds of the N95 material. And again, in this case, they are open sourcing the technology and looking to partner with other companies that also have the melt blown capabilities that can make the N95 materials.

Next slide. In the past year or so, the Department of Energy has announced three grand challenges—one related to energy storage, one on plastics innovation, and one on water security. And the Advanced Manufacturing Office is working in all of these areas. In the energy storage area, there have been remote workshops like the one we're having now over the last month or two to gather information from stakeholders to inform a draft roadmap that will be issued later this summer. And along with the roadmap, there will also be requests for information. So, for folks that weren’t able to join the webinars, an opportunity to weigh in on where you feel the right federal role is for energy storage.

AMO has been partnering with the Vehicle Technologies Program. Last year, we had a topic in our funding opportunity to use manufacturing, battery manufacturing, to help drive down the cost of battery energy storage systems for vehicle applications. And just a couple weeks ago, we released a joint lab call with Vehicle Technologies looking for industry to partner with the National Labs through CRATAs to use the National Lab capabilities to help scale some of their energy storage systems. So, look for some additional information coming out about how you might partner with the National Labs on that. The applications are due July 17th.

Also, under the Plastics Innovation Challenge, this was issued to address the issue of waste plastics getting in the oceans and in our landfills. And what the Plastics Innovation Challenge is looking to do is both develop technologies that can make plastics that are recyclable by design, and also help the value proposition for dealing with that waste plastic that’s already in our landfills—so, making value added products out of the waste currently in landfills and oceans.

And then, the third grand challenge area is under Water Security. And last September, AMO announced the selection of the National Alliance for Water Innovation to lead an energy innovation hub to produce pipe parity water from nontraditional sources. So, that team has recently started a series of roadmaps to inform what work should be done under the hub. They are open for additional members so, you know, if you're interested in that area, you know, just look for those opportunities to join. They're open for membership.

And then, the other thing that we're working on in the water area that may be of interest is that, in our fiscal year ’20 appropriation, we received $20,000,000.00 for efficient water and wastewater research and development and we plan to issue a funding opportunity soon on that.

So, next slide. This is my last slide. This is an example, again, that I wanted to share with you about the High Performance Computing for Manufacturing program, and this is a program where we seek to use the capabilities, the high performance computing capabilities at the National Lab to solve industry challenges. And if you're not familiar with this program, we have two calls a year. The funding does go to the National Labs, it’s about 300K, for them to use their computing resources to solve some of your challenges.

And this example that I have here is from a partnership between Lawrence Livermore and Vitro Glass, and what they did is, they used the high performance computing capacity to develop a fast running machine learning algorithm that can be used on a laptop computer. And so, typically, when they're trying to optimize their melt furnaces, it could take up to a couple of weeks, and with this machine learning algorithm, they can now do that real time and make adjustments in their furnace. So, this is just one example of how industry has used that capability to optimize their process.

So, next slide. I just wanted to throw up a few of these examples just to encourage you to continue to work with Eli and the team to explore some of these opportunities to expand your partnership with the Advanced Manufacturing Office, and I look forward to hearing about the successes that made you award winners, so—thank you.

*Bruce Lung:* Well, thank you very much, Valri. I'd like to go back real quick and do one last bit of housekeeping. As you may know, we are working with Slido this year and if you can go back real quick, we'll just let everybody know about the Slido slides—Slido slide.

Basically, if you can just go to www.slido.com, either on your computer or your mobile device, and open a window in your browser, if you can plug in the code for today's event, it's #bbsummit, so B-B-S-U-M-M-I-T. Once you enter this event code, then you'll see a menu, a drop down menu, and you wanna select Best of the Betters. This is how we will have questions and comments for our panelists. So, if you have any questions, you can submit them any time in this presentation, and we'll be answering them at the end of the session.

In addition, you can select the thumbs up icon and up vote some of the questions or comments that you like, and this will kinda move them up to the top of the queue, so we'll know they're important to a lot of you attendees.

I'd like to just take a quick moment for everyone to open up Slido and be able to select our session.

Okay, hopefully, everyone is there. Hey, Cliffton, can you include the Slido info in the chat for everyone?

Okay. Hopefully by now, everyone's been able to get onto Slido. If you can advance the slides, Cliffton, we're gonna jump into our first—yeah. And also, be advised, we are using social media, so this is the Twitter and LinkedIn links for the Better Buildings, Better Plants and the Summit.

Alright. I'd like to introduce our panelists, starting with the first one. In the interest of time, we will not be reading all the bios, but we will be available with the conference materials on our website. Please bear in mind each speaker will have six minutes. Our first speakers today are from Electrolux—Mike Brown and Daniel Lefebvre. Mike Brown is a Manufacturing Engineering Manager, and Daniel Lefebvre is a Project Manager and a North American Green Spirit leader. Electrolux was a project awardee for an Innovative Sphagnum Moss Water Efficiency Project.

So, Mike and Daniel, please go ahead.

*Daniel Lefebvre:* Thanks, Bruce. Hello, everybody, I'm Daniel Lefebvre, Project Manager at Electrolux. So, thanks to the DoE Better Plants program for this recognition. This project that my colleague, Mike Brown, will cover in a few seconds is a typical example of projects that we are doing at Electrolux to contribute to our sustainability strategy for the Better 2030. Can you change the slide, please? Yeah, thank you.

So, this innovation supports to our drive to be climate neutral. So, drive clean and the resource efficient operations, and elimination of harmful material. I will let Mike, our ME Director of our Kinston, North Carolina dishwasher facility explain this water treatment solution. So, thanks again, to DoE. Mike?

*Mike Brown:* Yeah, next slide, please, please.

Again, my name is Mike Brown, I'm the Manufacturing Engineering Manager for Electrolux Home Products, Kinston, North Carolina dishwasher facility. Our project involves the implementation of Sphagnum moss that took the place of the hazardous chemicals that historically are typically used in treating processed water such as cooling towers, chilling water loops, quench tanks.

The specific species of Sphagnum moss that is used in this system promotes the breakdown of scale and other contaminants and it has special properties that enables this to happen. And it actually, it gives us better results with better operating efficiencies, so it’s better and it’s also a very environmentally favorable solution.

If you look at the bottom left picture, you'll see the moss is provided or created in either bags or coupons. One of the challenges that the team worked on is to provide sufficient contact time, order contact time on the process order for the moss to do its work. And we went through all the operations in the factory and we are now 100 percent converted over to moss, and we have sustained it since 2017.

So, Sphagnum moss, it provides Electrolux with a sustainable biological wastewater treatment technology that has improved water efficiency, energy efficiency, and better water quality and odor and so forth. Next, please—slide.

Okay, so, you see the water savings, energy savings. Next. And then, as we say, it improves—it's less maintenance, because with the reduction in scale, for instance, in our towers, we now do not have to clean periodically. The towers essentially stay clean with little or no maintenance needed, and the material is actually reusable, recyclable as mulch or an oil absorbent. It's got a 10 time ratio on oil absorbency. Next slide.

The picture to the left shows the inside of the plastic tower for our plastics injection molding operation. That's before moss implementation. And if you look at the picture in the middle, this is after implementation and you can see a dramatic difference in the clarity of the water and scale buildup. And then, if you carry to the right picture, you'll see present day, we have sustained that same cleanliness—in fact, it's continued to get cleaner as we use moss. That's the one characteristic of this project—the longer you use it, the better the water characteristics are.

The information on the bottom shows the plastic water loop molybdenum, iron, conductivity, and microbiological contamination before the testing and before our conversion, and then after conversion, you see the dramatic improvements in every area, every category. Specifically, we were going after improving the conductivity and the molybdenum and the recent test, you can see the analysis of May of this year, we have continued to improve, and you see all the numbers are getting steadily better over time. So, we have, to demonstrate this, this will absolutely prove that it is very sustainable project. Next slide, please.

One of the key KPIs that we have on Green Spirit, our Green Spirit program, is water reduction year over year targets. Thanks to Sphagnum moss, we were able to achieve the goal of—we actually had a 5.6 year over year reduction from 2017 to 2018, and moss was a big part of that. So, in addition to having a cleaner process that's more manageable, maintenance-wise, we also had a very good water savings program. *[Alarm bell rings]*

*Bruce Lung:* That's the six minute mark. If you are just gonna be finishing it up, that would be helpful.

