

*Holly Carr:*

Hello, I'm Holly Carr with US Department of Energy's Better Buildings Initiative. Happy New Year to everyone. I'd like to welcome you to the January edition of the Better Buildings Webinar Series. In this series we profile the best practices of Better Buildings Challenge and Alliance Partners and other organizations working to improve energy efficiency in buildings. Next slide, please.

There we go. Today we will uncover a hidden treasure of energy efficiency opportunity in warehouses and distribution centers. As online sales increase, distribution centers and warehouses are gaining prominence in building portfolios. From 2003 to 2012 warehouse floor space in the United States grew from approximate 10 billion square feet to approximately 13 billion square feet. That makes warehouses and DCs the second largest building type by square footage in the US behind commercial office space, which comprises nearly 16 billion square feet of space in the United States.

And refrigerated warehouses are the real energy hogs using an average of over 250 kBTU per square foot per year compared to 184 kBTU per square foot per year for commercial office space. So you can see that this is an important place for us to be looking at energy efficiency opportunities. So let's move to the next slide and we'll introduce our panelists for today. All of these speakers have focused on warehouses and distribution centers either in their own corporate portfolios or in client work and are here to share their learnings with you today.

So first off, we'll hear from Bob Valair. Bob is the Director of Energy and Environmental Services for Better Buildings Challenge Partner Staples. Bob has an impressive background over the past 25 years in energy management. His role at Staples is to lead the Comprehensive Energy Management Initiative, which is a key component of Staples' sustainability program. Bob's responsibility expands to over 2,000 retail stores, 250 distribution centers, major data centers and three corporate offices. Today Bob will be describing Staples' Eco-Treasure Hunt Program in distribution Centers

Second, we'll hear from Kirk Myers. Kirk is the Senior Sustainability Manager for REI, Recreational Equipment, Inc. REI is a specialty outdoor retailer headquartered near Seattle. Kirk works to develop and implement sustainable business strategies that drive efficiency, innovation and environmental benefit across

REI's footprint. And today Kirk will be talking specifically about REI's new zero energy distribution center recently opened in Arizona. So we'll have some suggestions for existing DCs, suggestions for new construction of distribution centers and warehouses.

And then finally helping us tackle the refrigerated warehouse energy use is Alan Moran. Alan is a Senior Project Engineer with Cascade Energy, which is an engineering firm specializing in industrial energy efficiency. Since 2007, Alan has completed over 400 projects and led over 60 facility retrocommissionings at industrial sites. He's worked with customers in industries including food processing, cold storage, wood products, oil and gas production and chemical production. Alan will provide a sneak peek to highlight new on-site refrigerated warehouse training that Cascade is developing with DOE. That training will be available this spring, and so we hope to get some interest amongst our audience today and perhaps folks would like to learn more about applying for that in-plant training.

So thank you all very much for being with us today. Let's move onto the next slide. So before we hear from our panelists, I just want to remind you quickly that we will hold questions until near the end of the hour. Please send in your questions through the chat box on your webinar screen, which is on the righthand side control panel there on your webinar screen. We will try to get to as many of those questions as we can during the Q&A period.

This session will also be archived, both the slides and the audio, and posted to the Better Buildings Solution Center for your reference later. So with that, I'm gonna turn it over to Bob Valair. Bob, can you tell us what Staples is doing in your existing distribution centers?

*Bob Valair:*

So thank you, Holly, and you can go to next slide. Next slide as well. So we really want to give you a little background in what led our statement. When you look at distribution centers and retail, just to show that Staples is 25 countries backed with 96,000 employees, the No. 3 e-retailer, the fact that we have over 1,800 stores in North America and over 200 distribution centers. So next slide, please, so as we start to talk about what led us, a lot of times it's really all about the journey and building up a portfolio to allow us to step in because a lot on the retail sector a lot of energy managers only manage the retail stores and not their distribution network, which was very interesting that we saw.

But what allowed us to build that credibility and allowed us to set the tone on how we manage our energy and led us into treasure hunts that when we started our EMS systems and became a green partner and started doing sustainability commitments reducing our carbon footprint, we really had to be able to measure our portfolio and adding green technologies and partnering with EPA and Better Buildings Challenge and then taking on Europe and LEED certification. So it started to get pretty complex on the way we manage our energy and it was really we talk about the journey so if you could turn to the next slide, please.

We really join different programs and there's some timelines to say, you know, starting the EPA partner for six consecutive years, now nine, certified buildings. One of the interesting things is to think that here we build energy-efficient buildings, not only for our retail stores, but our distribution centers. We built them pretty efficient out of the gate, and we looked at our baseline, the fact that it started as a 48 and now is a 63. That's in the millions of dollars achieving that 75 level to say we're really doing a good job in managing our portfolio. And we benchmark all of our sites so what's interesting is – go to the next slide, please – when you look at our channel, a lot of our distribution centers, our retail stores and the products that we sell is energy efficiency, so it's gonna carry a theme. When I get into different things around the treasure hunt, all this will come into play. Next slide, please.