*Mike Brown:* I'm finished.

*Bruce Lung:* Okay. Great. Well, thank you very much. That was a great presentation. Next, I'd like to introduce Ms. Amy Costello from Armstrong Flooring. Armstrong Flooring was, they were a practice awardee this year for a Zero-Kilowatt challenge that enabled them to shut off a lot of unneeded applications. Amy is the Sustainability Manager for Armstrong Flooring, and with that, I'll let Amy take it away.

*Amy Costello:* Awesome, thank you. Armstrong Flooring is honored to have been selected as a Best Practice winner. Our Best Practice submission was actually titled Zero-Kilowatt Challenge, and the goal of this challenge was to reduce energy by updating our planned shutdown procedures. And so, what we mean by a planned shutdown procedure, it’s just when the plants have been intentionally brought down, so when we're not operating our production lines. You can change the slide.

And so, what we wanted to do is reduce the energy when we, our plants were shut down, and we also wanted to benchmark our process, because we really didn't understand, as a company, what should the amount of energy be for our plants when they were shut down. So, what we did is, we asked our plants to simply update their procedures, their planned shutdown procedures when the plant was not running, to reduce the energy to the extent possible.

And so, they systematically went through and they looked for the opportunities to reduce energy. And we titled it a Zero-Kilowatt Challenge, even though we knew we would not be able to get to zero kilowatts, because when our plants are shut down, we still have maintenance crews that are in the plants that are working in the plants. But we really wanted the plants to be able to go as low as possible.

And so, we started off with some really simple, easy things that, changes that they made to their shutdown procedures, things as simple as including in our shutdown procedures a map of where the light switches were located so that anybody who was new to the company would know how and where to turn off our lights. We progressed into adding sensors so that the lights would go on and off automatically so that was not an issue.

But the real effort that, where we got probably the biggest impact was really analyzing the equipment that was running in the plant during our planned shutdown procedures and really trying to determine how we could turn the pieces of equipment that were running, turn those off on the weekends and during the planned shutdown. So, for example, we had our compressors, we were running our compressors at our Lancaster, Pennsylvania plant, which is the plant we started doing our challenge with, and we were running our compressors over the weekends. And we were running them because we wanted, we had to maintain the fire suppression system, but what we realized is, we didn't need to run those compressors to maintain the fire suppression system. So, we were able to bring down one compressor and still be able to run our fire suppression system with the other compressor.

And so, our maintenance manager was able to look at what, how much energy we were using at the plant. We used our demand management system, so it’s real time data, he could go in, he could turn off equipment, look at our demand management online system and see how that was impacting our energy. And that really led to kind of our key performance metric and that was kilowatts used during plant shutdowns.

So, we basically looked at how much, how many kilowatts we were using at 11 p.m. on a Saturday when the plant was shut down, and we did this before we started studying and making changes to our shutdown procedures, and then we did this after we made changes. We were using about 800 kilowatts at 11 p.m. on a Saturday. And after—on average; there were fluctuations and we’d go up and down, but kind of as a mean, it was about 800 kilowatts. And as we went through this process, we could watch the, it’s almost like a stair step of watching our kilowatts go down, Saturday after Saturday, as we implemented new things to further reduce energy. And by the time we were finished, we were actually, had gotten down to 350 kilowatts was kinda the lowest that we were able to bring the plant, but on average, *[Audio skips]* plant staff to really look for these opportunities to further reduce our energy.

And so, what the *[Audio skips]* was really that you need to establish and review your shutdown procedures at least annually, and probably more. And what we're doing, and we were not doing before, is when we have our engineering, our capital engineering, when we have large projects, when we close out those projects, the last step in that phase is to really go back and update the shutdown procedure. So, as we put in new lines and new equipment, we were not updating our shutdown procedures on a regular cadence, and I think that’s really important if you're not doing that to look at how—when were your shutdown procedures last updated.

Also, regularly monitor, track, and share the energy use during shutdown. We shared it with our plants in house, we shared it with the team of what we were doing, but we also learned there was a lot of value in sharing between our plants. So, with not just the Lancaster plant, but with our other plants as they learned how to do things such as bring down—turn off the chillers and the learning that was involved in figuring out how to do that, transferring that knowledge to our other plants so they could also take advantage of that situation as well.

And then, the last piece that I'll share is really understanding the energy use, data as a diagnostic. I mentioned that we shut down our compressors. We learned that our compressors would actually turn on every six hours to maintain our fire suppression system. And then in December of last year, our Maintenance Manager noticed that our compressors were now turning on every five hours. And then at the beginning of this year, our compressors were coming on every three hours. And we were actually able to diagnose a water leak because we were monitoring our shutdown procedures. And I thought this was really cool that we were able to use our shutdown energy and the fact that we were monitoring it so closely to identify our water leak before it even showed up on our water bill or there was any sign of a water leak within our facility.

Also, as a procurement tool, one of the things we've learned as we've gone through this process is that some of our equipment, we cannot shut down. And we've talked to our equipment suppliers and they've said, “No, absolutely, you cannot bring this piece of equipment down, because it will cause damage and you'll permanent cause problems with the equipment.

And so, that’s really led us to think about, as we look at new technologies, to ask the question up front when we're thinking about different technologies and different equipment is to ask, you know, how do you shut this piece of equipment down, can it be brought down, and use that as maybe part of the selection process as you're looking at equipment to use in your facility. So, again—

*Bruce Lung:* Thanks, Amy. I think we're just past the six-minute mark.

*Amy Costello:* - *[Cross talk]* for the Best practice challenge and hopefully you've gained something from this presentation. Thank you.

*Bruce Lung:* Thank you very much, Amy. Next, I’d like to present, from the Ford Motor Company, Jeff White, who’s the Energy Manager for Global Utility Supply and Efficiency. Ford Motor won a Better Project Award for redesigning their plant and including CHP in the new plant's redesign. There's also a lot of other innovative things, and I'll let Jeff go ahead and tell us all about it. Go ahead, Jeff.

*Jeff White:* Thank you to the DoE team for hosting this conference and inviting me to speak on Ford's behalf about this new Central Energy Plant. Next slide.

Yeah, next slide. The who, what, when, where, why, and how of this project is a remarkable story of vision, collaboration, and cooperation to deliver a state of the art energy center that will function as the heartbeat of Ford's Research and Engineering Center in Dearborn, Michigan. Next slide.

The companies listed on this screen cooperated to do an amazing construction feat, such as putting up the tilt up pre-cast walls for a 100,000-square foot, 2-story building in one week, putting a 5,000,000 gallon tank up in 2 weeks, building everything on skids to minimize congestion on site, prefabrication of pipes and structures to minimize on site welds and labor. For example, more than 80 percent of the piping installed on this project was shop fabricated to minimize field welding. Next slide.

This project began with a vision of a new, modern campus to attract and house the next generation of Ford's employees in Dearborn, Michigan. Next slide.

The utilities serving the campus were old, failing, and inadequate. So, a new, 200 psi gas service to power the plant and consolidation of six different electrical feeds into two 120 kV services ensures energy reliability for the foreseeable future for this campus. Next slide.

For those of you who don't know, the Ford campus is in Michigan. Next slide.

All of the necessary utilities to heat, cool, and power up the new campus were considered in the development of this project. We said good bye to the old Albert Kahn designed steam plant to welcome the addition of a new, modern central plant. Next slide.

Beginning in 2016 and concluding with the Certificate of Occupancy and commencement of commercial operations on December 31st of 2019. Next slide.

N+1 utility resilience and environmental impact of this facility were two of the key design requirements that drove a recursive co-design process intended to ensure risk mitigation and cost controls. Next slide.

There were many questions as to how this project would come together. Next slide.

And this slide represents a sample of how those questions drove the thought process, the selection of the partners, and the ultimate design as an ahead of the meter facility. Next slide.

The contractual relationships that were developed between private regulated and non-regulated entities is unique and serves as a model for how this country can solve regional and local utility infrastructure needs and improvements. Next slide.

For example, the regulated utility owns the gas turbines and heat recovery boilers. The output of those assets are sold to Ford at tariff rates. The balance of plant and the building itself are owned and operated by the unregulated affiliate. The output of those assets are owned by Ford and the ownership of the assets themselves transfer to Ford at the end of term. Next slide.

I've included some pictures of key systems, but six minutes is woefully inadequate to cover the amazing team effort that went into the design, construction, and commissioning of this facility. Next slide.

While scrolling through the remaining pictures, I will take about the digital twin aspects of this project. Next slide.

The entire project was developed as a 3D model. The model dictated where every pipe hanger, every fire suppression head—next slide—every conduit, cable tray, and pipe should be located in 3D space. Technology was used to mark precisely where each and every pipe hanger should be located. Each one was installed before any pipe was delivered to the site. Next slide.

The pipes were numbered and lifted into place, and then technology was used to validate the actual installation and ensure alignment with the 3D model. Next slide.

Systems such as the thermal storage tank were used to model stratification design for the chilled water supply and return to the campus. Next slide.

Pipe fitters had several on-site computer displays to reference the 3D model as needed. Next slide. The 3D model was then further enhanced into a digital twin that contained specifications and operating parameters—next slide—on over 3,500 distinct operating assets. Next slide.

Handheld devices and augmented reality capabilities will leverage the 3D functional capability of the digital twin to validate operations and establish preventative maintenance requirements. There are many unique design features of this facility, including the ability to incorporate future planned geothermal capacity. Everything from a central plant perspective is integrated to include up to 3,000 tons. Next slide. And next slide. And next slide.

This picture was taken on the day the steam blows to clean out the steam piping was occurring and you can see the plumes in the background there. This was just about, I don't know, a month before the final commissioning activities were taking place in the central plant. Next slide.

Overall, this was a stellar project that I was privileged to be involved with. The vision and goals set back in 2016 were achieved due to amazing efforts of so many people working together to turn an idea into an unbelievable end product. I could use my entire allotted time saying thanks to those people. Likewise, there are many innovative aspects of this project that’s left untouched with this presentation, and I'm sure those discussions will come at some future date. Thank you for your time. Next slide.

*Bruce Lung:* Thank you very much, Jeff, and I think we're gonna get a lot of important questions based on the slides so far, so hopefully, you'll get more chance to talk about this project.

I’d like to then introduce our next speaker right quick, here. The next person is gonna be from Celanese Corporation, David Reid, who is Senior Manager for Global Energy and Productivity. Celanese won a Better Practice Award this year for its employee engagement and education initiative called the Energy Sparks. So, David—feel free.

*David Reid:* Alright. Thanks, Bruce. Before I get started, I'd like to thank the Department of Energy Better Plants Program for recognizing us with this award. It's really great recognition for our energy program and the energy teams that put this together. Next slide, please.

For a success energy program, those technical solutions to energy reduction are essential and really drive the energy improvements that we're all looking for. And many of the projects that you'll see today fit into that technical arena. But when Operations teams that operate these projects and our plants lack the knowledge of the energy systems and the equipment, sometimes even the best energy and technical project can underachieve. But with more knowledge and understanding, the 24/7 teams, the Operations teams can better operate, better troubleshoot and resolve the energy issues faster and more effectively, allowing some of these projects to really hit their marks.

So, the Energy Sparks are a simple tool to increase that knowledge and understanding of the shift team level in a manufacturing plant. Next slide, please.

So, unfortunately, the people side of an energy program is an often overlooked aspect of a long-term successful energy program, engaging and getting commitment from those employees to get involved and participate is really essential. And I think that most people want to contribute, but sometimes they feel like they don't have enough information or enough knowledge to take part, so they don't participate. And like I mentioned before, some of the best energy projects and equipment that we put in can underperform through things like misoperation or just lack of knowledge on how the system is supposed to work. So, through those misunderstandings or knowledge gaps, the system sometimes can be operated with things like incorrect set points, inefficient lineup of equipment, or sometimes even in manual mode to bypass the automation that we put in.

I think we've all seen this in our plants, I'm sure. When energy people in the plants don't have that knowledge of how basic equipment works or the knowledge to recognize when it's faulty or in need of repair, sometimes they can fail to identify and correct the problem. And also, they can become complacent in efficient operations.

So, also, when our teams don't know the dollar value, the magnitude of the energy losses, they don't realize the magnitude of what can seem like an insignificant issue, like a steam or a compressed air leak. Next slide, please.

So, what are Energy Sparks? So, Energy Sparks are a tool we developed in Celanese to give our Operations teams who are running our plants that knowledge that they need, enabling them to have a stronger understanding of energy as it relates to their jobs and what they do in the manufacturing plant. We picked topics that made sense for our plants. The goal is to share that knowledge and spark conversation, get action in the Operations teams, and also generate some new ideas around energy efficiency and cost. So, using some resources like Department of Energy tip sheets, Energy Sparks are a simple and quick, two minute fact sharing and conversation starter in a simple, "did you know?" format. They cover a wide range of topics, again with that manufacturing mindset, including things like steam traps, compressed air, insulation, and pumping systems—things that our operators see every day. Now, the Energy Sparks can be shared at shift toolbox meetings at the beginning of their shifts or also can be displayed on bulletin boards, electronic bulletin boards across the plants.

Now, our shift supervisors in Celanese are always looking for topics to cover with their teams to generate engagement for whatever topic, and Energy Sparks give them that tool to get their team thinking and motivated about saving energy. Next slide, please.

So, the Sparks are really only part of an overall energy management strategy and they contribute indirectly to energy reduction by driving engagement to make that difference, but that difference is, in the end what results in the improved energy efficiency use and cost. So, one example of how Energy Sparks made that difference—at one of our plants, an Energy Spark on steam traps was shared with the Operations shift team, and the Energy Spark talked about how to detect a failed trap and shared with the shift operators at the toolbox meetings.

Now, the site already had a maintenance program in place and annual inspections of their steam trap that was done by an external company, but the operators, following up on what they learned, suggested to do some further checks. Now, only two weeks after the external steam trap inspections were done, an operator who was doing his own checks found a critical broken steam trap and was able to get it repaired, almost immediately saving almost $7,000.00. Now, that may not seem like a lot of money, but these small improvements add up, and most importantly, they engage the operators with the result that they feel like they contributed to.

So, this is only one example of how Energy Sparks initiated conversation and action at the shift team level. Next slide, please.

So, currently, we have 16 Energy Sparks that are available in English and Spanish, and our goal is to do two things—one is translate them into other language to ensure we connect with the teams covering the footprint right across Celanese, and also to continue to expand the number with new topics that relate, again, to our Operation teams.

Now, a couple of things that are really important, I think, that Energy Sparks can be adapted to any subject in the sustainability space, including things like water and waste as well as any kind of safety and environmental subject. And also, I think this is really important—as employees become more engaged in energy reduction at work, this mindset carries over to their home and community life as well. And this tool, you know, for other companies, it can be easily adapted to any company who, like us, are trying to engage employees in energy and sustainability efforts. Companies can develop Sparks that are relevant and specific to their business, ensuring that meaningful topics are covered that connect with their teams.

So, again, thank you to the Better Plants program for the recognition and thank you, everyone on the call, for your attention.

*Bruce Lung:* Great. Well, thank you very much, David. That was a great presentation and right on time. I'll go right now to the next speaker. We have with us today Alex Zhang from Lineage Logistics. Alex is a Senior Systems Engineer on the Data Science team, and this year, Linear won a project award for an innovative blast feature design and controls optimization project, so I'm really looking forward to this and Alexander, go ahead when you're ready.

*Alexander Zhang:* Okay, thank you. Good morning, everyone, and thanks for attending, and thanks to DoE as well. It's an honor to be presenting here today.

So, I'd like to see how Lineage has been improving its blast freezing process. It's been an extensive and long journey and it's still ongoing, so let's dive right into it. Next slide, please. Next slide.

So, real quick—what is Lineage? Lineage is, we own and operate a bunch of cold storage warehouses, like the one pictured right here, and it's pretty self-explanatory. We store frozen food and we're a critical step in the global food supply chain. Next slide, please.