So we started doing the programs. We're involved with a lot of stuff with the Better Buildings and the Better Buildings Challenge and actually did a case study that's gone on the website and you could see our propel site as our case study. We started in Orland and different things what happened so next slide, please. So this really gets into the nooks and the crannies to talk about although we still focus on retail, we put a lot of emphasis on the non-retail. So what we saw was we can really tell you how energy is being used. So, for example, if I look at the lighting whether it be in a retail store, lighting is 28 to 33 percent. HVA is anywhere from 38 to 43. Copy centers 13, plug loads 10, miscellaneous.

Now the days of looking at energy from your bill is archaic. We're using data analytics information to help us drive efficiency real-time. When you look at a million square feet, actually, some of our distribution centers on the retail are a million square feet in size. So imagine 17 miles of thinned air, over 300 forklifts, 250 loading dock doors, air compressors, lighting, all kinds of controls, pretty standard, not air conditioning. But when you look at how energy's being used in the square footage, there's a lot of focus on a

distribution center. [Audio glitch] ... a non-retail space. It was really a big focus and allowed us to step into the next opportunity.

So getting into – next slide, please. So what we decided to do is really to partner with energy champions in each of our distribution centers because think of these sites that are run 24/7 almost 360 days a year, three shifts, you know, 24 that these folks work. So we really needed somebody to be an energy champion on that. We started to develop these webinars so that when we measured the performance and do the program, it was important to let them know how they ranked as an Energy Star facility. Were they best in class? What could they do to improve the efficiencies at these buildings? And then we shopped around seasonality using big-ass fans to be able to move air and purge the building. We put together some educational and training material, both only for new hires but also ongoing because we wanted to engage the associates on how to be able to drive that.

And what we did was our first trainer – Holly, if you go to the next slide, please – we really started and our first one was probably close to ten years now we went to Orlando. And I think one of the things that I want to share is you hear from corporate. We brought together a team of experts: both lighting, HVAC, conveyor people, fork truck, air compressors, communication education. We actually went to a facility and brought a team and partnered with the facilities and the operations team. In the beginning one of the challenges were people get very defensive that we're coming into their house and kind of trying to find fault. It was really coming in and partnering with the people to be able to say hey, how can we help you? How can we make a better program, get the money to do the opportunities and things that you share?

So as you can see from the slide, to really engage all the associates and what we do is we do an employee rally because when they see people walking around the home office or the distribution center, they get nervous and say "What's going on? Why are these people here?" It's really to get them engaged and we actually do an employee rally and we give away gift cards to the employees that come up with the best energy-savings idea because they always felt that I worked second shift or third shift. I never see anybody. Nobody really pays attention to some of the ideas we have. What we found is they came up to say, "Hey, these lights were left on. Nobody's here but the section of the conveyor section is running." Next slide, please.

So I think what we did is when we started to partner with these teams, which show up on a Saturday or Sunday afternoon, and walk this with the facility and would kind of see if the facility was gone quiet to make sure that we look at the old building. And they knew we were coming, so we really walked the facility and took a look at some of the opportunities, looked at the space temperature, really brainstorm, regrouped as teams because we had a lighting team, an HVAC team, a conveyor team and really shared practices. How does things go? We really started to brainstorm in opportunities to look at how does the building start up? How does it shut down? Why do you turn things on the way you do?

And what we found is sometimes some of the fallout was the facility said, "Well, I get in early after the weekend when it's shut down and I get it – I throw everything on to get the building up and running." What we realized by putting all the conveyors on with the flick of two switches, he was starting to peak his load first thing in the morning and didn't realize the savings he was – or the money that he was incurring, the savings that he could have.

For example, we're not perfect and here's a clear example. In the truck-washing bay, which is 40,000 square feet, we retrofitted at the time with T8 lighting with motion sensors, 28 watt. We look up at the middle of the bay and there were four HID's still plugged in. I remember looking at my contractor, Paul. How did we miss that and he goes, "I don't know. I'll have to check with Chris." And Alan pipes up, "Oh no, we weren't sure of the new technology when you were installing it, so we wanted to be safe so when you guys left, we went back into the Dumpster, took out a couple, plugged them in." Here we are two years later after we did that project. The facilities thought they were doing the right thing, but we didn't do a good enough job education and training the team. So it was really around working with the folks and letting them know that we really could make a difference.

So when we finalize, walk the building, come back with the ideas, we start crunching numbers. And we work with the teams to show that, hey, we're really gonna make this a real project. So next slide please. So after that on Monday when we kind of walk, we arrive with the teams, mark the startup. We measure all the equipment. We put data-loggers in. We validate everything. We look at the utility bills over the last six months, twelve months, understand. We kind of regroup during the course of the day, have people get up and talk about the projects, what they found. We do a lunch rally in the morning. We do one in the evening and one in the

middle of the night. So we want to make sure that we touch all the employees.

And at the end of the day, we're able to share those results back. If you go to the last slide, please. We actually share. We get in there early Tuesday, put together all the analyses and we do a report out, you know, in front of the team, and then after that, the final report hour is the management. So when we walk away on Tuesday, we're able to share with the organization that we're gonna make these enhancements. We're gonna ask for this amount of money, so we have the buy-in from management prior to going down and saying when we walk out, these become real jobs. We don't just walk away. We stay with them for the next 12 months when things are implemented. We put up on the bulletin board. We share the great ideas and the people who won the gift certificates. We show them that, hey, it's made a difference.