So, we have a global presence. We're the largest international refrigerated warehousing company now with over 200 facilities worldwide—or almost 200 facilities, I think. And in the U.S., around 30 percent of all frozen food will touch our warehouses at some point. But these warehouses use a lot of energy as well, so we have a large energy footprint, in the megawatts for some of these facilities. Next slide, please.

So, real quick—what is blast freezing? Usually, we just store frozen food where the food is already frozen, and people give it to us, and then we keep it there for the duration before sending it off to the end user. But in the blast freezing process, we take food that is still at ambient temperatures, like freshly produced meat packed product, things like that, and we rapidly chill it in a room we call a blast cell, which is at negative 20 or lower Fahrenheit, and then we cool it as quick as possible to maintain the food integrity, food quality, and food safety so that they can go into our freezer before we ship it out to the end users, the supermarkets, et cetera, restaurants. Next slide, please.

So, here's an example of blast product where, at a certain facility we have in California, overnight, they might just see this show up. These are just a bunch of 2,000 pound pallets of strawberry drums. And so, the customer will ask us, "Hey, we have these truckloads of these drums you see here. Can you quickly blast freeze it all for us?" So, next slide, please.

So, we have to put them into what we call a blast freezer, which is a room, using the refrigeration system that we have that blows out really cold air from these evaporators—again, negative 20 Fahrenheit or lower—and cycles it through this racking space where we'll put all the different products. So, in this case, it would be all these strawberry drums as the example put forth. Next slide, please.

So, what makes a good blast cell? There's two main components. You need the blast cell to be cold enough—so, that's part one. The temperature and refrigeration capacity needs to be appropriate. And then two, you need good air flow. So, I think the best analogy here is, it’s kind of like a water hose. You need enough water pressure and you need good distribution so you can water effectively. Next slide, please.

Please play this video. So, this is just a quick video of how a good air flow should look like when it’s going through the, like, one pallet. In this case, these are just boxes. So, you want the air to be able to touch as much surface area as possible as it’s moving through each of these pallets. Next slide, please.

So, we 3D modeled the existing design that we had to see how the air flow distribution was within the cell, and these are the results that we got. So, red is fast and blue is slow, and you can see what we're really aiming for is equal distribution of air flow and we're not getting it here. So, next slide, please.

So, we took a fluoroimager as well to see if the real world results would match our simulation results, and we got what we kind of expected where there’s like a differential gradient in the freeze rate of the pallets when we load one load. And that’s not good because each of these pallet loads are loaded in one batch, so we have to freeze and remove everything at the same time. Next slide, please.

So, we basically ran an R&D project where we tunnelized the design. The easiest way to control air flow is just to blow through a tunnel, point A to point B. So, we modulized these tunnels, we put these louvers on the back to control the air speed, and that was the idea behind this design. Next slide, please.

And so, here’s the simulation results of the tunneled design where you can see the air is being drawn through equally through each tunnel, and the air flow is controlled by the louvers on the back side of each tunnel. Next slide.

And we built it in real life, so pictures in real life, it matches the model that we made. Next slide.

And we tested it out using temperature sensors where we put in each of the pallets to get the freeze curves. So, these are the results—we managed to cut down the average freeze time from 75 hours to 50 hours, so it’s a good result. Next slide.

We wanted to come up with a newer design that uses less moving parts, and so you see it here, what we call the guided air flow design. We're just using more air guiders to control the air flow. Next slide.

Here again, you can see the air guiders. The idea is just to use these kind of like turning veins to control the air flow instead of using louvers. Next slide.

And we tried to make this modulized as well. Next slide.

So, here, you can see the comparison between one of the existing designs on the left and the new design on the right. And after a couple seconds, you can see how we get good temperature distribution on the new design, but on the old design, you have this disparity between the pallets that are on the top and the pallets that are on the bottom. Next slide.

And you can see that here as well with the air flow. Next slide.

So, we built it in real life. Next slide.

And then you can see it here as well. I LiDAR scanned it, so it looks pretty much as you would expect. Next slide.

I just want to dive into the results here where we cut down the freeze time to 35 hours from a 72 hour freeze at this facility. Next slide.

And if you look at the projections, we are basically able to double the throughput with a 20 percent energy efficiency increase. Next slide.

So, we're still working on new changes. We want to work on bidirectional air flow and things like that, so it’s still a work in progress. Next slide.

And then the next, last two slides is, we patented this design and we're still working on future improvements.

*Bruce Lung:* So, I think we're just past the six-minute mark, Alexander—thank you very much.

*Alexander Zhang:* Yep, thank you.

*Bruce Lung:* Yeah, very good—impressive, and we're glad that you all applied and got the award this year.

I'll go ahead and introduce our next speaker. That is gonna be, from General Motors, Ms. Kate Peterson. Kate is the Energy and Carbon Optimization Engineer, and this year, General Motors won a Better Practice Award for their project tracking and interplant communications. So, I'll late Kate take it away.

*Kate Peterson:* Thank you, Bruce. And Cliff, you can go to my title slide.

Hello, everyone. So, I'm with General Motors Sustainable Workplaces in the Energy Carbon Optimization Group. And first of all, we want to thank DoE for selecting us for the Better Practices Award. It’s an honor to talk here. And today, I'll be focusing on the General Motors Project Roadmap. You can switch to the next slide.

So, this Roadmap was created to address our GM sustainability goals. In particular, one of our goals is to reduce our 2010 carbon emissions by 31 percent by 2030, and this goal is largely achievable with energy efficiency projects, which I'll talk about today, and our renewable energy strategy. So, energy efficiency projects are largely identified by third parties, by people in the plant, and by energy treasure hunts. And energy treasure hunts are really just three day deep dives into the energy and water procedures of plant production—doing plant production in non-production times. And then on the third day, you can see there’s a picture on the right, it shows a presentation to plant leadership which presents our findings and then potential projects that the plant can pursue.

So, we've done a lot of these energy treasure hunts, which is great, because it means we've amassed a lot of efficiency projects and water efficiency projects. The only downside to that—and actually, Cliff, if you’d go to the next slide. Thank you. The only down side to that is, we've really never thought to try to share all of the plant projects with each of the plants. So, pursued projects were generally tracked as a part of the plant’s energy performance measures. However, suggested projects like ideas from the energy treasure hunts really just kind of remained in the energy treasure hunt folder for that particular plant. So, in general, it was kind of kept, like, out of sight, out of mind for a while. And then any completed projects were not really compiled for other plants to view. Instead, project information was generally delivered, like, through the grapevine—if one plant manager knew another plant manager, for example. You can go to the next slide.

So, we realized we needed a tool that would track both past and current planned projects, and we wanted this tool to be live so that it would update with the most current plant project information. We also wanted this plant project information to be available to all plants. So, we wanted to share both past projects that were created maybe in like 2016 all the way up through the current projects that plants are working on today with all of the GM facilities. And we wanted this information to include the granular details, like the cost to implement, the energy savings that they expect, the energy savings that they actually found, et cetera.

And we wanted this tool to be really easy to use. We knew that if it had some sort of interface that was a challenge for plant managers to learn, they probably wouldn't use it. So, we kind of stuck to the Excel format to really showcase this tool. And we also wanted to show really concise and easy to understand project information in visuals that the Plant Energy Managers could present to plant leadership, for example, if they were trying to suggest some sort of energy or water project. Next slide. Thank you.

So, we came up with the Project Implementation and Identification Roadmap, which is a mouthful, so we just say Roadmap, and on the bottom right, there is a screenshot of one tab of the tool, and as you can see—I mean, you can't see because it's all blurred out, but we've listed all of the projects from all of the plants. And then, towards the top, you can see that plant managers can go into their specific roadmap and actually filter down to see the specific equipment or system that they're interested in and look at energy opportunities that any other plant has pursued in the past, I think, four years is what we've been tracking. And as I said, this is live, and we are able to do that using Power BI. And if you guys have any questions on that, you can feel free to submit the questions to Slido and I can address that at the end if there's time. So, you can go to the next slide.