One of the things right out of the gate just by being there, we saw anywhere between a two and four percent just in drop in energy efficiencies just by educating the associates. That's without doing anything. We've actually been able to achieve anywhere from 21 to 24 percent energy savings on top of a building that was energy efficient. Next slide.

So when we walk away, this is kind of some of the things that we do with the program and get the commitment from all the employees and engagements. And at the time, we actually do some school kids while we're down at that facility. So if we're down in Hagerstown, Maryland, or Portland, Oregon, we actually go out to the store with Inspector Watson and kind of promote some of the programs. So I know I went through a lot very quickly but that's kind of our program. Next slide.

*Holly Carr:* All right. Thank you so much, Bob.

*Bob Valair:* You're welcome.

*Holly Carr:* I love that you guys visit schools as part of the schedule for these across the country. It sounds like a fun job.

*Bob Valair:* It's about giving back and one of the things we've learned is our kids are honest and they ask some really heart-wrenching questions so it's humbling.

*Holly Carr:* Yeah and another key aspect to this that you mentioned but I think is very significant and doesn't always happen with a lot of retrofit

attempts and that is to secure the funding before you even step foot on one of these distribution center sites for a treasure hunt, that you know that that facility has the funds ready to go to make those changes and that you stick with them until the implementation is complete so ...

*Bob Valair:* Yeah, I think that's key. One of the things is having the finance people behind you so that you make these real jobs because people say, "I've heard this before. It's not a real job. Yeah, we get the funding and then it gets put on hold for next year."

*Holly Carr:* Yeah, yeah, great. Well, thanks very much. We'll move on over to Kirk out in Seattle and I guess, Kirk, you can start implementing these treasure hunts in your new distribution center in Arizona in six months to a year from now. But for the moment, let's talk about the distribution center design and how you all went through the process to actually build a zero energy distribution center.

*Kirk Myers:* [*Crosstalk*] Sounds great, sounds great. Well, good afternoon all and thanks, Holly. Excited to share a little bit quickly about what we did in designing a new distribution center. As mentioned earlier, I focus on REI sustainability strategy, which really comes down to the simple question of what should be better in the world as REI grows and thrives? And then I focus a lot on our core practices, which are the day-to-day decisions we make around energy, climate, green buildings, the other areas of resource use that we want to make sure align in our operations with our actual values of how we respect the outdoors.

So I'll share some details on this distribution center that opened this last summer just outside of Phoenix and Goodyear, Arizona, talk a little bit about our goals, our process. I think I really enjoyed in Bob's talk the talk about the process and how critical that is in his treasure hunt. We found process and design was really key for us also, talk a bit about efficiency measures, what worked, what didn't and then share some ideas about what might be successful for other distribution centers.

Quickly, talking a little bit about the background of REI, we were founded in 1938 up here in Seattle as a member-owned cooperative, so we actually are not a publically traded company. We're owned by our members and we're, of course, focused on getting people into the outdoors. We're at a bit of a different scale than, say, a Staples. We are proud that we have about 150 stores, 6.5 million active members and we sell about \$2.5 billion of outdoor and camping gear each year. I'm hoping that some of you

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here on the webinar are enthusiastic members, but that's the only unabashed sales pitch I'll make here.

But as we were looking at our new distribution center talking about scale, we had two existing distribution centers and this one that we built was our third so next slide, please. So back in 2012 our logistics leadership started looking at expanding this network from the two DCs I mentioned to three. And I was able to take advantage of a great program, the EDF Climate Core Program, to bring in a summer fellow to assess the technical and financial feasibility of setting a net zero energy goal for this building. And our fellow took our two existing distribution centers – one in Washington and one in Pennsylvania – and modeled them as if they were in the Southwest just to see how our existing operations might perform. We knew this new building would be about 400,000 square feet in somewhere in the Southwest, a hot arid climate.

At the time, our Climate Core fellow concluded that net zero was likely technically possible, that is, we could squeeze enough efficiency out of the building to sit enough solar on the roof to power the building on an annual basis. And she also assessed that there was a decent financial return, both good news, and led us to our other aspirations. Our Pennsylvania distribution center was one of the first LEED-certified distribution centers in 2007 when it opened. And so because of this and the analysis, our CFO was comfortable at holding the tension and setting the net zero and LEED goal that is a minimum target, sustainability target, to guide us through the design process.

Why do we focus on energy? Of course, all of us on this call have some hand in that. And for us it comes down to not only the business benefits but also because of the impacts of climate change and energy on the outdoor places our members love to recreate. And in that same vein, I'll mention a bit about our thinking on water just because in the Southwest water is as locally important I'd say as climate, if not more so, just because it's such an arid region.

So a couple of notes about our design. You know, for us we added an additional level of complexity to achieve our goals in that we were looking to build a roboticized material handling system that would add a lot of roboticized shuttles actually move product throughout the building that would use a significant amount of energy but would also increase the efficiency and throughput of the building. And then finally people, as a company that's been ranked



on *Fortune's* 100 Best Companies to Work For, we always focus on the employee experience. Not only do we want a building that shares our love for the outdoors and inspires our employees, but for example, we also condition our DCs to ensure employee comfort. And for us cool weather Seattlites thinking about Arizona, that was especially important, but has large impacts on energy.