So, while this does improve plant to plant collaboration, it also really improves project tracking within the plant—like, for the Plant Energy Manager. So, it tracks projects from ideas that were suggested in treasure hunts—like, you can see is selected in the screenshot there—all the way through completed projects. And we asked plants to input information like what kind of budget it came from, their actual energy savings and their estimated energy savings that were estimated when this was an idea, and then all the way down to the actual cost of the project so that we can actually know and be better—better estimate for next projects that we come up with. All of these details also offer project duplication and benchmarking for other plants to pursue. If you could go to the next slide.

So, this Project Roadmap could always be improved and, due to COVID-19, we weren't exactly able to get any feedback up until this point, but we're excited as clients are starting up again to receive that feedback. We're also excited to expand globally to all of GM manufacturing sites, because as of right now, it's really only been broadcast in the United States, and I would also love to collaborate with industry partners.

Thank you. I think that's all the time that I have for this, but it's been a great privilege.

*Bruce Lung:* Thank you very much, Kate. You're actually a couple seconds early, so thank you very much for your great presentation.

Our next speaker is Mr. Nathan Onchuck from Ozinga Brothers. And Ozinga Brothers, I'll just give an aside, is technically more of a construction company, although they do they have industrial scale energy using applications, and this shows how we've been able to expand beyond the mainstream manufacturing and we're still growing, so we can continue working with companies like this.

Nathan is the Energy and Sustainability Manager for Ozinga. They've won a Project Award this year for their Data Log-in to Maximize Energy Efficiency project, and they also have a great compressed air example. So, Nathan, take it away.

*Nathan Onchuck:* Thanks, Bruce. You can go ahead to the next slide. Again, we're really appreciative of the help that we've gotten with this project from the DoE. You'll see shortly that their loan program—their equipment loan program actually ended up being the catalyst behind all of this.

But I wanted to start with this map that shows all of our locations in the, all of our ready mix concrete locations. And I think there's a unique challenge to our industry that each dot you see on here, the entire plant really has a motor load less than a single piece of equipment at some of the other major manufacturers that are recognized by the program today.

So, anything that we wanted to do to get real time data from these plants on their energy usage had to be, I guess, cost effective sounds a lot better than cheap, but I think cheap gets the point across better. *[Laughter]*

So, if we go to the next slide, we've got—we already had a good idea of what some of our significant energy users were going to be, and it was the air compressor that ran the plant, the feed belts that move all of the raw materials into the plant, the central mixers at plants that have those, dust collection, and then we expected the remainder to be made up by just small horsepower ________ blowers, but for the most part, we don’t have major cooling loads or anything like that. So, overall, it’s a relatively simple list of equipment.

And if we go to the next slide—we ended up coming up with the equipment loan program partially because we, I have friends in IT, so we had initially started looking at what it would take to connect everything and let’s just get real time data for every piece of equipment in the plant. And we kinda quickly found out that that would cost more than we spend in energy, so it wasn’t going to be possible to recover those costs.

So, we started small and worked with both our TAM Christina and Darryl who helps run the DoE’s equipment loan program to just try out different data loggers. And we found that using just CT clamps and pressure transducers, we were able to get a surprising amount of information off of our plant equipment. So, if we go to the next slide.

One of the first projects that we had done was just monitoring one of our rotary screw air compressors. And the compressor was set up initially to maintain just a 10 psi pressure band, and it would run in a load/idle cycle. So, the motor was turning the entire time that the plant was open. And we were able to make these charts that you see, just showing whether the motor was loaded, idling, or shut down completely.

So, you can see the first chart shows that the compressor was running all day long. And, when we really dug into the compressor manual, we found that it actually had some different operating mode settings. And one of them was called this burial mode that the compressor would actually track its own motor starts and motor temperatures to decide whether or not it could idle or just shut down completely. And then, in order to give it more time to be shut off between loads—our plants are very batch focused. We're either loading a truck and using air, or we're waiting for the next truck to pull under and we're not using any. So, we reduced the lower pressure set point by 15 psi to now give the compressor 25 pounds of storage between cycles and then put it into this burial mode. And what we saw was a 68 percent reduction in the compressors' run time throughout the day, and a 65 percent reduction in the compressors' energy intensity.

And the next slide shows how we were able to take that same data—although this chart is actually from a different compressor—and model how much air we're using throughout the day. So, we used a three-minute average—that's the red line—as that lines up pretty well with what our batching timing takes. So, we actually found that this compressor was undersized for the plant when we were really busy and it'll be moving to a new plant that's smaller, has lower air demand, and it'll be getting replaced by two smaller machines that we were able to size based off of this data.

And then the next slide shows one of the other tests we did just on conveyors. So, this is from a feed belt, and we realize that the conveyor runs empty almost the entire time that it's running, just because it's on manual controls. So, we're going to be installing a soft starter on this conveyor and tying it into our batch sequence, so it starts and stops automatically as it's needed, and we'll hopefully see that utilization ratio go up after the project.

And the next slide—so, that knocks out two of our biggest energy users. And our hope is, with this data, we're going to be able to prove out these projects and start to build a repeatable project that we can take to all the other locations and hopefully start to really scale some of these different energy savings projects.

And that is all I have, so thank you, guys.

*Bruce Lung:* Great. Well, thank you very much, Nathan. That was a great presentation.

I'll jump now to our next speaker. This is Robin Davis from Imerys Carbonates North America. Robin is the Energy Engineer for Imerys and they won a Better Practice Award this year for their dust collection system optimization and standardization across the enterprise. So, Robin, go ahead, please.

*Robin Davis:* Thank you. We're real excited to win this award and I'm very excited to be sitting here talking to you guys today. Next slide, please.

So, yes, our award, or our project that we took over was the dust collectors within our plant. A little bit of background on Imerys. Next slide, please.

Imerys is a mining and mineral resource company, a world-wide, global company. We mine out of the ground around 30 minerals, and what we like to tell people is, we take dirt and rocks and we make it a usable product. Some of us never really grew up. We still like playing in the dirt.

So, one of the challenges we have with taking this dirt and all these rocks are, it generates a lot of dust. We end up with multiple types of processes that require dust collectors, and we have this all across the sites worldwide, and we noticed that no two sites handled it exactly the same. If you'll jump to the next slide.

We have, electricity is our second biggest energy consumer and one of the biggest uses of our electricity is compressed air. And most of our compressed air is used in these dust collectors. Most of our dust collectors throughout the plants, they're there for environmental compliance, you're gonna stick with, you know, maybe EPA or an EPB compliance, but some are also used for conveying purposes or process purposes. When we realized that multiple sites across the U.S. were managing it differently and had different projects going on and different ways to save energy and some weren’t saving energy, we realized there was a big opportunity here.

And so, we sat down as a group and we had the Asset Management Group from our Corporate Group as well as our Global Energy Teams basically sat down and said, “This is gonna be our first area.” And we like it because it covers EHS, it covers energy, it covers plant reliability—it basically covers a whole spectrum of the business, and this is gonna really help us be a better company and be more sustainable. Next slide, please.

So, looking at just North America, you know, we have 40 plants in North America. Within these plants, there’s over 500 dust collectors. Again, most of them had different kinda ways of handling this. So, what we did was, we reached out and we took all the leaders from these plants and said, "What are you doing with your dust collectors? How are you managing them?" Most had some initiatives ongoing that we were able to bring in. Some said, "We just make sure they're in operation and we forget about 'em." So, we kinda rolled all this up and put it all into one package of what's everybody doing and what's the best way forward for the company.

We then went beyond that and we reviewed industry standards. We talked to many of our suppliers, anything out there from other companies, other best practices, and we reviewed it and compiled it all into one document, which, you can see the cover in the picture, here. But basically, this is gonna be the reference form that everybody's gonna go to when they said, "I need to work on a dust collector. I wanna make improvements in my dust collection system." And this is full encompassing from the very beginning, all the way through the end of the process with a dust collector.

Again, we covered recommendations in there for EHS, the energy production, maintenance, the whole gamut that would affect the company. And we released this document on March 18th. So, it's just now getting rolled out. I want to talk about a few of the initiatives we've already had ongoing that went into this best practice. But now, everybody is a part of it, and we're starting to roll this out on a lot of the other sites. And we've gotten good feedback, too. A lot of the sites have already taken it and run with it and said we've been needing something like this and we want to implement as fast as possible. Next slide.

So, just kinda talking about some of the things that we included in this best practice, one of the first things we found was just lowering the plant air pressure. A lot of our plants kinda went through the years on, if 80 psi is good, 90 is better, and 100 is even better than that. And we realized that we were just over generating compressed air for no reason other than we said it was gonna be better.

So, some of our facilities have been able to reduce just overall plant header pressure which gives us a very easy, quick win on the energy aspect. We went out and we found new technologies as well, particularly with these pulse valves, and the ones we've kinda started using are from a company called MAC—MAC Pulse Valves. It's just a new way of handling this. The old system was an old rubber diaphragm that had been around since the 1960s. It does work, but of course, technology has come a long way. So, using these new technologies is helping us in terms of reducing the compressed air used in our dust collectors.

Water separation before the dust—you can imagine a fine dust, a fine dirt dust and water does not mix very well. So, we wanna make sure we get all that water out before it reaches our dust collectors. We've come across a couple companies, Tsunami is one that we're kinda looking for, but there's multiples out there. And along the lines of EHS and kinda how to not only save energy, but get kinda the buy-in and how to apply it across the board, we started looking at things like differential pressure on these dust collectors. This has been a big help. the environmental groups, EHS have loved this, because it helps them monitor their compliance, do some permitting, as well as troubleshooting when we do have something and we have to go back in and look. So, that's been a big help within the plant, just simply some automation and sensors within the plant.

And then also, we're looking at, have been putting in a pulse on demand system. And basically, a lot of our plants originally working under continuous pulsing, which basically means it's pulsing on a set schedule continuously, 24 hours a day, 7 days a week, 365 days a year, unless we flip the off switch. So, at a lot of our plants, the new way of going about technology is, we can actually put this on demand and it's based off the differential pressure. So, as the differential pressure climbs, it'll actually turn the pulses on when it hits a certain differential pressure point, and it'll shut the pulses off. So, again—

*Bruce Lung:* Robin?

*Robin Davis:* Yep.

*Bruce Lung:* You're right at the six-minute mark, so, if you can wrap up, please, I'd appreciate it.

*Robin Davis:* Oh, yep. Sorry. So, implementing the pulse on demand. Next slide, and I'll just hit the highlights.

So, I have some overview here about the Sandersville calcine plant. I think we've covered it with a lot of the new technologies. But essentially, what we've seen is, we've seen almost—or we have the potential of 14 gigawatts possibly reduced as well as 6,700 metric tons of CO2. So, it's a big impact for Imerys North America, and then on top of that, we're rolling it out worldwide. Thank you.

*Bruce Lung:* Great. Thank you very much. I'll go ahead and introduce our next speaker from PepsiCo. Michael Waitek is the Engineer on the Corporate Sustainability Team. This year, they won a Better Project Award for a co-generation project at one of their Gatorade plants in Indiana. So, Mike—go ahead.

*Michael Waitek:* Yeah, good morning, everybody. Thanks to the Department of Energy and the Better Projects Team for choosing our project for this recognition. It's really nice to be part of a project that can be recognized nationally. Go ahead and start in on the first slide, please.

I'm gonna present the Indianapolis Gatorade Cogeneration System, which is combined heat and power. The Cogen project at the Indianapolis facility was an important project for Gatorade and PepsiCo, and I'm excited to present the multiple benefits that the project provides.

The project was designed to lower electricity costs and save money as well as reduce our greenhouse gas emissions, which is part of PepsiCo's Winning with Purpose initiative. The PepsiCo's Winning with Purpose initiative is an initiative to reduce environmental impact of keeping our consumers hydrated and fed by making our products with the least amount of fuel, electricity, water, and plastic as possible. So, as I mentioned, this one reduces our electricity use from the traditional utility power plants and really helps with greenhouse gas emissions.

We had a couple partners with this project, both MacAllister Power Systems and Thermal Energy, Incorporated. MacAllister is the manufacturer of the engines—I'm sorry, and Caterpillar are the manufacturer of the generators and engines that produce the electricity, and Thermal Energy, Incorporated, has helped us with the design and installation of the heat recovery system ________ as well.

It was a $6,000,000.00 capital project that included the generators, the heat recovery system, and installation for all that. That provided about $1.45 million of annual utility savings in both fuel and electricity, and that resulted in about $1,000,000.00 a year net savings with the maintenance contract that we purchased to keep our generators and engines running in tip top shape. The really cool part about the project is, this resulted in a 35 percent reduction in greenhouse gas emissions for the plant, and with this particular plant being a large plant in PepsiCo, it represents about 6 percent of PepsiCo's 2030 goal to reduce greenhouse gas emissions. And we fired this system up on January 1st of 2019 wen the plant started up.

A little bit of information about the project that consists of three 1,700 horsepower natural gas engines that turn 1.2 megawatt generators, resulting in 3.6 megawatts of total output. That provides about 90 percent of our plant's electricity use when it's running at full load, and it also reduces our peak demand, which a lot of those in the industry know that peak demand can result in some really high electricity costs.

We really got this project in a good spot by utilizing heat recovery. So, all the heat, or I would say a lot of the heat that's generated by the engines from both the cooling system and exhaust are utilized for the processing of Gatorade. I'll get into a little bit more of that here shortly. It reduces the load on our natural gas boilers that are needed for processing Gatorade and of course reduces our overall and utility costs.

This system efficiency approaches 85 percent when it's running at its best, and that's really great because the normal utility efficiency for a coal-fired plant here in Indiana is about 35 percent. Next slide, please.

Getting into some of the details, the generators utilize a pretty specific or sophisticated control system to produce electricity only based on the plant load. Our generators are not intended to back feed the grid, here. It wasn't part of our project, based on financials. So, the generators are designed to analyze our plant load and only run to produce enough electricity to satisfy that load. They can run down to about 50 percent loaded, so basically, they run from 600 kW to 1,200 kW each.

I'm gonna get into the heat recovery. Gatorade is a thermally processed product, so, it provides a very large heat sink to utilize for engine cooling. So, the majority of the energy that's required to cool the engines is provided by transferring heat to our Gatorade product throughout multiple production lines. Now, we can raise the temperature of our product by nearly 40 degrees on some of our lines, dependent on the floor rate, which is, you know, is really good for more or less free energy used for cooling.

Not only in the cooling of the engines, but we also use the exhaust that's created by the three engines to make steam. So, the 700 degree exhaust is to make the steam with a boiler, a natural gas boiler that we converted for additional heat needed for processing. And you can see some of the graphics there that kinda show how our heat recovery system works and how the generators are controlled. Next slide, please.

Just wanted to show a few pictures of the project. The project did provide funding for a new building that all three generators are housed in. On the top left there, you can see the intake fans for building ventilation and then on the other side of the building is where the intake is for engineering. The project bid does have its own control room where you can see in the middle there, each generator has its own touch screen controls and operate individually or in tandem to the plant load.

There on the top right, you can see two of the three generators that are in that room. The generators are very large, but it's hard to get a picture of all three of them together, but you can see the size of the generators in that room, there. The bottom left shows the boiler, the natural gas boiler that we converted to what we call a heat recovery steam generator. There on the left-hand side, you can see the ductwork coming in from the engine exhaust center, and that replaced the burner of the boiler, that we used the heat from the exhaust to create steam. And then on the bottom right—

*Bruce Lung:* We're right at the six-minute mark. Real quickly.

*Michael Waitek:* - at the bottom right there, there's the heat recovery pump and heat exchangers that are responsible for circulating all the cooling water that cools the engine. And that's it for me.

*Bruce Lung:* Great. Thank you very much, Mike. That's a great project. I'll go ahead and introduce our next speaker.

Before I do that, I'm gonna say, we're probably not gonna have time to address the questions that we're getting, but we are gonna likely send them to the individual panelists and they'll be able to follow up with all of the people who submitted questions.

Our next speaker now is Bert Hill from Volvo Group North America. Volvo—I mean, Bert is in charge of Health, Safety, and Environment for Volvo Group. This year, they won a Better Practice Award for their Landfill Free diversion efforts. So, Bert, go ahead.