So these priorities led us to our goals, our owner's requirements and kicked off the design process. And I'm sure with many folks who build distribution centers, our logistics team had a short timeline. It was 13 months from start of design to when we anticipated initial occupancy. And they chose a design build process to be able to execute against that. Next slide, please.

So talking about process, we took an integrated design approach, which brought together all the parties in a multiday design show process. This included the general contractor, developer, mechanical, electrical engineers, architects, solar vendor, green building consultant, energy modelers, outside experts all supported by the experts at the Rocky Mountain Institute. And this design show really focused on three main targets: optimize our outcome and our impacts. We wanted to maximize the total cost of ownership. We wanted to save time in the process in that 13-month window by avoiding potential road bumps and potholes by dealing with them early. And one beautiful impact of setting that zero goal is that the financial point for us between investing in efficiency in the building in our four walls and the solar on the roof became crystal clear. We think there was a better return in the solar was something we invested in, efficiency.

And so this shift from a linear process to kind of multiple parallel processes allowed us to also understand how one decision that might be made – say, the choice of conveyor technology or some other equipment within the building – could change the waste T-loft coming off of it, influence HVAC sizing and how all these different variables were connected for us. We dealt very strongly and a recommendation from me is you have a fundamental of building shape and orientation are pretty straightforward. But if you don't deal with those early on, you can get some negative impacts later on that you really can't solve if you've oriented the building in a way that doesn't help on the energy-efficiency side.

So what in terms of sustainability efficiency what did we choose to implement? We'll go to the next slide here. And from the net zero energy perspective, the integrated design process led to significant

efficiency improvements in the building. And we ended up installing a 2.2 megawatt solar array that on an annual basis produces all the energy the building consumes, and we're actually trending a bit better than that. This one solar array actually more than doubles the other 26 arrays that we have spread throughout our retail stores. And the big win here also is that we look at this as a long-time investment, so this solar array provides essentially after we pay for it about 20 years of free energy.

We also hit LEED Platinum so we beat our LEED Gold goal, and we're thinking really about the total impact on the ecosystem. And obviously, LEED has a strong overlap with energy efficiency. That helped us in terms of our net zero goal also. And then I mentioned water conservation. We made an interesting choice to not use indirect or a direct evaporative cooling system and actually used mechanical chilling. Very high efficiency but mechanical chilling is less efficient than an indirect system. Because of this impact on water, we knew we had some extra space on the roof because of the design that we were tackling and the way that we did it that we could actually avoid those millions of gallons of water consumption in this desert Southwest by making this decision to counterintuitively use a bit more energy. Next slide, please.

The shred process led us to actually 57 different potential energy efficiency measures that we processed through, ran through an energy model in a fast, the basics optimizing orientation, envelope inflation was really to do the extensive energy modeling that we did. Some things that we didn't do actually were we looked at a direct microgrid, which is very cutting-edge technology where you can actually run loads directly off the solar array. And we looked at even things like putting in some sub-grade earth tubes to precool the cooling air coming in. None of those worked out. They were a little too cutting-edge for where we were at a couple of years ago. But as technology changes, I think some of those are much more feasible now.

Our focus was really fundamentally on the inflation, right sizing the HVAC, reducing the oversizing that sometimes happens with different systems when there's some uncertainty by having everyone focused and aligned on the energy model to really optimize to make sure that we didn't accidentally oversize stuff. And when it came down to the fundamentals mattered: the inflation, the orientation, the envelope, the right sizing and optimizing of the new systems and to really understanding the loads and heat loss.

One note for us was that the energy modeling was very different than we've done in the past where we're used to doing it for a retail store or a headquarters building. You know, DCs are variable production buildings and so that business demand and that business throughput have a huge impact on the energy. It took us quite a bit of energy to figure out how to get that right that we could actually make the decision on sizing with PV array properly. The next slide?

So one thing I mentioned water and I want to make sure I explain how this connects because as we think about energy, there is this kind of concept of embedded water and energy you take from the grid. And when you're thinking in a whole systems way around sustainability, this is something that's critical, right. A coal-fired power plant or other types of power plants use water for cooling, and so as we were thinking about this bigger picture like how do we ensure that what we're doing on the energy perspective is not only sustainable but is sustainable in terms of water for the local ecosystem. And besides the work that we did in the building on water, you know, waterless urinals, all the standard things you do when you're designing a high-efficiency building.

You had a choice around HVAC and then also thinking about this water project where we had an opportunity to actually put water back in the Verde River, you know, partnership with Bonham Foundation and the Nature Conservancy of Arizona in the watershed essentially above our building and so a really innovative program that we're really proud of for a couple of reasons. One is because it showed that whole system impact that our members care about water as much as they do about energy as well as the fact that USGBC, the organization behind LEED, actually through the process was able to recognize these water restoration for LEED points that allows other folks to take advantage of these opportunities in addition to the work that they do on energy. Next slide, please.