*Bert Hill:* Okay, thank you very much, Bruce, and I'd like to thank the DoE for this award as well as all the other cooperation over the last 10-some odd years. Next slide.

As Bruce mentioned, the name of this project is the Landfill Free Directive, which we developed at a corporate level, and then also a certification process for our plant to achieve that certification. Next slide, please.

So, a couple of things about the Volvo Group. We are about 100,000 people. We have production in 18 countries and sell our products in more than 180 markets. Next slide, please.

So, our stated mission is driving prosperity through transport solutions. And when we say prosperity, we main sustainable prosperity, because prosperity by itself is no good to anyone, so we want that to be sustainable and benefit mankind. And then Transport Solutions, we're moving from selling products to more selling solutions. So, an example of that is a pilot project we've got running in Norway where we have a piece of construction equipment that works kinda like a Roomba vacuum cleaner, but it hauls materials from one location to another all day long. When it gets tired, it'll go hook itself up to the charger and get charged up and go back to work. If it starts hurting, it'll call up the mechanic and say, "My bucket hurts. Can you come take a look at it?" and the mechanic will come out and take a look. So, we're moving into more solutions like that. Next slide, please.

So, the principle we've followed for all of our waste reduction activities, it's called the Waste Hierarchy, and some of you may have seen this before. But the best thing you can do in waste management is to prevent the waste to begin with. And that is followed by this big section with reducing, reusing, and recycling, which you've probably seen around. And the fraction we can't take care of with those methods, then we send to Energy Recovery. And what we try to prevent at all costs is incinerating something without getting any energy from it or sending it to a landfill. Next slide, please.

So, I'll run through some of the initiatives that we've used according to this principle of the waste hierarchy. We've done studies where we've looked at the amount and types of packaging that are coming from our suppliers with the components, so we get an idea of what they're sending us, how much they're sending us, and then working directly with the suppliers to reduce that amount of packaging. And one thing our logistics group has done in this is to create a system with returnable and reusable Volvo emballage. You'll see that in the photo at the bottom, there. So, we create a loop there with our suppliers where they supply the components in this emballage, then we send it back to them, and we prevent one time use packaging.

And then another big component of this are plant level initiatives, of things you need to set up to create this reduction, reuse, and recycling program. And that’s things like implementing the infrastructure, putting in signs, training employees.

And then also, here in the U.S., we're a little bit worried about our liability from sending waste to landfill, because many Superfund sites are landfills, and we don’t want to get caught up in that. So, we did a benchmarking project with nine other major U.S. corporations to see what they were doing to reduce their liability. And what came out of that project was that most of them are using a national account with a single waste vendor. That way, they can cooperate with this vendor to try to reduce their waste and also limit the number of facilities where the waste is going. So, we've done that to try to reduce that liability.

And then the project I'll be spending a little more time on, the Landfill Free Waste Directive and the certification process. Next slide, please.

So, the certification process comprises these four elements that you see here, and the first one we want to see from a site is that they've documented and mapped all of their different types of waste, because that’s where you start—you need to know what you have, how much of it you have, before you can map out what to do with it. And then we want to see a program that covers this big portion of the waste hierarchy of the reduction, reuse, and recycle. And we want to see that that’s been in place for at least 12 months, so, we look at records going back 12 months. And then we also want to make sure that not more than 1 percent is going to a landfill. Next slide, please.

So, to date, we've had four manufacturing plants that have achieved the certification, we have our Volvo truck plant in New River Valley, remanufacturing in Middletown, Pennsylvania, our Mack truck plant in Lehigh Valley, Pennsylvania, and our Volvo construction equipment plant in Shippensburg. We have three more on line that are going through this 12-month evaluation period, and as a result of these initiatives I've shown you, last year, only 6 percent of the waste from our facilities was landfill. Seventy eight percent of our waste from our operations was recycled.

I'd just like to quickly name a couple of our businesses that complete this loop in the circular economy. Our remanufacturing operations take engines and other power train components and remanufacture those to original specifications. So, I've seen serial numbers on engine blocks that go back decades. So, rather than use new raw materials, energy, and chemicals, we try to remanufacture these parts so they get several lives. And then also, our DEX Heavy Duty Parts takes in complete vehicles and completely disassembles those, and they'll sell parts like hoods, entire cabs, wheels, seats—you name it, on the aftermarket. So, those don't have to *[Cross talk]*.

*Bruce Lung:* Thanks, Bert. We're at the six-mark right now.

*Bert Hill:* Okay. Thank you, Bruce.

*Bruce Lung:* Thank you. I'll introduce our next speaker. We have with us today from ThyssenKrupp Elevator, Daniel Downen and John Keller. Daniel is a Facility Engineer, and John Keller is a Manufacturing Engineer. ThyssenKrupp won a Better Project Award for their innovative process heating/furnace optimization project. So, Daniel and John—go ahead.

*Daniel Downen:* Alright. Let's go to the next slide. First, I want to thank the DoE for the honor to be here to speak to you guys and for representing ThyssenKrupp Elevator on this project. Next slide.

I wanna tell you a little bit about ThyssenKrupp Elevator. We're located in Middleton, Tennessee, it's the only plant ThyssenKrupp has in the United States. We're a worldwide leader in elevator manufacturing. Also, our factory that we currently have was established in 1969. We have about 700,000 square feet of manufacturing space—of course, the rest will be office space. We employ about 1,100 dedicated, hardworking employees here. We created an elevator from start to finish inside our four walls.

Our sister company, Energy Management, is very important to them, and that's kinda how we got started with this. Some of the accreditations we have received, in 2019, we received ISO 50001 certification; also, in 2015, we were LEED Gold certified. Also, we're ISO 9001 and also 14001.

If you look to the right there, One World Trade Center is one of the projects we've recently done that we thought everyone would be familiar with. We tried to be a part of that as well. Next slide.

So, basically, in our, we have two paint lines here in our facility. One is a structural part, those are the parts that go under the elevator and the elevator shaft, and we also have one for our architectural parts or basically the parts you see when you step inside the elevator. As part of the 50001 certification, we realized that our structural ovens were significant energy users. We use, a little over a third of our natural gas is used in our paint ovens. So, we decided then that it was somewhere we needed to start to try to save some energy there. Our ovens run somewhere, we run two shifts a day, depending on overtime. We're 9 to 10 hour shifts, so we're spending 20 hours a day a lot of the time.

One thing we had to try to get buy-in as far as our manufacturing side, because our parts are so critical and quality is important to us, we didn't want to save energy and then mess up and make a bad product. So, we had to try to get buy-in on that, and that was the part that John and I tried to push. Next slide, please.

In 2018, we had an IAC audit done—basically, an energy treasure hunt, so to speak. The University of Memphis sent graduate Engineering students down here, and we put data loggers all over the facility, got measurements of our ovens, and also, we came up with the idea of installing insulation in our ovens. Our oven is multiple decades old, and so there wasn't a whole lot of data on that, but we knew, by shooting it with temperature guns, that there was a lot of heat loss we were having as a result of that. We decided to add about six inches of insulation to the tops of our oven. As a result of that, we used data loggers, as I said earlier. We also did an IAC, we showed some great things there as well, but we also had our TAM rep come in in 2019 and do another treasure hunt. With the help of him, we were able to get some baseline numbers to start with using the DoE measure tool. We constructed a model of that to see what our heat loss was through that. Next slide, please.

I'm gonna turn it over to John Keller, our Manufacturing Engineer. John?

*John Keller:* Alrighty, I'll give you a little more detail. As Daniel mentioned, we recognized or oven was a significant user, so we started, the journey had to start with a beginning point, so we gathered data and used our measure tool to build our energy balanced model. We used this data to identify what to do. The low hanging fruit for us was oven insulation. We used a tool called RockAssist that Rockwell made to input the scan temperature or the heat loss, the ambient temperature, the air flow to help calculate the maximum thickness or gave us the most payback.

We also—it calculated that six inches was optimal for us, but we used three inches because it allowed us to overlap our joints to have two separate layers and it sealed a little better. Throughout this, we used an energy balance model using the MEASUR tool to confirm our savings. The data also showed that we had an excess of exhaust leaving the oven.

So, we had two exhaust stacks running during the purge cycle, and then it was designed for one to cut off after the purge. We found that some time in the two decades it had been in operation, it had been disabled, and both exhausts ran the whole time, so we worked through the code requirements and disabled one after purge and to still meet the code required air changes, but not put excess heat straight out to the atmosphere. We also added a vestibule to the exit ends of the oven to help provide a natural convection role to help create a natural air seal.

And through doing this, we've—the data showed that we had a significant reduction in the firing rate from not having to overcome all the heat loss. We also noticed that the oven came up to full temperature in about 45 minutes. So, we reduced that tremendously. We used to take over 2 and a half hours for the oven to normalize and get up to temperature before the burner started to modulate, and now we're doing that in 45 minutes. So, we reduced how early we start the oven. So, it’s just hours that we're not running the oven per day. I'm sorry, go to the next slide, please.

We reduced our firing rate from 5.2 million BTU to 4.2—huge reduction for us. As I mentioned, we start to light the oven later. Collectively, it resulted in a 34 percent reduction in fuel use. Next slide, please.

*Bruce Lung:* John, we're right at the six-minute mark.

*John Keller:* Okay. To make sure we're getting a quality cure schedule on our paint, we run a data pack through to make sure we're still getting the correct temperatures. Next slide.

So, the results were, as mentioned, a 34 percent reduction in fuel consumption and an annual savings about $31,000.00 per year. Alright, thank you.

*Bruce Lung:* Thank you very much, John. I'll go ahead and introduce our last speaker, and thank you, all, for staying a little extra for the day. Marco Gonzalez from Waupaca Foundry Corporation. Marco is the Corporate Energy Manager, and this year, they won a Project Award for cupola furnace optimization by reducing humidity in the blast air. So, Marco, feel free to go ahead.

*Marco Gonzalez:* Well, thank you, Bruce, and we are really happy and honored to receive this award from the DoE. That means a lot for us in our energy journey, and we really appreciate the Better Plants team and everybody here making this presentation, so let’s start it.

We're gonna talk about our Cupola Blast Air Dehumidification System. That’s one of the projects we recently implemented at one of our locations and is part of a large portfolio of projects we're doing to improve our melting process, so—go to the next one, please.

So, who we are. Waupaca Foundry, a Hitachi Metals company, we are basically metal casters. We produce gray iron and ductile iron for different manufacturing sectors. We're basically, we have a high penetration in the market in the U.S. and globally. I'm pretty sure you may have some products at your house, in your car that has been made in any of our plants, so—keep going.

So, in the early 2000s, Waupaca started thinking about, how we can become, transforming to a more green process and a green—looking towards a green foundry process, and we define our sustainability goals in the early 2000s towards 2020. We're in our last year, right now, and thinking of adjusting our goals towards 2030 to 2050. Our energy program is basically, our energy goal matches the Better Plants Program. We were one of the first companies to join what is now the Better Plants Program and we're proud of it. And we also became the first metal caster in United States to earn the ISO 50001 certification. Next slide, please.

What we're gonna talk about was done, implemented in our Plant 5 in Tell City, Indiana. That’s one of our largest plants in the U.S. and we produce a lot of brake loaders and different parts for automobiles and commercial trucks. We employ about 10,000 people there in a footprint of 560,000 square feet. Next one.

Next slide, please. Okay. So, let’s talk about the melting process. As a metal caster, basically, we gotta grab the scrap material and melt it to transform and cast the pieces we're gonna sell in the market. And Waupaca is considered one of the largest foundries in the world. We have a capacity of 10,000 tons per day that we melt—just to give an example that’s equivalent to the Eiffel Tower. So, we can do that in one day, and 80 percent of that volume is melted using cupola furnaces at several locations.

A cupola furnace, for those that are not familiar with the melting process, is basically a vertical steel shell that’s basically the vertical column in the diagram shown, that is lined with a refractory brick, and then we start doing layers of steel scrap material and then coke, which is the fuel that provides the heat, but also provides carbon to the chemistry.

So, the coke is consumed in here, which is introduced using a blast air fan. We're talking about a volume of 17,000 to 18,000 CFM of air and oxygen injection. That will give us the temperatures we need to melt the iron and also to get the chemistry we require. That produces a lot of heat and a lot of gases and it’s to be filtered and burned and eliminated before sending our emissions to the environment, so we keep a clean stack for emissions. And if you see all, basically, the right part of the diagram, besides the brown column, it’s all the environmental control. That environmental control not only eliminates all the greenhouse emission gases, but also allowed us to recover a big part of the heat that we produce to melt the item. And that way, heat is usually implemented in other secondary applications—for example, building heating during the winters for Wisconsin plants.

And that was, the waste heat recovery represented one of our first efforts in recycling or reducing our environmental footprint, and we have earned, we're proud to say that we have earned several awards for waste heat recovery.

So, cupola plants and all the melting equipment represents about 70 percent of the total energy we use in our cupola plants, and that’s basically why we're focusing on this project. So, next one, please.

So, the problem was related to humidity impact on the cupola blast air. Injecting that huge volume there into the cupola was causing that we, basically, during the winter—during the summer, sorry—we see kind of a seasonal effect similar to what we see usually on an increase on electric demand, but that was affecting our melting efficiency.

So, during the summer, because of the high humidity that we're putting into the melting process, we saw an increase in coke usage and reduced combustion temperatures that were affecting our production. And there is, basically, the physics explanation about that is the oxygen reacting with the coke and producing more CO, and it’s stealing the heat from the system. But it’s like, a good example, if you're trying to do a barbecue using charcoal during a rainy day versus a summer day. I mean, the rainy day will definitely, will put humidity into your combustion process and it will steal your ________, okay? Next on, please.

So, the solution was part of a large portfolio we're doing to increase our energy efficiency across our cupola processes, and this one is basically focusing on selling a dehumidifier. The dehumidifier is a desiccant wheel that we implemented in a partnership with a cupola manufacturer and the humidifier manufacturer that basically removed the humidity air from the blast air we're injecting and provides dry air to the systems to the combustion process, so we increase our melting efficiency. The dehumidifier is a desiccant wheel, basically, that turns around that uses two main energy inputs. One is a heating system to dry and evaporate the water that it’s removing, and the other is a water cooling system to cool the air that is dry, but it’s too hot to go into the blower.

So, we are proud to say that, to reduce environmental impact even on this project and to maximize energy savings, the energy required to regenerate the air, which is basically the heat we're using, part of our waste heat recovery, and we tie this water cooling system to our cupola cooling system, so there was no additional load connected to the plant because of this system. Next one, please.

*Bruce Lung:* Marco, we are just past the six-minute mark, just so you know.

*Marco Gonzalez:* This is my last one. So, basically, to summarize the benefits, there was a 3 percent cupola melting increase of this. And the benefit of it is, now we see uniform performance of the cupola across all the year. We used to see in the summer on a very humid day how the efficiency drops, and now we can see our cupola performing in a steady state.

And that represents about 2.5 percent coke reduction in the savings we reduce, which is equivalent to 17,000 MMBTU or $335,000.00 in savings that allowed us to reach a payback project in about 3.5, 3.8. And just to provide a reference, the water we have removed over that blast air is about 126,000 gallons of water, equivalent to about 21 trucks of water. So, just to give you an idea of how big is this savings just in removing water from the air and how it's a huge impact for us.

That's all, Bruce.

*Bruce Lung:* Thank you very much, Marco, and I have to thank everyone for staying a little extra. I know we went over time.

Just a quick note that we are gonna have a webinar series this summer, so we definitely invite you to attend those. We'd like to thank everyone for attending, and we also have some contact slides, so if you have any questions and you want to contact the speakers directly, feel free to contact them there. We will be posting these slides on the Solution Center next week, as I understand, so you'll be able to contact them that way as well.

And I think that wraps up our presentation, our session for today. We look forward to seeing you at future sessions going on today and tomorrow. Thank you very much, everyone.

*Daniel Lefebvre:* Okay—thanks, Bruce.

*Bert Hill:* Thanks, Bruce.

*[End of Audio]*