So having in summary, as I mentioned, also about people, you can see in the top photo here we're really proud of how the building looks and feels. I mean it is something that is brand-right for us. It helps our employees even when going to their regular day jobs think about the outdoors and connect. One, this bottom righthand corner photo is of a hyperchair. It's the one very innovative thing that we did was actually putting in individually heated and controlled chairs for the office area, which allows us to essentially relax the set point and at the same time let our building operators know that their occupants can be comfortable, right. You can dial

in what level of cooling or heating you might need individually to make sure that you're always comfortable. Small thing but a cool thing that I think eventually gets to that thought of how do we make sure that we focus on conditioning people and not the spaces.

Yeah so next slide. We ended up the building opened up this summer and it is so far progressing very well, actually ahead of our net zero, our zero energy goal. And we did just recently get the LEED Platinum certification I mentioned, so we believe that we were able to build the largest DC that is LEED Platinum certified and that's zero energy in the country. With that, I'll hand it back to Holly and look for questions as we finish up the webinar.

*Holly Carr:*

Great. Thank you so much, Kirk. This is such a great example of walking the talk for REI, both on the energy and the waterfront, so very exciting. We do have a number of questions that have already come in for both of our speakers. So I encourage folks to just keep sending those in through the chat window. And we should have a good chunk of time here at the end to address many of those questions.

So finally I'd like to move to our third presenter, Alan Moran at Cascade Energy. And Alan will specifically address refrigerated warehouses and give us a sneak peek into some of the training materials that they are developing to help organizations reduce energy use specifically in these refrigerated facilities. So I will turn it over to you, Alan.

*Alan Moran:*

Thank you, Holly. Next slid, please. So, unfortunately, we won't be able to make everyone on the line an expert in refrigerated warehouse energy efficiency in the next ten minutes. But hopefully we can get some interest for a new refrigeration in-plant training offering from Better Plants Program. Next slide, please.

And so I work at Cascade Energy. We provide industrial energy efficiency consulting in a number of different industrial sectors. We spend a lot of time working at industrial refrigeration systems and so we've got a lot of experience helping customers reduce their energy spend on their refrigeration system. Next slide, please.

So just a couple of quick basically rough energy estimates for refrigerated storage: Between public refrigerated warehouses and food service and grocery distribution centers, we're looking at about 1,300 average megawatts of energy usage per year, which result in about \$800,000,000.00 on electricity bills annually. Next slide, please.

So we're spending a lot of money on electricity with these refrigerated warehouses. You know, in the past as long as the maintenance staff and the refrigeration operators kept basically the ammonia or Freon or whatever refrigerant inside the pipes and kept everybody safe and kept their refrigerated spaces cold, their job was done. But in the last 10 to 15 years, saving energy has become a higher priority, and so that's something that's been added to typically the refrigeration operator and maintenance staff's plates and so that's where we hope that some training and some of these energy-efficient principles and maintenance best practices will really help this sector reduce its energy spend. Next slide, please.

And so where does your energy go? Unfortunately, we don't have the words on this pie chart, but this is basically the energy breakdown of a food distribution center that has some cooler space, some freezer space and then a dry warehouse. And so the wording is missing for some reason but – oh, there we go. There we go so we've got, obviously, the refrigeration system is our energy hog, right, and it uses about half of the facility energy usage. And then if we're talking about a public refrigerated warehouse that's all freezer space and has blast freezing, that number can be as high as 80 percent, so that's obviously where we want to start when we talk about reducing our refrigerated storage facilities' energy spend. We want to look at the refrigeration system. Next slide, please.

And so if we're gonna move forward with saving energy and implement an energy management program, it's crucial that we're tracking our energy performance. We need to know which way our energy usage is trending. And so whatever that may look like, that needs to be done in any successful energy management program. And so I've got just at a high level we've got a graph here, and basically all we want to know is we've got – the orange line is daily energy usage and then the blue line is a daily baseline value based off of historical energy data. And so basically this particular facility, they track their energy usage on a daily basis, and they'll mark when they make changes that should save energy and are directed towards energy efficiency. And so you can see as they make a couple of changes there as indicated by the text boxes, those two lines start to diverge. And as an energy-efficiency consultant, that's what allows me to sleep at night when I see those two lines get further and further apart. Next slide, please.

And so with a refrigeration system, there are many moving parts that can fail. And so that's when it's really important to have a good

preventive maintenance program and staff that can implement good maintenance best practices whether it be, you know, you've got regulators that need to be checked and set appropriately, pressure transducers and temperature sensors that need to be calibrated periodically, evaporator valve groups that need to be exercised and tuned to make sure we're getting our peak performance out of our evaporator coils and then condenser nozzles that need to be cleaned and condenser water that we need to make sure we've got an appropriate water treatment program so that we're getting our design capacity out of each piece of equipment. And so that's where it's really important to have maintenance staff and refrigeration operators who are trained in these maintenance best practices. Next slide, please.

You know, another common opportunity we find – and this is where the operations part of the refrigerated warehouse comes into play – is keeping the heat out of the refrigerated space. It's simple but it's an opportunity almost everywhere we go. So practicing good door closing practices and then making sure we're using the automatic capabilities of fast-acting doors as well and not locking those open. Next slide, please.

Another no-brainer but it's an opportunity at a high percentage of the facilities that we go to is not controlling the refrigeration system at a temperature that's lower than it needs to be. And typically this just requires good communication from facility management and corporate management to the maintenance staff and the refrigeration operators so that they understand what those corporate specs are and what the contracted temperature set-points for the different customers they may have are. Next slide, please.

And then when we start to look at the control of the refrigeration system, one of the biggest opportunities we typically see is setting the suction pressures and the condensing pressures on the refrigeration system appropriately. And so when you think about it, compressors typically make up about 70 percent of your total refrigeration system energy usage. And what we want to do is reduce what we call compressor lift and basically just make that compressor work less. And so to do that to reduce the lift, we're talking about either raising the suction pressure on the compressor or reducing the condensing pressure. And so that can typically result in a pretty significant energy savings. Next slide, please.

Another thing to think about with refrigeration system energy efficiency, you know, most systems for refrigerated warehouses are designs based off of the highest temperature during the summer

in that region, and so that only happens a couple days of the year. Most of the year you're operating at some part-loaded condition, and so it's very important to have – to basically efficiently match that refrigeration load with our equipment capacity, and so there are a lot of considerations to take into place. If you've got multiple compressors, how are those compressors sequenced on and off? With our trim compressor, are we using slide valve unloading? Do we have a BFD on that compressor? And then there are many more considerations to think about when we think about how to control the capacity for evaporators and condenser fans. Next slide, please.

And so here we've got a Venn diagram. We like to visualize all the different team members at a refrigerator warehouse. And so obviously management, they've got to push this program. They need to provide the resources and the funding for the maintenance staff to attack these efficiency opportunities. Operations, you know, they play a critical role in making sure that we minimize the heat that gets into the space. And then your maintenance staff, your plant engineers and your refrigeration operators, those are the folks who have the most control on ... *[audio glitch]* to the different pieces of refrigeration equipment and also that they have a good understanding of maintenance best practices. Next slide, please.

So, fortunately, the Better Plants Program, they provide in-plant trainings. In the past since 2011 there have been 60 in-plant trainings that have been completed and these include steam systems, compressed air systems, process heating, pumps and fans. And now they're offering some – they've got some new offerings and one of those will be a refrigeration in-plant training. Next slide, please.

And so with these refrigeration in-plant trainings, there will be a mix of classroom lectures, breakout groups, brainstorming sessions to kind of introduce those energy efficiency principles and how they relate to the different pieces of equipment on your refrigeration system. We'll introduce maintenance best practices, and then we'll introduce a couple of analysis tools that facility staff can use to quickly estimate the energy savings magnitude of some of these different opportunities. And then we'll actually do some hands-on equipment checks as a part of the training so we're getting some hands-on experience with some of the theoretical principles that we discuss and talk about during the classroom sessions. Next slide, please.

And so these trainings will be three days onsite at a host site and really anybody who's making decisions about how to control the

preventative maintenance program or has their hands on the refrigeration system, it would be worthwhile for their time to participate in these trainings. And the application process will open later this spring. It'll be, you know, you'll get an email. The partners will get an email with the typical in-plant training offerings and refrigeration will be a part of that so ... and then there's also additional information at the link shown here on the slide. With that, thanks for your time and hopefully we get to work with some of the folks on the line in the future.

*Holly Carr:*

Excellent. Thank you so much, Alan. And, folks, if you are listening online and you are not a Better Buildings ... a Better Plants participant, you can either become one *[laughs]* or you could perhaps attend a training that is hosted by one of our Better Plants partners. So don't give up hope if you're not directly related and involved in the Better Buildings and Better Plants programs. Really encourage folks to take advantage of these trainings. They're gonna be very strong and it's onsite so you really get to put your learnings in the classroom right into action. So let's see, if we can move to the next slide and the next slide after that, I think we have ...

Okay so we have one resource here, which is the Staples Showcase Project, which is the Coppel Fulfillment Center in Texas. This is an example of a distribution center in the Staples portfolio that went through the treasure hunt process that Bob described a little earlier. There's also an implementation model that describes that treasure hunt process in great detail and provides some template documents and resources that Staples uses as a part of those events that you are welcome to use as well. We will post that implementation model on this slide so you can go directly to it when we post the entire archive.

And there is a third resource that I think is so new that it didn't quite make it onto our slides today because I think it was completed maybe moments before the session started, and that is the showcase project for the REI Distribution Center in Goodyear, Arizona, and you can go in there and look at the details of the implementation and energy-efficiency strategies that were used in that building. Moving onto the next slide, please.

All right so this is our Q&A. I'm just gonna go down the line here a little bit starting with Bob. Can you speak to some of the specific energy-reduction strategies that you have employed after one of these treasure hunts, specifically talking about the major building



systems, the conveyors, the forklifts, the lighting, HVAC, any renewables projects that you might be doing and so forth?

*Bob Valair:*

Sure so on conveyors, you might realize when you have over 15 or 17 miles, a lot of motors. So we want to make sure that they're high-efficiency motors, the fact that there's the opportunity to put variable speed drives. Then we look at the schedule. It's a simple thing to say when people take breaks or go to lunch, are all the conveyors running or can some of them be shut down for periods of time so really look at the schedule.

Same thing with fork trucks. Look at the battery-charging equipment to make sure it's a high-efficiency charger. Are you charging batteries in off-peak? Is there an opportunity to do that? So we look at the whole strategy around forklifts. Same with lighting, what technology is in there. A lot of times it's simple things like we've gone from HID to T8, T5, LED. We have motion occupancy sensors. So depending on the strategy that's in place today, what is the new technology to add to that because what you realize is it's pretty efficient right out of the gate. We look at same thing as – so if a, say, might be already gone from a T8 32-watt down to a 25-watt or a T5, there was a 54 down to a 44-watt with the occupancy, with the motion sensor. At what point do you retrofit or upgrade with the lighting? So there's different strategies within that.

Same thing with the HVAC, you know, the efficiency, the cleaning, the economizers, all the things of tuning up a piece of equipment, make sure it's running optimally. So we kind of tear apart every one and deploy those different strategies along with sharing the education with the maintenance team and the service team that works and those so it varies.

And then on renewable that you saw in Hagerstown in one of those photos, we actually had three different solar arrays up to 3.5 megawatts. One was a thin film, one was one on a roof and another is a rotating. So depending on the opportunities with savings availability with tax credits in the markets if we can take advantage of that, we deploy the technology whether it be a fuel cell, battery storage or solar or wind.

*Holly Carr:*

Great. Just a couple of notes on that. You mentioned the lighting upgrades and moving to LED, and we did have a question about the percentage savings that are anticipated by switching from fluorescents to LEDs. And I have a response to that one, which comes from our tech team, our lighting tech team lead for the

Better Buildings Alliance, who's Michael Myer at Pacific-Northwest National Labs. And he responds that for Type A TLED retrofits, you can expect to see approximately a 29 percent energy savings on those up from the fluorescent baseline. And from Type B or C TLEDs you can expect approximately a 45 percent energy savings from your fluorescent baseline. So hope that answers a question from one of our participants.

And then regarding the conveyor belts, Bob, someone asked how much energy is used per mile of conveyor? With 17 miles of conveyors it seems like it must be significant?

*Bob Valair:* [Crosstalk] So it's around 42 percent. Yeah, I don't have per mile but we do have percentage for the building, so depending on the size of the building because some buildings have 17. Some have 15 and 12, but on average on a million square feet it's around 17. It averages around 42 to 45 percent of the energy for the building because of the fact that it's running, has a lot of motors. That's why we look at making sure we're variable speed. Can we shut things down when people go to break, lunches, things like that? We have wave overlap so if the system was full, it circles the product back around the building. From start to finish, it takes ten minutes to get a box from Point A to Point B.

*Holly Carr:* So definitely a good place to focus on those treasure hunts.  
[Laughs]

*Bob Valair:* Yes.

*Holly Carr:* Okay, Kirk, a couple questions for you on the – excuse me folks. I'm gonna have to take a drink – on the distribution center. A participant is asking if you can share the design for that distribution center. How do you get to zero?

*Kirk Myers:* Great, absolutely and, as Holly mentioned, the Showcase Project will be up soon. They'll give some more details. The other thing that our team is very open to is having folks tour through, so we've had a number of companies come through and check out what we do. So anyone who's interested in that can contact me through the contact information at the end of the webinar. But we're definitely interested in that because this ties into potentially another question around repeatability for us on this. We don't build distribution centers very often, so we hope that in terms of our values and our goals for sustainability that what we've learned here – which some of it's very novel, some of it's fairly straightforward – other folks can take the information and implement it on their own. So we

don't have any desire to keep this secret at all. We want to be open about what we did, what we wanted to do, what we didn't – weren't able to do so that folks can replicate it and go further.

*Holly Carr:* Fantastic. That's what Better Buildings is all about: sharing information and helping others move the ball down the field so that's great news. And then, yes, that does also address one of the questions we also had for you was will you do this again or was it a showcase only? And sounds like not anytime soon but that this would be a strategy that you would try to employ in future DCs. And then a related question is are there any strategies from the DCs that you might migrate over to new store builds, which you probably have more of?

*Kirk Myers:* Yeah, great question actually. I think in terms of the word "strategies" absolutely. We're looking at this integrated design process and really using that to tune and optimize our store design, particularly on the HVAC side not only for the climate that it's in better than we might do today but also in terms of making sure that we are putting in just the right sizing and system in technology to make – to achieve our goals: comfort as well as energy efficiency. Some of the technologies don't translate super-well but the process for sure is something that we found great value in adapting for our retail stores, which we build. We don't open up a ton, but we open up usually five to seven per year. And that's something that's very present for both our employees and our member where they see and they understand how we show off our values in concrete and brick.

*Holly Carr:* Great. I'm sure everybody wants one of those hyper-chairs so ...

*Kirk Myers:* *[Laughs]* They're pretty – a lot of folks – it's amazing. Some folks, there will be a few folks who will be on heat all the day, even in Arizona, and then most folks are on cool. But there are folks who are actually cold so it makes our operation team very happy to have a solution for them so that they can get more folks in their comfort range.

*Holly Carr:* Great. Last question I have for you, Kirk, is one about trends in rooftop solar on warehouses and distribution centers and whether or not you had any specific challenges in promoting rooftop solar. And also a second question in this same ask here about how rooftop solar can protect wildlife and wild places and if that was a concern or a part of your thought process as you made decisions around solar.

*Kirk Myers:* Yeah, yeah, great question. I don't have a perfect view of the trend of solar across all distribution centers, but I do have a good sense that, especially in areas where there's both good sun as well as good incentives, it's pretty popular in the financing hurdle that people have solved. If you don't have the capital to pay for it yourself or don't want to, through power is leading to a lot of adoption. I think Bob mentioned Staples has done quite a bit in this space also. One thing that I didn't mention during the talk also is I think part of the shred process that is really important if you look at the photo of the roof of our building, we were very, very specific about where we put our skylights and clustered them in areas where our people would be underneath them, which opened up huge areas of roof for continuous solar installation, which reduced the cost quite a bit. And so I'm pretty proud that if you just look at our building or the roof of our building, you can get a sense – you can actually see kind of tangible outputs of that design shred process and how that played out. But we think, you know, we do solar on our retail stores and DCs and, especially at this scale, you can get a very, very low price per watt when you're doing it at this scale and if you're able to make it so it can be big open areas for solar.

*Holly Carr:* Great. Thank you very much. Alan, a question for you regarding specific percent savings that you see are common in the refrigerated warehouses that are retrocommissioned. Can you give us a ballpark? And we have two related questions here. One is what are the percent savings from just low and no-cost upgrades that are common? And then the second one is can you provide some typical savings percentages for each of the strategies you described? And I would say maybe not each of the strategies you described but some that you might know the numbers of.

*Alan Moran:* Sure, two good questions. So to address the first question, that depends and it's a case-by-case basis obviously. What's the baseline? What's the starting point of the facility that you begin this process at? And so you've got different levels of experience from operators around the country and different legacy control strategies and maintenance practices. But on average we're looking at anywhere from 5 to 15 percent of total facility energy use can be shed from those low-cost, no-cost opportunities. And there's some outliers sometimes that can be as low as two or three percent, which as an energy-efficiency engineer that's tough to work through a big retrocommissioning event and only provide a couple percent savings. But then there are also times when we visit facilities and do this process and we see as much as 20 to 25

percent. But, yeah, on average 10 to 11 percent savings seems to the kind of typical average.

And then as far as each – some of the specific opportunities I was describing, there's a lot of interactive effects. And so it's hard to pin down exactly what percentage comes from reducing the condensing pressure and raising the suction pressure and what comes from doing some type of sensor calibration. And so a lot of times there will be multiple of these – two or three of these opportunities will have to work together to achieve a large percentage of savings. For instance, we may have to do some adjustments to a defrost regulator so that we can lower our condensing pressure. Adjusting that defrost regulator doesn't really do much to our energy savings, but lowering our condensing pressure could provide a couple percent savings on our total facility energy usage.

So I would say typically the larger opportunities come from reducing our compressor lift and then making sure we're implementing efficient par load control strategies for evaporating fans and compressors.

*Holly Carr:*

Excellent. Thank you so much. A couple of general questions real quick here. Someone asked about contests between DCs with prizes to see which ones can save the most energy. *[Clears throat]* Excuse me. One sort of contest that comes to mind is the Battle of the Buildings, which Bob Valair mentioned, where participants can enter a portfolio or a subset of buildings and let them compete against each other. And I think that you could do that within your own portfolio and have all of your distribution centers competing with each other or you could perhaps do that with other organizations as well so that's one idea. And then, of course, you can always joint Better Plants and sort of compete with yourself to reduce energy use across your portfolio by 20 percent. So please consider both of those options as you're looking at your own strategy.

And then a second question on the cost for these in-plant trainings that were mentioned for refrigeration. My understanding is that the host organization there is a cost share request and then folks can attend those once the cost share is met. Folks can attend those on an invite basis, so I think there will be more information on exact details of cost in the application that comes out in the spring.

And with that, let's run to the next slide. So certainly invite you to join us for our next webinar in February, which focuses on paid-

from-savings energy efficiency financing for small organizations and small projects. So this has been out there for quite some time for large projects, large organizations so the smaller projects are a bit of a new evolution for this type of financing. You can register at the Better Buildings Solution Center or from this link. Next slide, please.

And then, of course, our Better Buildings Summit, which is our big once-a-year gathering of all things and all people Better Buildings. This year it will be May 15<sup>th</sup> through the 17<sup>th</sup>. Registration for the summit just opened on Monday so I encourage folks to check that out and get yourself signed up. And next slide, please.

All right, this is the moment some of you have been waiting for. Contact information for our presenters so you can get more information about a zero energy design for your next distribution center. Feel free to reach out to any of our three presenters here or to me, Holly Carr, if you're interested in DOE programming or participating in Better Buildings activities and program support from Kendall Sanderson and Holt Mountcastle down there on the bottom. You can always follow us on Twitter and get the latest activities and events happening in Better Buildings.

Thank you very, very much to our three presenters for joining us today and sharing so much of your best practice and learning. And thank you very much to the audience for being here as well. Have a good afternoon.

*[End of Audio]*